

Nordic Aquatic Food Systems

System Preparedness and
Recommendations for Increasing
Seafood Consumption



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Summary

This integrated report brings together two complementary perspectives on aquatic foods in the Nordic region. The first part analyses production systems, trade flows, processing capacity, and structural vulnerabilities across Nordic aquatic food value chains. The second part examines consumer behaviour, identifying the cultural, individual, and product-related mechanisms that shape the consumption of aquatic foods. Together, the findings highlight that strengthening Nordic food security and increasing sustainable aquatic food consumption require both system-level measures and behaviourally informed interventions.

Recommendations for preparedness

The following measures address the structural vulnerabilities outlined above and aim to strengthen preparedness in the Nordic aquatic food system.

1) Systematically assess and prepare supply chains disruptions

Nordic seafood value chains are closely integrated with global markets for inputs, processing, and logistics. Coordinated, scenario-based assessments should be used to examine how disruptions to feed supply, processing capacity, transport routes, or market access would affect product flows. This would help identify critical bottlenecks and clarify the minimum levels of regional processing flexibility and routing capacity needed to maintain supply when external routes are constrained. Strengthening such internal options can reduce exposure to disruptions and support both crisis preparedness and consumer access.

2) Diversify feed sources

Nordic aquaculture remains highly dependent on imported feed ingredients, exposing the sector to global supply disruptions and limiting preparedness. Increasing the share of regional or domestically sourced feed materials would reduce risk and improve the robustness of primary production across the Nordic region.

3) Strengthen management co-operation on shared stocks and management of all stocks

Fisheries management is a core element of Nordic preparedness. While the management of many stocks is science-based and well-functioning, several important stocks now face biological pressure due to high fishing mortality, low spawning biomass, or unresolved management frameworks. For shared stocks, unresolved coastal-state agreements and quota disputes further reduce predictability and long-term resilience. Such constraints should be mitigated in peacetime.

Recommendations for increased consumption of aquatic foods

Insights from the aquatic food choice framework and the COM-B model show that aquatic food choice is shaped by multiple interrelated factors. As a consequence, no single policy instrument can shift behaviour on its own.

This complexity calls for comprehensive, long-term strategies that combine multiple policy tools. Building on the Nordic Council's dietary recommendations and the identified determinants of aquatic food choice, the following sections outline actionable measures across market-based, regulatory, nudging, and information-based approaches to promote sustainable aquatic food consumption.

1) Reducing VAT

Aquatic foods have experienced the steepest price increases in the Nordic region, rising over 40% since 2015, making cost a major barrier to meeting dietary recommendations. Because price is one of the strongest determinants of aquatic food choice, reducing VAT on fish and seafood, would significantly improve affordability and stimulate consumption.

2) Information Campaigns Targeting Young Consumers

Young people consume far less aquatic food than recommended, and information-based tools can effectively strengthen their motivation and capability by increasing awareness, knowledge, and practical skills. Funding integrated campaigns, combining nutritional messaging with cooking tutorials, hands-on workshops, and pretested communication materials, would give young consumers clearer guidance and greater confidence in choosing and preparing fish and seafood.

3) Clear and Harmonised Labelling

Consumers increasingly want to make healthy and environmentally responsible choices, but unclear or inconsistent labels reduce their opportunity to act on these intentions. Strengthening and harmonising labelling systems would make it easier for consumers to identify healthier and more sustainable aquatic foods at the point of purchase.

4) Strengthening Public Procurement

Public procurement has the potential to influence everyday food choices by ensuring that schools, hospitals, and workplace canteens offer fish and seafood at least twice a week. By doing so, institutions make these options readily available while reducing the need for individuals to prepare the dishes themselves, thereby improving both the opportunity and the practical capability to choose nutritious aquatic foods. To improve implementation, training support for catering staff would help increase their capacity to create appealing, nutritionally appropriate aquatic food dishes.

5) Mandatory Training in Schools

Introducing mandatory education and training in handling and preparing fish and other aquatic foods in schools would strengthen young people's capability to cook and consume aquatic foods. As younger age groups report both lower seafood intake and limited cooking skills, early skill-building would reduce practical barriers and support adherence to dietary recommendations.

6) Make fish the default option

Default options can help shape everyday habits and social norms by making fish the standard protein choice in settings such as schools, workplace canteens, and hospitals on selected days. This nudging approach increases aquatic food consumption without limiting their freedom, since most individuals tend to stick with the option that is already in place rather than actively selecting an alternative.

7) Promoting Lesser-Used Aquatic Species

Aquatic food consumption in the Nordic region is concentrated on a small number of familiar species, even though many lesser-used options are both widely available and more affordable. Encouraging people to choose these species requires building food literacy through education, recipes, and cooking guidance, while also reducing neophobia by offering tastings, working with chefs, and using cultural stories to make unfamiliar fish feel more familiar. Introducing lesser-used species as default options in public meals and ensuring clear sustainability and health labelling can further expand opportunity and normalise their consumption.

Introduction

Part 1: Aquatic food systems, food security, and preparedness

This first part describes the Nordic aquatic food system and sets out why it matters for preparedness. It maps production, processing, and trade in each country and shows how the region's role as a major producer and exporter sits alongside structural dependencies outside the Nordics. The country chapters and the Nordic synthesis together document how globalisation runs through the value chain, from feed inputs and outsourced processing to concentrated export markets, and how this shapes actual availability in the region.

The material also shows a clear structural asymmetry: large producing nations in the North Atlantic versus more populous markets further south that depend on imports and on processing foreign raw material. Across countries, recurring bottlenecks include reliance on imported feed ingredients, limited regional processing capacity for domestic raw materials, and biological and regulatory constraints linked to overfishing and the absence of stable coastal state agreements for key pelagic stocks.

Taken together, Part 1 provides a factual baseline for preparedness work: what is produced where, how volumes move, and which dependencies may bind under stress. It points to concrete next steps, diversifying feed sources, improving regional processing capacity, strengthening stock management, and the value of stress-testing Nordic supply chains to identify practical choke points before a crisis

Part 2: Challenges and opportunities for increasing consumption

Building on this systemic overview, the second part of the report examines consumer behaviour and the opportunities for increasing consumption. Despite the region's formidable biophysical capacity for self-sufficiency, access for ordinary consumers is uneven and shaped by export-oriented value chains.

Using the Aquatic Food Choice Framework, this section analyses the cultural, individual, and product-related factors that influence Nordic consumers' dietary choices. It discusses barriers such as limited cooking skills, price developments, and neophobia, as well as opportunities to diversify consumption toward underutilised species. The analysis aligns with EU initiatives to promote healthier, more sustainable food choices, offering concrete recommendations for policy measures, from nudges and information campaigns to regulatory interventions, that can help close the gap between current intake and nutritional recommendations.

Summary and objectives

Taken together, the two parts of the report provide an overall picture of aquatic foods in the Nordic region. By linking insights into the structure and flows of Nordic aquatic food systems with knowledge of consumer behaviour, the report lays the foundation for a coordinated Nordic food strategy. The aim is to show how the region's strong seafood position can support a stable food supply during crises while also promoting healthier, more sustainable diets in everyday life.

Recommendations

Recommendations for preparedness

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Aquatic food systems, food security, and preparedness

This part of the report provides a detailed description of the aquatic food systems in each Nordic country. Each national chapter follows a common structure, covering primary production (capture fisheries and aquaculture), processing capacity, trade flows, and the estimated availability of aquatic foods for consumption. The chapters also outline key challenges and opportunities relevant to food security and preparedness.

Together, these country profiles provide a harmonised and comparable overview of the Nordic aquatic food system. Part 1 includes both the national descriptions and the Nordic synthesis, which integrates findings across countries.

The following sections describe the data sources, methodological approach, and limitations that apply across all chapters in Part 1. These common elements ensure comparability between countries and underpin the Nordic-wide analysis presented in the synthesis.

Data, methods, and limitations

Estimating the aquatic food available for consumption

Aquatic food available for consumption is estimated using a harmonized approach across all Nordic countries. The indicator reflects what is *theoretically* available for consumption, not what is actually eaten. Storage losses, waste, re-exports, unreported landings, and other irregularities may influence what is ultimately consumed.

All quantities are converted to live weight equivalents to allow comparison across species, product forms, and countries. Availability is calculated as:

$$\text{Available for consumption} = \text{total catches} - \text{industrial catches for feed production} + \text{aquaculture production} + \text{imports} - \text{exports}$$

Trade flows for human consumption are derived from HS Chapters 03 and 16, while products used for reduction (fishmeal and fish oil) are captured under HS 1504, 23, and 05. These codes cover the main product groups relevant to both consumption and industrial uses.

Limitations

Several limitations should be considered when interpreting the estimates:

- **Seasonality:** Annual averages mask seasonal variation in catches and aquaculture harvests.
- **Data quality:** National statistics may contain under-reporting, inconsistent species coding, broad product categories, and incomplete coverage of small-scale, informal, or unreported activities, all of which reduce the level and accuracy.
- **Conversion uncertainty:** Live-weight conversion factors vary across species and processing methods; indicative factors must often be used.
- **Product classification:** Broad HS categories make it difficult to precisely assign species and processing forms.
- **Stocks, waste, and inventories:** Changes in inventories, waste streams, offcuts, and by-products are not systematically captured.

Overall, these estimates should be interpreted as indicative measures of availability, not exact measurements of consumption. They nevertheless provide a robust basis for comparing broad patterns across the Nordic region.

1. Norway

Introduction

Norway is one of the world's leading producers and exporters of aquatic foods, and the seafood industry remains a key national sector. In 2023, the sector accounted for 2.3% of mainland GDP^[1] and employed 96,000 persons, directly and indirectly, corresponding to 3% of the workforce. Of these, we find 42,000 in the core activities and 54 000 as spillover effects among suppliers, their suppliers, and so on (Nyrud et al., 2024). Aquaculture, and in particular Atlantic salmon farming, is the dominant segment and generates more than half of the industry's total value creation.

With a small domestic population, Norway exports most of its seafood production. The EU is the most important destination, and the Nordic countries account for 12% of Norwegian exports for human consumption and 25% of Norwegian imports of aquatic foods.

A large share of exported volumes is processed abroad, mainly in European hub and processing markets such as Denmark, Poland, and the Netherlands, as well as in Asia. These products are either consumed locally or re-exported to other markets. Although Norway also produces emerging aquatic foods such as algae and seaweed, these volumes remain insignificant in the context of human consumption.

Primary production

Norway's aquatic food production is built on both capture fishery and aquaculture. Capture fisheries in Norway comprise all wild-caught aquatic resources, including fish, crustaceans, molluscs, and algae, delivered for human consumption, reduction, or other uses. The sector shows considerable variation across species groups, both in landed volumes and economic value. While capture fisheries remain more important in terms of total quantity, aquaculture dominates Norwegian seafood production by value.

1. Mainland GDP refers to Norway's economy excluding offshore oil and gas activities, a quite substantial sector.

Capture fishery

Norway's capture fishery consists of a wide variety of wild-caught species. Pelagic species such as Norwegian spring-spawning herring and mackerel account for the largest volumes, whereas demersal species, particularly cod, drive economic value. In addition to fish landed for human consumption, a substantial share of pelagic species is directed to reduction, mainly for meal and oil production. Landings of crustaceans and molluscs are modest in volume but important to specific coastal regions and market segments. Nearly all harvested seaweed is directed to non-food uses or employed as an ingredient in food processing, for example, in the production of alginate. The figures in Table 1.1 represent the total catch by Norwegian vessels that is landed in Norway, where about 1,487,043 tonnes were available for consumption, at a value of NOK 27.7 billion, in 2023. In addition, 58,769 tonnes of fish for human consumption were caught by Norwegian vessels and landed abroad. The majority of this was landings of pelagic species such as capelin, Norwegian Spring-spawning herring, and mackerel in Iceland and the Faroe Islands, and North Sea herring in Denmark. These figures should appear in the export statistics and will not be included in the residual analysis.

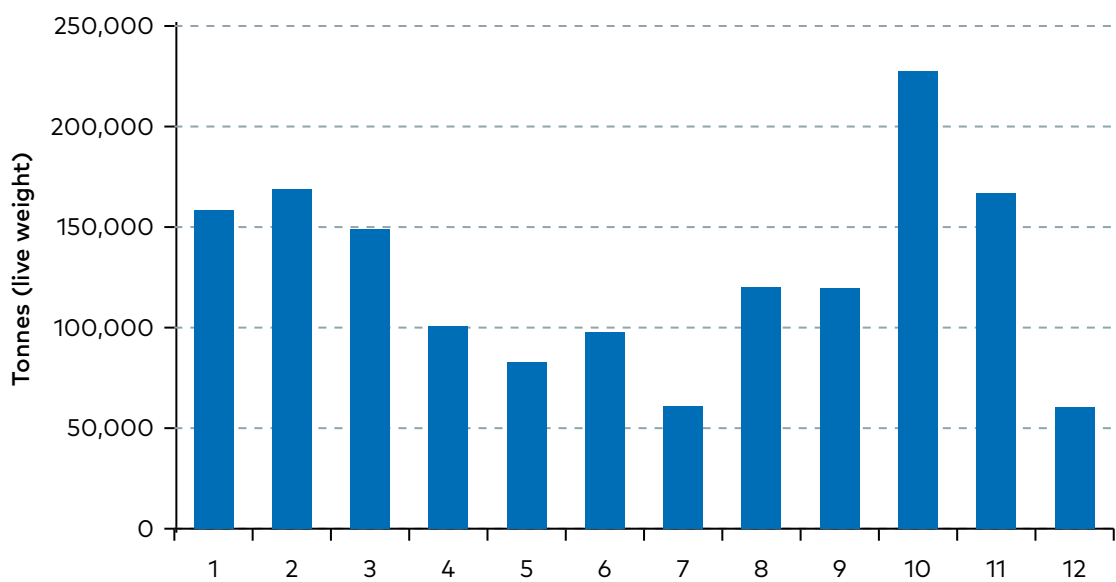
The availability of aquatic food from fisheries varies considerably from year to year, largely due to quota fluctuations. Among demersal species, cod volumes declined sharply in 2023, while saithe landings increased, and overall demersal value recovered strongly from the low point in 2021, though it remained slightly below the 2022 level. Pelagic catches rose until 2021 and subsequently decreased, yet the total value climbed to NOK 8.2 billion in 2023, driven by strong prices for herring and mackerel. Shellfish and other invertebrates showed steady growth in landed volume, with a value peak in 2022, followed by a mild decline in 2023. Production for reduction purposes displayed high volatility, notably due to a significant rebound in blue whiting landings in 2023.

Table 1.1: Primary production from fisheries. Source: Norwegian Directorate of Fisheries, 2025b.

	Quantity (tonnes live weight)					Value (NOK million)				
	2019	2020	2021	2022	2023	2019	2020	2021	2022	2023
Fishery for human consumption	1,384,548	1,438,463	1,661,913	1,587,016	1,487,043	18,910	18,949	12,872	26,875	27,655
<u>Demersal fish, flatfish, deep-sea spc.</u>	727,784	722,479	792,265	772,642	736,098	12,721	11,855	8,325	16,807	16,732
Cod	328,589	331,198	381,457	354,213	293,609	7,450	7,334	4,980	9,874	9,433
Saithe	191,862	189,159	190,411	209,356	228,120	1,638	1,651	1,131	2,763	3,008
Haddock	94,992	88,847	101,551	89,467	92,265	1,568	1,263	1,122	1,695	1,513
Redfish	31,646	40,680	52,645	49,273	52,821	324	330	304	577	698
Greenland halibut	17,020	17,259	16,291	16,884	16,919	646	450	268	669	817
Other	63,675	55,336	49,909	53,451	52,364	1,094	828	520	1,229	1,261
<u>Pelagic fish</u>	615,560	678,677	820,229	757,285	685,132	4,524	5,494	2,630	7,058	8,197
Norwegian Spring-spawning herring	391,017	395,269	467,767	359,237	356,182	1,709	2,273	1,232	2,558	3,349
Mackerel	149,669	203,102	253,202	282,348	198,832	2,396	2,688	581	3,679	3,621
North sea herring	55,700	64,313	57,571	55,350	59,376	317	440	345	403	628
Other	19,174	15,993	41,689	60,350	70,741	102	93	472	419	599
<u>Molluscs, crustaceans, echinoderms</u>	39,004	34,998	47,546	55,174	63,733	1,658	1,592	1,915	3,005	2,719
Northern shrimp	26,162	22,844	31,343	37,586	38 106	941	799	815	1,208	1,165
Snow crab	4,056	4,315	6,861	7,964	7,636	265	283	641	735	449
King crab	1,724	2,081	2,121	2,166	2,802	303	371	359	841	781
Other	7,062	5,758	7,221	7,458	15,189	149	139	101	220	324
<u>Cartilaginous fish</u>	2,201	2,309	1,874	1,915	2,080	7	8	2	4	7
Aquatic food for reduction	536,818	629,263	382,553	441,275	456,447	1,654	2,208	1,136	1,763	1,854
Blue whiting	259,774	291,542	168,613	125,362	327,731	661	953	408	329	1 080
North sea herring	56,092	38,926	28,853	65,504	43,797	269	209	145	362	317
Other	220,952	298,795	185,087	250,408	84,919	724	1,046	583	1,072	456
Aquatic food: other uses	166,095	155,214	162,961	173,612	189,762	254	254	161	223	234
Total Fishery	2,087,461	2,222,939	2,207,426	2,201,903	2,133,251	20,817	21,411	14,170	28,860	29,743

Another aspect not analysed further in this report is the seasonal pattern of catches throughout the year. Figure 1.1 presents the average monthly landings of aquatic food for human consumption from 2019 to 2023. Clear seasonal peaks emerge across all species groups. Cod and other demersal species dominate landings in winter and early spring, reflecting established seasonal fisheries such as the Skrei fishery. Pelagic species, in contrast, show pronounced peaks in the autumn and in the first months of the year, primarily driven by herring and mackerel fisheries. Shellfish, molluscs, and echinoderms display a more even distribution throughout the year, though several species, particularly shrimp and snow crab, show elevated activity in early summer and autumn. Flatfish and other deep-water species also exhibit stable seasonal patterns, with modest increases in spring and early summer. Cartilaginous fish contribute only small volumes, but their catches show slight peaks in late autumn. Overall, these seasonal dynamics influence both the availability of raw material and the temporal distribution of processing activity within the seafood sector.

Figure 1.1: Average monthly landings of catch by Norwegian vessels 2019-2023.
Source: The Norwegian Directorate of Fisheries (2025)



Aquaculture production

Total aquaculture production for human consumption, presented in Table 1.2, amounted to 1.65 million tonnes in 2023, valued at NOK 114.2 billion. Atlantic salmon remains the dominant species, representing 93% of volume and 94% of total value. Trout accounted for 91,000 tonnes, valued at approximately NOK 6 billion.

Production of other farmed species remains limited but is increasing. Farmed Atlantic cod has grown from zero in 2019 to 11.4 thousand tonnes in 2023, following earlier biological and market-related challenges. Farmed molluscs and crustaceans remain small in scale, and seaweed cultivation is still at an early stage, with 768 tonnes produced in 2023, of which 22% was used for human consumption.^[2] Aquaculture for other uses includes algae.

Table 1.2: Primary production from Aquaculture. Source: Norwegian Directorate of Fisheries, 2025a.

	Quantity (tonnes live weight)					Value (NOK million)				
	2019	2020	2021	2022	2023	2019	2020	2021	2022	2023
Aquaculture for human consumption	1,452,026	1,489,577	1,664,866	1,661,520	1,649,847	71,709	68,716	80,434	108,259	114,239
Atlantic salmon	1,364,042	1,388,434	1,562,415	1,564,948	1,542,480	67,990	64,677	75,783	102,464	107,534
Trout	83,489	96,263	95,058	85,615	90,641	3,477	3,782	4,228	5,237	5,856
Cod	0	163	1,622	5,116	11,389	0	8	67	189	450
Molluscs, crustaceans, echinoderms	2,164	2,071	2,200	2,646	2,234	29	21	30	17	39
Halibut	1,524	1,870	2,716	2,291	1,903	155	175	267	278	259
Other	807	776	855	905	1,200	58	53	59	74	100
Aquaculture other uses	117	336	246	221	137	4,359	8,618	6,224	4,227	4,561

2. Species, such as lumpfish, have been taken out of the equation because farming of this species is primarily cleaner fish, used in salmonoid aquaculture.

Regulation and management

Norway has one of the world's longest coastlines, stretching from Kattegat and Skagerrak in the southeast to the North Sea, Norwegian Sea, and Barents Sea in the north. Including Svalbard, the country's maritime zones are about seven times larger than its land area. Inland lakes and rivers also provide fish resources, but mainly for recreation and household consumption. In 2023, 62% of the catch by Norwegian vessels was taken within the Norwegian Exclusive Economic Zone (EEZ). This was followed by fisheries in international waters, primarily in the Antarctica and Irminger Sea/Reykjanes Ridge areas, accounting for 19% of the total catch. Catches in the United Kingdom EEZ accounted for 7%, the EU zone for 4%, and the Fisheries Protection Zone around Svalbard for 3%; the remaining ~5% was taken in other areas, including the Icelandic, Faroese, and Russian EEZs.

Modern fisheries management in Norway emerged after the collapse of the spring-spawning herring stock in the 1970s, which underscored the need for strict regulation. The introduction of 200-nautical-mile Exclusive Economic Zones (EEZs) in 1977 gave Norway control over its marine resources and enabled regulated fishing. Over the past five decades, the sector has shifted from open access and heavy subsidies to a quota-based system with individual transferable quotas (ITQs), turning it into a resource rent-generating industry. Today, both fisheries and aquaculture are tightly managed.

Norwegian fisheries management is grounded in scientific advice and international cooperation. Stock assessments from the Norwegian Institute of Marine Research (IMR) and recommendations from the International Council for the Exploration of the Sea (ICES) guide annual Total Allowable Catches (TACs) and conservation measures. These decisions are negotiated through bilateral and multilateral agreements with partners such as the European Union, the United Kingdom, and Russia, and coordinated through regional bodies such as the North East Atlantic Fisheries Commission (NEAFC). Norway also adheres to global frameworks, including the United Nations Convention on the Law of the Sea and the United Nations Fish Stocks Agreement, ensuring sustainable practices and joint efforts to combat illegal fishing.

Table 1.3 shows fishing pressure and stock size for the main commercially important stocks in Norwegian and adjacent waters, evaluated relative to maximum sustainable yield (MSY) reference points in the 2025 advice. Green indicates stocks for which fishing mortality is at or below the MSY level and whose spawning stock biomass is above the MSY trigger level. Red indicates stocks that are either fished above MSY or whose spawning-stock biomass is below the MSY trigger. "Not defined" denotes stocks for which MSY reference points are not available and which are managed using alternative precautionary or management-plan targets.

Table 1.3: Status of main stocks for Norwegian fisheries: stock status and fishing pressure. Source: ICES (2025b, 2025c, 2025d, 2025f, 2025h, 2025k, 2025l, 2025p, 2025q); IMR (2024a, 2024b, 2024c; 2025a, 2025b)

Species/stock	Fishing pressure	Stock size
	$F \leq F_{MSY}$	$SSB \geq MSY$ Btrigger
Northeast Arctic cod (cod.27.1-2)	Not good	Not good
North Sea cod (Southern substock)	Not good	Not good
Northern Norwegian Coastal Cod (north of 67°N)	Not defined	Not defined
Southern Norwegian Coastal cod (between 62°N and 67°N)	Not good	Not good
Northeast Arctic saithe (subareas 1–2)	Good	Good
Saithe in the North Sea and Skagerrak	Not good	Not good
Northeast Arctic haddock (subareas 1-2)	Not good	Good
Haddock North Sea, Skagerrak (had.27.46a20)	Good	Good
Norwegian spring-spawning herring (subareas 1, 2, 5; divisions 4.a, 14.a)	Good	Not good
North Sea autumn-spawning herring (Subarea 4 and divisions 3.a and 7.d)	Not good	Good
Northeast Arctic Mackerel	Not good	Not good
Northern shrimp (Barents Sea, subareas 1–2)	Good	Good
Northern shrimp (Skagerrak & Norwegian Trench, 3.a–4.a East)	Good	Not good

For several major stocks, fishing pressure is now at or below MSY, including haddock in the North Sea and Skagerrak, Norwegian springspawning herring, North Sea autumnspawning herring, Northeast Atlantic mackerel, and northern shrimp in both the Barents Sea and the Skagerrak–Norwegian Trench. However, for many of these stocks the spawningstock biomass (SSB) is still below the MSY Btrigger level, which means the stocks are recovering even though fishing pressure has been reduced. This is particularly the case for Norwegian springspawning herring, Northeast Atlantic mackerel, and northern shrimp in the Skagerrak–Norwegian Trench.

In contrast, several key demersal stocks still have fishing pressure above MSY and/or SSB below the MSY trigger. Northeast Arctic cod and North Sea cod (southern substock) both have $F > MSY$ and $SSB < MSY$ Btrigger, indicating weak status relative to MSY benchmarks. Northeast Arctic saithe and Northeast Arctic haddock show different patterns: both have $SSB \geq MSY$ Btrigger, but fishing pressure still exceeds MSY for saithe and is slightly above MSY for haddock. In the North Sea and Skagerrak, saithe is fished at or below MSY, but SSB remains below the trigger.

Northern Norwegian coastal cod (north of 67°N) lacks defined MSY reference points and is therefore shown as “not defined”, reflecting the use of management-plan or precautionary targets rather than formal MSY benchmarks. Overall, the 2025 advice indicates that while fishing pressure has been brought down to sustainable levels for several pelagic and invertebrate stocks, many stocks in Norwegian waters still have SSB below MSY-based thresholds, and some demersal stocks continue to show $F > MSY$ and/or $SSB < MSY$ trigger. Rebuilding spawning-stock biomass therefore remains a central task, even where current harvest levels are consistent with MSY.

Aquaculture

Norwegian aquaculture is regulated under the Aquaculture Act and operates under a licensing system based on Maximum Total Biomass (MTB). Salmon farming is controlled through a traffic-light system that adjusts production based on environmental indicators such as sea lice levels, and farms must meet strict standards for fish health, welfare, and biosecurity. The Norwegian government's White Paper *The Future of Aquaculture* (Regjeringen, 2025) outlines a new impact-based regulatory framework that proposes replacing today's volume-based limits with a system based on actual environmental effects, including tradable quotas for sea lice emissions and a fee on lost fish. Other farmed species, such as cod and halibut, fall under the same regulative framework with species-specific rules: cod farming requires monitoring of sexual maturity and spawning risk to protect wild stocks, while halibut farming operates under MTB licenses with strict hygiene and annual safety monitoring. Across all species, Norway promotes environmental responsibility and incentivises green technologies to reduce ecological impact.

Tourist and recreational fishing

Tourist and recreational fishing in Norway are regulated to ensure sustainable use of marine and freshwater resources. Sea angling remains generally allowed for everybody without a license, but other types of regulations have tightened substantially in recent years. Tourist fishing in Norway is regulated much more strictly than recreational fishing by Norwegian residents. Tourists must fish through a registered tourist fishing enterprise if they want to export their catch, and these businesses are required to submit daily digital catch reports, covering all catches, including released fish. Tourists may only use handheld gear, face strict documentation rules, and are subject to steadily tightening export quotas, 15 kg from 2026 and 10 kg from 2027. Norwegian recreational fishers may fish freely with rod and handline and may also use certain forms of passive gear under strict limits. Both groups must follow conservation rules, such as respecting minimum and maximum size limits for different species and observing a fishing prohibition during the closed season for certain species, such as halibut. Reliable figures on tourist and recreational fishing are difficult to obtain, as reporting is limited and participation outside registered operators is largely unmonitored.

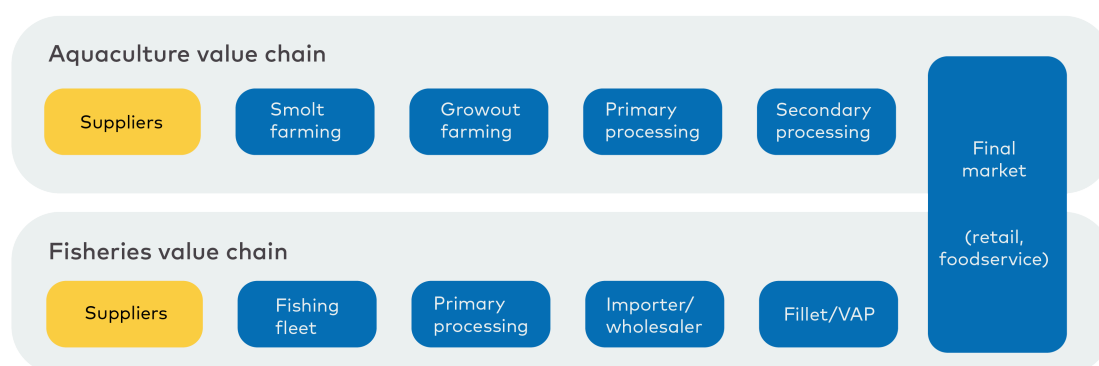
Processing and Value Chain Overview: Norway

Figure 1.2 illustrates the Norwegian fisheries and aquaculture value chains. In aquaculture, production begins with smolt farming, where juvenile salmon are raised before being transferred to sea cages for grow-out farming. Once harvested, the fish enter primary processing (slaughtering and initial preparation), followed by secondary processing (filleting, value-added processing, or ready-to-eat products), either in Norway or abroad, before reaching final markets in retail and foodservice.

In the fisheries value chain, wild fish are harvested by the fishing fleet and delivered to local fish processing plants. Here, the fish may undergo further processing, but it is often sold unprocessed to processors or buyers domestically or abroad. The products then move through importers or wholesalers and may undergo additional processing before reaching their end markets globally.

Together, these chains form an integrated system that delivers Norwegian seafood from ocean to consumer.

Figure 1.2: Norwegian aquatic food value chain. Source: inspired by Bergesen & Tveterås (2019).



Of the total landings by Norwegian vessels of about 2.5 million tonnes, 84% is landed in Norway, where 70% is fish for human consumption. The remaining 14% of landings by Norwegian vessels are primarily pelagic species for reduction abroad. Norwegian landings abroad are included in the export statistics.

In 2023, 85% of landings at Norwegian ports were by Norwegian vessels, 5% by Nordic vessels (the Faroes, Denmark, and Iceland), and 9% by vessels from other countries, with British vessels dominating. About 71% of the foreign landings in Norway are for human consumption. All landings from foreign vessels in Norway bought by Norwegian companies are included in the official trade statistics.

Table 1.4 presents the number of companies in each sector, total fisheries landings, and aquaculture production by region. About half of the total primary production of aquatic food for human consumption takes place in the two northernmost regions, where both whitefish, pelagic, and crustacean fisheries are particularly important. Møre og Romsdal and Vestland also play significant roles. The eastern regions, despite being home to half the country's population, account for only 4% of the country's aquatic food production.

There is a strong correlation between where fish are landed or produced and where companies are located. Nearly 60% of companies, as well as production, are in the two northernmost counties (Troms and Finnmark, and Nordland). However, processing does not necessarily occur at the landing site. Fish is frequently sold between companies and across regions. Due to limited public data between catch and exports, it is not possible to determine the exact quantities processed by each company.

Troms and Finnmark, Nordland, and Vestland are the dominant counties in Norwegian seafood production. More than half of all whitefish landings occur in Troms and Finnmark, although most companies are in Nordland. Troms and Finnmark also have the largest share of crustacean landings (primarily Northern shrimp and crabs). Møre og Romsdal dominates the pelagic industry.

Table 1.4: Regional distribution of processors and total landings/farming. Source: Norwegian Directorate of Fisheries (2025a,b)

Region										
Farmed ^[3]		Human consumption								
		Whitefish		Pelagic		Crustaceans		Total		
N. of comp	Tot. Prod	N. of comp	Tot. Landing	N. of comp	Tot. Landing	N. of comp	Tot. Landings	N. of comp	Tot. Landings	
Troms and Finnmark	13	342,741	56	407,241	2	57,666	24	46,504	95	854,152
Nordland	13	367,032	73	143,656	4	132,176	3	7,048	93	649,912
Trøndelag	17	2,43,100	10	4,456	2	62,760	11	2,717	40	313,033
Møre og Romsdal	16	222,704	41	144,497	9	209,119	5	1,955	71	578,275
Vestland	23	344,543	11	28,536	5	138,602	6	280	45	511,961
Rogaland	6	107,850	5	8,107	4	54,964	7	1,205	22	172,126
Other	9	21,877	11	1,686		29,844	11	4,024	31	57,430
Total	97	1,649,847	207	738,178	26	685,132	67	63,733	397	3,136,890

3. We do not have the regional distribution for farmed molluscs, crustaceans, and echinoderms for consumption; thus, these figures are incorporated into the "Other" category.

The regions where most of Norway's seafood production takes place are also the least populated (see Table 1.5). Located in the far north, these regions are also the furthest away from the main markets. Troms and Finnmark, and Nordland, each with around 240 000 inhabitants, stand out with exceptionally high primary production per capita, 3 523 and 2 696 kg, respectively. In contrast, more densely populated regions such as Rogaland and Trøndelag have far lower percapita production levels. The rest of the country, home to more than 3 million people, accounts for only 18 kg of primary production per capita. This illustrates how seafood production is heavily concentrated in sparsely populated coastal regions, where natural conditions, coastline availability, and industrial structure support large-scale aquaculture and fisheries activity.

Table 1.5: Inhabitants and primary production available per capita, 2023. Source: SSB (2025)

	Inhabitants (1000)	Primary production per capita
Troms and Finnmark	242	3,523
Nordland	241	2,696
Trøndelag	478	654
Møre og Romsdal	268	2,155
Vestland	646	792
Rogaland	492	350
Other	3,120	18
Total	5,489	571

Marine products for reduction

A substantial share of pelagic fish is used to produce fishmeal and fish oil. In addition to feed production, fishmeal and fish oil serve as key ingredients in omega-3 supplements, protein powders, and a range of health and nutraceutical products.

There are five feed producers in Norway: Cargill/EWOS, Biomar, Skretting, MOWI Feed, and Polarfeed, with ten production facilities spread along the Norwegian coast, from Finnmark in the north to Rogaland in the south. Only Polarfeed is Norwegian owned. In addition, there are smaller producers specializing in live feed and starter feed for farmed cod (Iversen et al., 2024).

In addition, these industries rely on cutoffs from the processing industry, for which no publicly available figures are available.

Table 1.6: Regional distribution of meal and oil companies. Source: Norwegian Directorate of Fisheries (2025b)

Region	Number of companies	Meal and oil	
		Primary production	Refinery
Troms and Finnmark	3	1	2,044
Nordland	8	1	13,303
Trøndelag	4	1	886
Møre og Romsdal	3	8	58,116
Vestland	3		51,817
Rogaland	5		329,963
Other		2	318
Total	26	13	456,447

Fish processing in Norway and abroad

The Norwegian industry primarily relies on domestically sourced fish. Some segments, however, depend on imported raw materials; for example, salted and dried cod producers can use frozen fish, including from foreign vessels. The pelagic industry also uses fresh fish from foreign vessels landed in Norway, for both human consumption and reduction.

However, compared to the substantial primary production of aquatic food in Norway, the processing sector is relatively small. Table 1.7 displays the estimated quantities of whole fish available for the Norwegian processing industry.^[4] Of the 3.2 million tonnes of whole fish available in Norway, 2.1 million tonnes are exported as whole fish.^[5] This leaves 1.1 million tonnes that can potentially be used by Norwegian processing (for domestic or foreign consumption). However, some of this fish is frozen, either on land or onboard the vessels. About one-third of the wild-caught fish intended for human consumption, such as cod, saithe, and haddock, is frozen onboard. A substantial share of this frozen fish is landed at independent cold-storage facilities for later export. These volumes should, in principle, be captured in export statistics; however, because frozen fish is a durable product, some of it may be exported in the year after it is caught. Consequently, exports reported in a given year may include fish landed the previous year.

This, however, does not illustrate the capacity, as it is potentially substantially larger. Filleting of wild-caught fish is highly seasonal, and a lack of fish due to fewer fish leaves the facilities with no production for many periods of the year. However, when the fish is available, the capacity is used to its maximum.

4. The figures in the table must not be confused with what is available for consumption in Norway, as a substantial share of this will be exported.
5. Raw materials of seafood products for human consumption in Norway were estimated by adding the primary production of whole fish and imports of whole fish, and then subtracting exports of whole fish.

Table 1.7: Primary production, imports, exports, and quantities available for production in Norway. Source: own estimations based on data from The Norwegian Directorate of Fisheries (2025a,b) and NSC/SSB (2025).

Specie	Primary production	Imports	Exports	Available for production in Norway
Atlantic salmon	1,542,480	264	1,117,766	424,979
Trout	90,641	314	76,839	14,117
Herring	415,558	46,105	86,484	375,179
Mackerel	198,827	108,532	296,357	11,002
Cod	280,521	25,547	142,895	163,172
Saithe	189,423	5,674	82,322	112,774
Haddock	75,262	119	74,092	1,288
Shrimps	38,106	9,727	13,227	34,606
Other	200,431	12,950	209,076	4,306
Total	3,031,249	209,233	2,099,058	1,141,423

Exports and hub markets

About two-thirds of Norway's total exports of aquatic food for human consumption consist of whole fresh or frozen fish. Approximately 14% of Norway's exports (in liveweight equivalent) go to other Nordic countries, and more than 80% of this is whole, unprocessed fish.

Among the Nordic countries, Denmark and, to some extent, Sweden serve as important hubs and processing markets for Norwegian seafood. Several nonNordic countries also rely on Norwegian raw material in their processing industries, including the Netherlands and Poland. In addition, large volumes are shipped overseas for secondary processing, particularly to China, where Norwegian fish is processed for other end markets, for example, frozen whitefish fillets for European consumers and mackerel products for the Japanese market. It is estimated that around 40% of Norway's most important species pass through hub or processing markets before reaching their final consumer destinations (Kontali Analyse AS, 2016; 2019).

Trade flows of Aquatic food: Norway

Imports for human consumption

Norway imported around 250 thousand tonnes of aquatic food for human consumption in 2023. The largest category of imported aquatic foods for human consumption is fresh/chilled products, with more than 90% consisting of fresh whole mackerel, herring, and blue whiting. A share of the imported fresh produce is primarily for meal and oil production. This share is calculated based on official landings statistics and subtracted from the following tables.

Cod and saithe dominate the frozen whole category (95%), with the majority being imports from Russian vessels used in Norwegian (salted and dried) production.

Imports from the Nordic countries are also dominated by fresh products, particularly fresh whole herring and mackerel, which accounted for 66% of imports in 2023. These are primarily landings of Nordic vessels at Norwegian ports, and blue whiting, mackerel, and herring are the dominant species. In 2023, 66% of imports of aquatic food for human consumption were from European countries outside the Nordic region, while 4% originated from Asia, and 5% from North America.

Given that a relatively large share of fish exported from Norway is shipped as whole fish, a considerable portion of it is subsequently processed abroad. It is assumed that a substantial share of this processed fish is re-imported into Norway. Because the origin of fish cannot be identified in official trade statistics, the actual share of Norwegian fish in imported processed products is uncertain. However, if we assume that the majority of processed fish (i.e., filleted, salted, or otherwise processed) of the major species^[6] (cod, saithe, haddock, salmon, trout, herring, and mackerel) originates from Norwegian catches, the data suggest that only about 17,000 tonnes, or roughly 6% of total imports, can reasonably be assumed to be of Norwegian origin. Of this amount, approximately 7,000 tonnes are imported from other Nordic countries, representing around 12% of Norway's fish imports from the Nordic region. It is nevertheless likely that some of this fish is originally from, for instance, Russia or the US, particularly products that enter Norway after processing in China.

6. Shrimps are excluded from this calculation, as Norway imports substantial quantities of other shrimp species, particularly warm-water varieties, and because the Norwegian shrimp industry relies largely on imported raw material. Domestic catches by Norwegian vessels are insufficient to meet the processing industry's demand, and imports therefore play a structurally important role in supplying the sector.

Table 1.8: Imports of fish for human consumption in 2023 (tonnes). Source: NSC/SSB, 2025.

Products and species	Quantity (tonnes live weight ^[7])		Value (million NOK)	
	Import total	Import Nordic	Import total	Import Nordic
Salmon	473	434	76	72
Fresh whole/live	264	263	23	23
Frozen whole	1		0	
Fillets	85	62	10	8
Salted, dried, smoked	90	87	10	10
Processed	34	22	3	3
Other	0	0	30	28
Herring	47,528	14,763	502	168
Fresh whole/live	46,093	14,063	457	148
Frozen whole	12	1	0	0
Fillets	5	5	0	0
Salted, dried, smoked	16	10	1	1
Processed	1,402	684	44	18
Other	0	0	0	0
Mackerel	108,877	16,583	1,814	207
Fresh whole/live	108,530	16,244	1,810	203
Frozen whole	2		0	
Fillets	345	339	4	4
Cod	36,022	6,815	1,284	188
Fresh whole/live	1,473	1,473	28	28
Frozen whole	24,073	2,416	818	75
Fillets	7,554	471	284	18
Salted, dried, smoked	201	26	11	3
Processed	2,721	2,429	62	56
Other	0	0	79	8
Saithe	8,518	1,736	154	42
Fresh whole/live	103	102	1	1
Frozen whole	5,571		81	
Fillets	1,938	887	33	10
Processed	907	747	39	30
Other	0	0	1	0
Trout	365	323	17	14
Fresh whole/live	314	314	14	14
Frozen whole	0		0	
Fillets	51	9	3	1
Haddock	2,157	1,558	52	44

7. Live weight figures have been calculated relying on relevant conversion factors from the Norwegian Directorate of Fisheries, EUMOFA, FAO, and adjusted based on industry knowledge.

Fresh whole/live	61		1	
Frozen whole	58	61	1	1
Fillets	2,038	1,497	38	32
Other	0	0	13	11
Prawns	13,808	7,809	1,030	463
Fresh/live	214	163	18	12
Frozen whole	9,513	6,611	517	326
Processed (peeled)	4,081	1,035	495	125
Other	33,751	13,940	1,148	373
Fresh/live	9,806	9,294	160	82
Frozen	3,144	1,063	139	38
Fillets	4,769	572	114	17
Salted, dried, smoked	1,096	153	46	20
Processed	14,880	2,858	589	170
Other	56	0	100	46
Total	251,501	63,960	6,077	1,570
Fresh/live	166,858	41,917	2,511	511
Frozen	42,375	10,151	1,557	441
Fillets	16,784	3,841	485	89
Salted, dried, smoked	1,403	276	69	33
Processed	24,026	7,774	1,233	402
Other	56	0	222	94

Imports of Marine Ingredients and Feed^[8]

Imports of fresh whole pelagic species include blue whiting, mackerel, sardines/sprat, and herring, which are landed by foreign vessels in Norway. The majority are landings by Nordic vessels.

Flour/meal and pellets are sourced primarily from Iceland, Denmark, and the Faroe Islands (79%), with 17% from North and South America, and the remaining from the rest of Europe.

About 50% of the fish oil is sourced from Nordic countries, while the rest is dominated by overseas markets such as Mexico (10%), Mauritania (9%), and Chile (9%).

The other category consists primarily of algae, and fish oil/flour not for human consumption.

8. The following are listed as meal and/or oil for animal feed in Norwegian imports: 23012010, 15042011, 5119113, 12122910, 15041011, 5119119, 5119111, 12122110, 5119112. In addition, some share of the imports of fresh, whole pelagic fish is for meal and oil; this share is found from the official Norwegian landing statistics.

Norwegian aquaculture production is heavily dependent on imports of feed, according to Aas et al (2022): only 8% of the ingredients were sourced from Norway, specifically the fish meal and fish oil. The remaining 92%, including all micro-ingredients, were imported. According to them, salmon feed in 2020 was composed of 12.1% fish meal and 10.3% fish oil, alongside 40.5% plant-based protein sources and 20.1% vegetable oils. Carbohydrate sources accounted for 12.5% of the feed, while micro-ingredients made up 4.1%. An additional 0.4% consisted of emerging ingredients, including insect meal, single-cell proteins, fermented products, and microalgae. This amounted to 1,976,709 tonnes of ingredients, where 239,710 tonnes of marine protein and 203,598 tonnes of marine oils (including 4,531 tonnes of oil from by-products from farmed fish).

Table 1.9: Imports of marine ingredients in 2023 (tonnes). Source: NSC/SSB, 2025.

Product categories	Quantity (tonnes product weight)		Value (million NOK)	
	Import total	Import Nordic	Import total	Import Nordic
Fresh whole pelagic	44,472	43,946	248	236
Flour/meal/pellets	228,143	180,282	5,068	3,981
Oil	173,250	88,444	8,556	3,885
Other	93,865	64,191	1,924	355
Total	539,730	376,862	15,796	8,458

Exports for human consumption

Total exports of aquatic food for human consumption in 2023 amounted to about 3.1 billion tonnes in live weight. About 67% of the total export volume, measured by live weight, is whole fresh/frozen/live fish. As only a small share of this whole fish is made available to consumers in this state, this suggests that a substantial share is further processed abroad^[9]. The main destination markets for the whole products are Poland, Denmark, China, and the Netherlands, which are typical producers or hubs, followed by countries such as France, the UK, and Spain, which are consumer markets but also have substantial fish processing industries.

In addition to the dominance of whole salmon exports, Table 1.10 also illustrates how strongly species differ in their product composition and degree of processing. Pelagic species such as herring and mackerel are exported mainly as frozen whole fish, whereas demersal species, particularly cod and saithe, show a much more diversified product structure, with significant volumes in salted/dried/smoked

9. Of the remaining product, some will be further processed to some extent. For instance, some share of the whole, dried cod will be soaked and produced into portions, a substantial share of the salted whole cod will be dried in Portugal, some salmon fillets will be smoked, and so on.

categories. This reflects long-standing processing traditions and market preferences in Southern Europe, Africa, and parts of Asia. Processed products (including fillets) remain a comparatively small share of total export volume across most species, but they account for a disproportionately high share of value, underscoring the greater profitability of value-added production. The Nordic region accounts for only a modest share of Norway's total exports (12%) but stands out for a higher share of fresh whole/live products, especially salmon, cod, and saithe, reflecting well-integrated regional supply chains and short distances. About 34% of exports of aquatic food for human consumption were for overseas markets in 2023, of which 19% were to Asia and 8% to North America. While 54% is destined for other European markets.

Table 1.10: Exports of fish for human consumption in 2023 (tonnes). Source: NSC/SSB, 2025.

Products and species	Quantity (tonnes live weight)		Value (million NOK)	
	Export total	Export Nordic	Export total	Export Nordic
Salmon	1,407,329	191,105	122,268	15,336
Fresh whole/live	1,093,726	155,350	91,123	12,217
Frozen whole	24,040	1,079	1,990	83
Fillets	285,882	34,154	27,669	2,996
Salted, dried, smoked	3,382	496	387	30
Processed	298	26	27	3
Other	0	0	1,072	6
Herring	371,243	36,403	4,002	427
Fresh whole/live	14,696	14,695	139	139
Frozen whole	71,788	38	953	0
Fillets	245,424	1,459	2,259	16
Salted, dried, smoked	9,698	6,223	125	76
Processed	29,637	13,989	417	193
Other	0	0	110	2
Mackerel	325,110	3,781	6,666	76
Fresh whole/live	8,690	3,534	162	70
Frozen whole	287,667	236	6,106	5
Fillets	28,701	0	396	0
Processed	51	11	3	1
Cod	306,360	49,800	12,214	1,904
Fresh whole/live	66,687	35,793	2,464	1,314
Frozen whole	76,208	2,058	2,636	66
Fillets	31,625	11,610	1,124	491
Salted, dried, smoked	131,683	290	5,901	11
Processed	157	49	88	22
Saithe	263,646	26,404	3,960	478

Fresh whole/live	28,069	20,945	496	361
Frozen whole	54,253	1,794	798	29
Fillets	11,392	3,655	252	87
Salted, dried, smoked	169,932	10	2,411	0
Other	0	0	3	1
Trout	92,963	3,461	5,487	151
Fresh whole/live	66,246	2,192	3,544	93
Frozen whole	10,592	795	487	33
Fillets	13,207	362	1,097	21
Salted, dried, smoked	2,917	112	359	5
Haddock	80,779	10,742	1,704	247
Fresh whole/live	14,392	8,862	325	187
Frozen whole	59,700	15	1,203	1
Fillets	6,607	1,865	174	59
Salted, dried, smoked	79	0	1	0
Other	0	0	1	0
Prawns	23 341	13 985	1 261	655
Fresh/live	679	675	20	20
Frozen whole	12,547	8,483	384	216
Processed (peeled)	9,499	4,213	797	360
Salted, dried, smoked	615	613	60	60
Other	252,963	31,703	7,334	1,243
Fresh/live	93,392	27,842	2,184	863
Frozen	115,684	2,847	3,301	154
Fillets	646	328	24	11
Salted, dried, smoked	42,696	483	1 178	58
Processed	521	180	73	89
Other	23	22	575	69
Total	3,123,732	367,383	164,894	20,518
Fresh/live	1,386,578	269,888	100,456	15,264
Frozen	712,480	17,343	17,858	588
Fillets	623,484	53,433	32,995	3,681
Salted, dried, smoked	361,003	8,227	10,422	240
Processed	40,164	18,469	1,404	667
Other	24	22	1,759	77

Exports of Marine Ingredients and Feed

Exports of aquatic produce for feed and other uses amounted to 411 thousand tonnes in 2023, and more than half were to the other Nordic countries.

Exports for Feed and other products are dominated by fresh whole pelagic (blue whiting, mackerel, sardines/sprats, and herring), which are landings by Norwegian vessels in foreign ports, mainly in other Nordic countries, where Denmark is by far the most important.

The main markets for Norwegian fish meal and pellets are the United Kingdom (32%), the USA (15%), the Faroe Islands (13%), and Denmark (10%).

Most of the fish oil is exported to Turkey (51%), followed by Denmark (17%) and Greece (9%). Other markets are a combination of other European and overseas markets.

Table 1.11: Exports of marine ingredients in 2023 (tonnes). Source: NSC/SSB, 2025.

Product categories	Quantity (tonnes product weight)		Value (million NOK)	
	Export total	Export Nordic	Export total	Export Nordic
Fresh whole pelagic	68,435	52,251	246	199
Flour/meal/pellets	67,214	16,135	1,505	278
Oil	81,882	14,506	1,884	369
Other	193,267	146,548	3,236	598
Total	410,798	229,441	6,871	1,444

Aquatic food available for consumption in Norway

Aquatic food available for consumption in Norway reflects the balance between domestic production and trade. Norway has substantial harvests from both capture fisheries and aquaculture, but a large share of this production is exported. The figures below show the volumes that remain in the country after accounting for these trade flows, expressed as live-weight equivalents and grouped by key species.

The wide range of product forms produced and traded in Norway means that precise conversion factors are not available; some trade categories are broad and may include multiple product types. The species shown in the table should therefore be regarded as illustrative examples. For example, for salmon, a large share of exports consists of whole fish, which makes live-weight estimates relatively reliable. For cod, however, nearly half of the production is salted, dried, or both, and differences in processing practices and storage times affect the appropriate conversion to live weight^[10].

10. In addition, variations may arise due to seasonal factors (for example, cod during periods of high stomach content) or differences between facilities in how the fish is cut.

It is important to emphasize that these figures do not represent what is actually consumed in Norway, but rather what is theoretically available. Storage losses, waste, re-exports, and irregularities such as unreported landings (Svorken et al., 2023) all influence the quantities ultimately consumed. Recreational fishing for own consumption is also not included in these figures.

The estimates are presented in Table 1.13. In total, 48 kg per capita is available for human consumption in 2023. These figures are closely aligned with FAO's estimate of 49 kg per capita (FAO, 2026). Salmon is by far the largest species, followed by herring and cod. For comparison, the Norwegian Directorate of Health reports that 30.4 kg per capita in live weight (equivalent to 18.5 kg per capita edible weight) of fish and seafood was available to consumers in 2023, based on sales from wholesalers to retail and foodservice (Norwegian Directorate of Health, 2025)^[11].

Table 1.12: Available for consumption in Norway in 2023, total and a selection of species. Tonnes, live weight. Source: Own estimations based on The Norwegian Directorate of Fisheries (2025a,b) and NSC/SSB (2025).

	Primary production	Imports	Exports	Export share	Available for consumption
Total quantities (tonnes)	3,136,890	251,501	3,123,732	92%	264,659
Salmon	1,542,480	473	1,407,329	91%	135,624
Herring	415,558	47,528	371,243	80%	91,844
Cod	304,998	36,022	306,360	90%	34,660
Other	873,854	167,477	1,038,801	100%	2,530
Quantities per capita (kg/year)	571	46	569		48
Salmon	281	0	256		25
Herring	76	9	68		17
Cod	56	7	56		6
Other	159	31	189		0,5

Potential availability

In a theoretical scenario where all landings were directed to human consumption, total availability would increase by nearly 650 thousand tonnes to about 3,78 million tonnes. This would raise aquatic food availability from the current 48 kg per capita per year to 165 kg per capita per year. Of this, the volume of herring and mackerel that, in 2023, was for reduction, would contribute nearly 64,000 tonnes. However,

11. These figures do not include direct sales from producer to consumer, such as distributors and retailers who have a license to buy fish directly from the fisher.

approximately 338,000 tonnes would come from blue whiting, which currently is not used for human consumption in Norway. This theoretical scenario illustrates the magnitude of Norway's latent seafood resources, even though only a share of these volumes is realistically available for human consumption

A more likely scenario would be to increase only the 64,000 tonnes from herring and mackerel, which would still increase the availability of aquatic food to 60 kg per capita per year.

Challenges, threats, and opportunities

Norway possesses a significant untapped potential for national food security through its massive seafood production. According to Grünfeld et al. (2023), the theoretical maximum capacity is estimated at 76% of the average daily requirement (2350 kcal). Aquaculture, particularly the production of fat-rich salmon, is a primary source of calories in this context, accounting for roughly two-thirds of the total potential caloric output (Grünfeld et al., 2023). However, seafood production in Norway fluctuates to such an extent that in some months (such as October and November) it can cover more than 100% of the population's energy needs, while in other months (such as April and May) it falls to around 55–60% (Grünfeld et al., 2023).

In addition to its potential for food security, Norway faces several governance-related challenges, particularly in the international management of shared pelagic stocks. The nations fishing for mackerel have disagreed on quota allocations, leading to catches far above scientific advice, declining recruitment, and a marked reduction in stock size and distribution over the past decade (Institute of Marine Research, 2025b). The situation is similar for Norwegian spring-spawning herring, where the fishing nations do not agree on each country's total quota. Thus, since 2013, it has been fished substantially more than recommended by scientists (Institute of Marine Research, 2023).

Climate change represents another primary structural driver shaping future opportunities and risks for Norwegian fisheries. Its impact is expected to differ across Norwegian species (Kjesbu et al., 2021). Cold-temperate stocks in northern areas, such as Northeast Arctic cod, Northeast Arctic haddock, Northeast Arctic saithe, Norwegian Coastal cod (North), Norwegian spring-spawning herring, Northern shrimp (northern stock), and Northeast Atlantic mackerel, are projected to benefit from warming due to expanded feeding areas, increased primary and secondary production, and retreating sea ice. In contrast, cold-temperate stocks located near their southern thermal limits, including North Sea cod and Norwegian Coastal cod (South), are expected to decline as rising temperatures exceed tolerable thresholds and key prey organisms shift northward. North Sea herring represents an exception among North Sea cold-temperate stocks, as it is

nonetheless projected to experience a positive directional effect. The assessments are based on a combination of expert analyses and scientific models of physical and biological ocean processes for the year 2041, under a moderate greenhouse gas emissions scenario.

Table 1.13: Climate risk for different species (Kjesbu et al., 2021).

Stocks	Directional effect of climate change
Northeast Arctic cod	Positive
North sea cod	Negative
Cod, Norwegian Coastal - North	Positive
Cod, Norwegian Coastal - South	Negative
Northeast Arctic saithe	Positive
Norwegian spring-spawning herring	Positive
Northeast Arctic haddock	Positive
North sea herring	Positive
Northern shrimp	Positive
Northeast Atlantic mackerel	Positive

Despite Norway's large production capacity, several systemic vulnerabilities could limit the country's ability to utilise this potential in a crisis. Grünfeld et al. (2023) also find that Norway possesses a highly robust cold-storage and logistics infrastructure: national freezing and storage capacity is more than sufficient to smooth out seasonal fluctuations in landings, and domestic transport capacity is considered adequate to redirect seafood from export markets to domestic consumption when needed.

However, the seafood value chain remains highly exposed to external shocks. Energy supply is identified as the most critical threat: the entire infrastructure, from diesel-dependent fishing vessels to electricity-reliant cold storage and domestic transport, depends on prioritized energy access during a crisis (Grünfeld et al., 2023). Geopolitical conflicts or trade disruptions could also reduce the availability of feed inputs and restrict access to vital fishing grounds such as the Barents Sea (Grünfeld et al., 2023).

Norway always maintains a substantial standing biomass in sea-based aquaculture. As of 31 December 2023, the live biomass of Atlantic salmon and rainbow trout amounted to 882,261 tonnes (Norwegian Directorate of Fisheries, 2025a). This biomass is not included in the earlier availability estimates because it represents fish that have not yet been slaughtered. However, in a crisis, it constitutes a significant strategic reserve that could, in principle, be slaughtered and redirected to domestic consumption. The presence of such a large livestock underscores aquaculture's dual role, both as a significant export industry and as a potential buffer for national food security.

A further major vulnerability concerns reliance on feed. The aquaculture industry depends heavily on imported feed ingredients: 92% of the raw materials for fish feed are currently sourced from abroad (Aas et al., 2022). Disruptions in global supply chains for fishmeal, fish oil, plant proteins, or micro-ingredients would quickly constrain Norwegian aquaculture production. This reliance is considered one of the sector's most significant systemic vulnerabilities. There is political recognition of this risk, and Norway aim to increase the share of domestically produced feed ingredients to 25% by 2034 (Research Council of Norway, 2025).

2. Iceland

Introduction

The fishing industry has been the backbone of the Icelandic economy for the last 150 years, although its importance has waned in recent years. In 2023, fishing, aquaculture, and fish processing together accounted for 6.5% of GDP, and 4.8% of the working population worked in these same industries. Seafood then accounted for 37.6% of all exported goods, and aquaculture for 5.5%, for a combined share of 43.1%.

Although fisheries no longer hold the same national importance as before, fishing and fish processing remain the primary economic activities in most coastal villages and small towns along the Icelandic coastline. Thus, while fisheries accounted for only 1% of economic activity in the capital region in 2017, they accounted for 11-24% in other regions. Fisheries management has been an integral part of rural development policy pursued in the last 50 years, with special measures in place for small, precarious communities.

Primary production

Capture fishery

In 2023, Icelandic landings totalled 1,375,000 tonnes. Pelagic catches amounted to 946,000 tonnes, demersal to 423,000 tonnes, and crustacean catches to almost 6,000 tonnes. Most demersal catches were landed in the capital area, but the distribution was even across all regions. By contrast, almost two-thirds of all pelagic catches were landed in harbours in the Eastfjords, and some 240 thousand tonnes in the south of the country.

Table 2.1: Catches in 2023 by regions. Tonnes. Source: Statistics Iceland

	All	Capital	West	Westfjords	Northwest	Northeast	East	South	Southwest	Abroad
Cod	220,281	28,232	37,704	27,164	28,221	25,196	21,689	28,038	22,996	1,042
Haddock	69,387	10,540	8,548	7,310	9,975	5,237	8,792	12,351	6,597	37
Saithe	42,178	14,326	2,026	2,765	3,412	3,146	4,133	7,965	4,335	71
Redfish	39,122	17,972	3,235	1,795	2,924	2,520	3,176	4,758	2,716	25
Other demersal	51,991	9,373	7,309	6,470	2,463	6,865	4,625	6,010	8,859	11
Demersal total	422,959	80,443	58,822	45,504	46,995	42,964	42,415	591,22	45,503	11,86
Herring	109,770	6,626	2			1,701	44,987	48,086		8,369
Norwegian spring-spawning herring	76,550	5,39				10,427	48,169	15,277		2,137
Capelin	300,711	2,413	21,309			24,550	155,622	94,733		2,085
Capelin roe	25,038		3,659			2,034	11,790	7,555		
Blue whiting	292,858	2	5,745			737	244,445	38,310		3,618
Mackerel	14,1125		1		0	13,905	87,566	35,735	12	3,906
Pelagic total	946,052	9,580	30,716	0	0	53,354	592,579	239,696	12	20,115
Shrimp	2,610	8	44	682	1,876					
Scallop	54		54							
Iceland cyprine	4		4							
Other shellfish	3,097	2	617	413	35		1,821	33	177	
Crustaceans total	5,765	10	719	1,095	1,911	0	1,821	33	177	0
All species	1,374,776	90,033	90,257	46,599	48,906	96,318	636,815	298,851	45,692	21,301

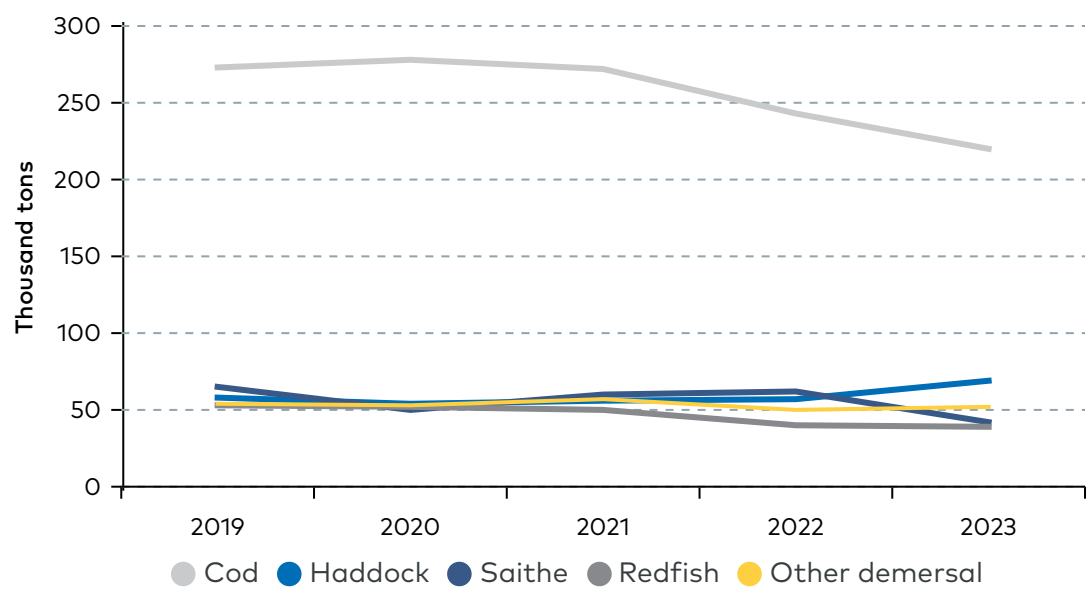
In 2023, all blue whiting catches and 83.5% of capelin catches were processed into fishmeal and oil, while 70% of the herring and more than half of the mackerel were processed for human consumption. Most of the catches of other species were processed for human consumption.

Demersal species

For centuries, cod has played a leading role in Icelandic fisheries. Although cod catches have declined, cod remains by far the most valuable species, accounting for around half of demersal catches, both in terms of quantity and value.

In 2019, demersal catches were 500,000 tonnes, but had declined to 420,000 tonnes five years later. Declining cod catches explain most of the decline in demersal catches during 2019–2023. Catches of cod were 273,000 tonnes in 2019 but had fallen to 220,000 tonnes five years later. Harvests of saithe and redfish have also declined, but haddock remained more stable.

Figure 2.1: Icelandic catches of the main demersal species in 2019-2023. Tonnes.
Source: Statistics Iceland.

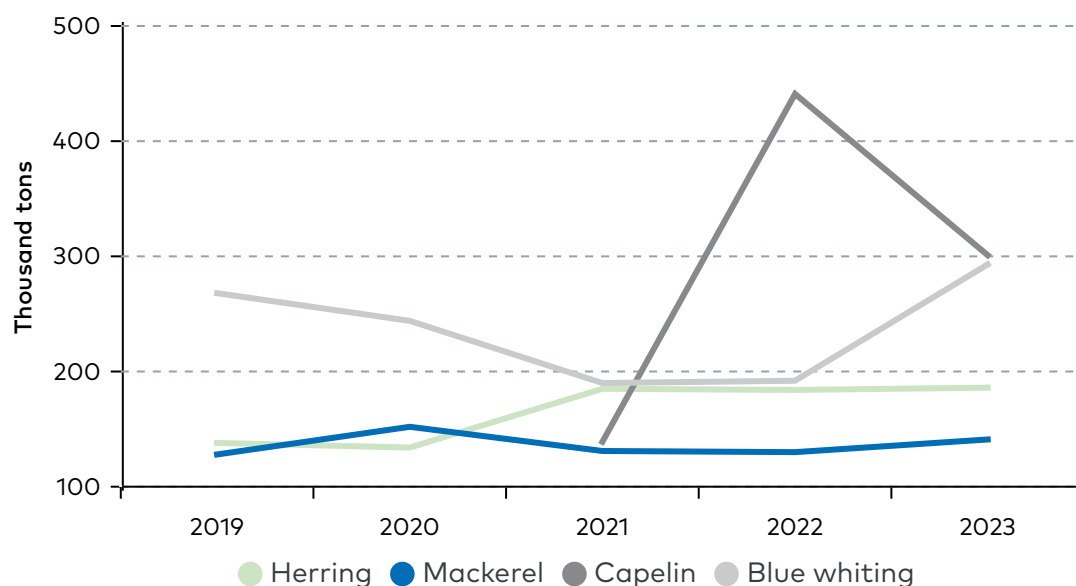


Pelagic species

The pelagic catches, on the other hand, had increased from 530,000 tonnes to 950,000 tonnes in 2019–2023. Capelin, herring, blue whiting, and mackerel are the main pelagic species targeted by Icelandic vessels. Capelin is a short-lived species that is found in the North Atlantic and North Pacific. The short life span manifests in significant year-to-year variations in stocks and harvests, leading to years when very low, or even no, catches have been recommended. Changes in the marine environment in the area between Iceland, Eastern Greenland, and Jan Mayen have reduced the spawning stock, further reducing the fishable biomass and harvests. Since 2015, the capelin fishery has been subject to a harvest control rule that aims at maintaining a minimum spawning stock of 114,000 tonnes. The fishery is closed when this condition cannot be statistically fulfilled. The stop-and-go nature of the capelin fishery is evident in Figure 2.2: no quotas were set in 2019 and 2020, and catches in 2021–2023 fluctuated wildly. Catches of the other three species have been more stable. The figures for herring refer to catches from two stocks, the Norwegian spring-spawning herring and the Icelandic summer-spawning herring.

Figure 2.2: Icelandic catches of the main pelagic species in 2019-2023. Tonnes.

Source: Statistics Iceland

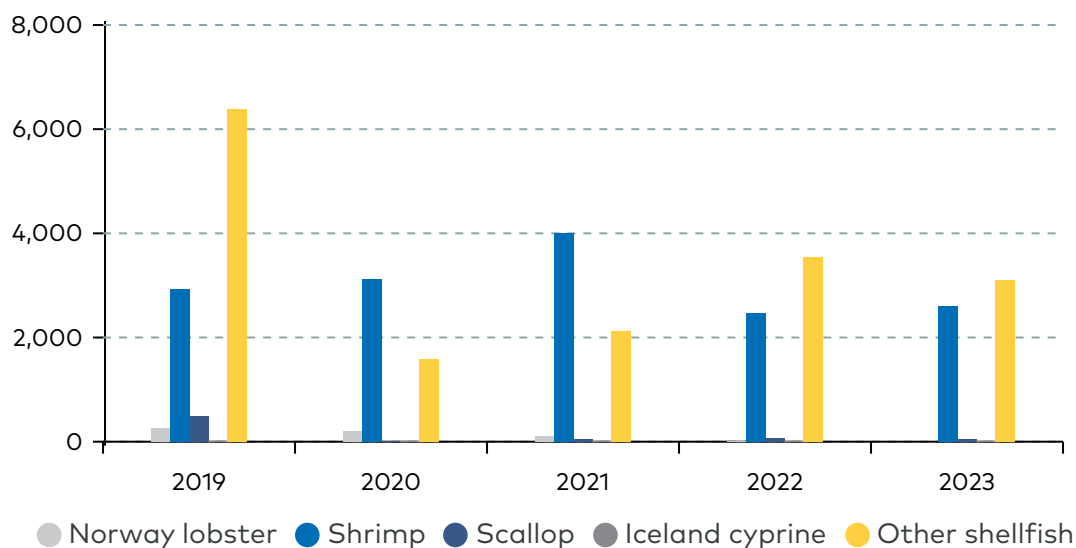


Crustaceans

Catches of crustaceans have decreased dramatically over the last decade, amounting to only around 6,000 tonnes. A moratorium is in effect on Norway lobster, with the Icelandic Marine & Freshwater Research Institute (MFRI) recommending a zero catch for 2024 and 2025, and scallop catches are presently limited to 40 tonnes per fishing year. Catches of Iceland cyprine that were 1,500–2,500 tonnes per year until a decade ago, are now only a few tonnes. Most inshore shrimp stocks around Iceland are in dire straits, and MFRI has recommended that no catches be allowed. Stocks of deepwater shrimp have also been curtailed, but a quota of 4 500 tonnes was set for the fishing year 2024/2025. The category other shellfish includes several other crustaceans, including various crabs, blue mussel, ocean quahog, common cockle, and sea cucumber, as well as non-crustaceans such as sea urchin and squid.

Figure 2.3: Icelandic catches of the crustaceans in 2019-2023. Tonnes.

Source: Statistics Iceland

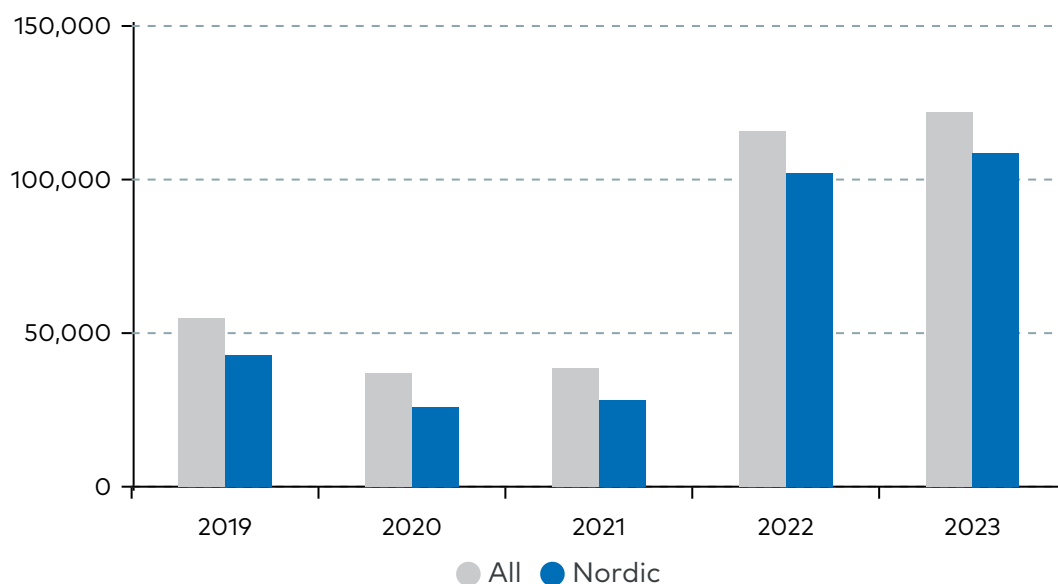


Almost all demersal catches have been registered in Icelandic waters in recent years. In 2023, Icelandic vessels also caught 5,000 tonnes of cod in the Norwegian fishing zone, under an agreement between the countries on Icelandic vessels' fishing in the Arctic region. Most of the Icelandic pelagic catches in that same year were recorded in Icelandic waters, but Icelandic vessels also caught 400,000 tonnes in international waters.

Foreign landings

Landings of foreign vessels in Icelandic ports increased sharply in 2022 and 2023 from the previous three years. They amounted to 25–40,000 tonnes in 2019–2021 but were 115–120,000 tonnes in 2022 and 2023. Pelagic species accounted for around 70% of total catches in the first three years, but for around 90% in the last two years. Total landings and the share of pelagic species depend crucially on migrations and distribution of the large pelagic stocks of the Northeast Atlantic. Cod and shrimp make up most of the other landings.

Figure 2.4: Catches by foreign vessels in 2019-2023. Tonnes. Source: Statistics Iceland



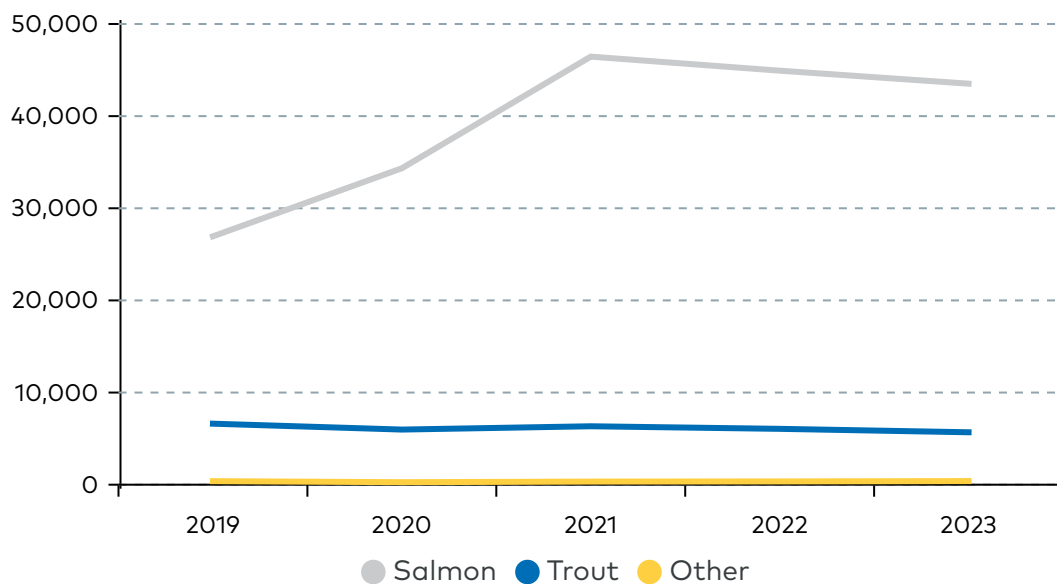
Landings abroad

Icelandic vessels sometimes land their catches abroad, especially those engaged in pelagic fisheries. These landings have totalled 20–30,000 tonnes in recent years.

Aquaculture production

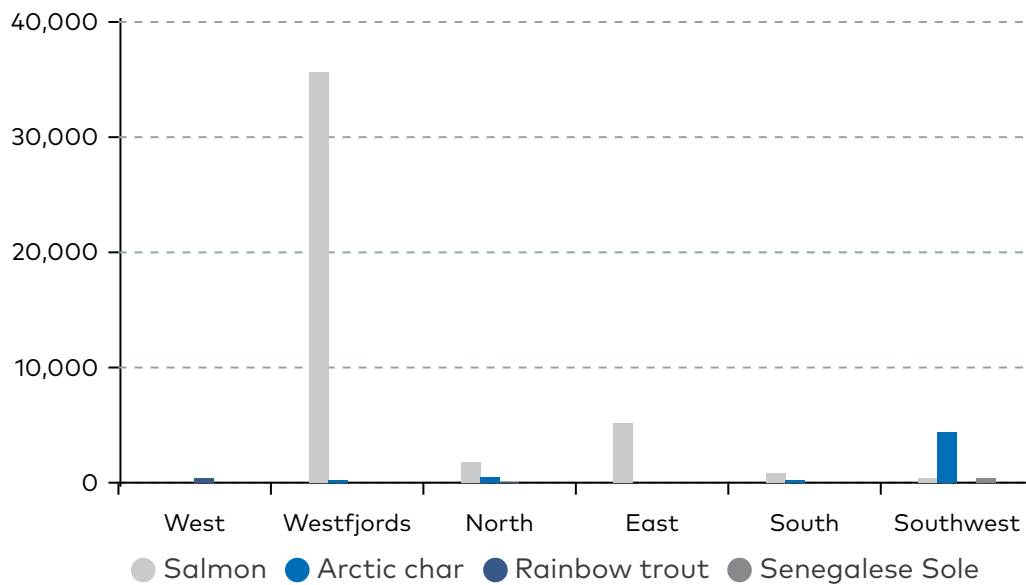
Aquaculture is a relatively young industry in Iceland. From the beginning in the 1980s, the emphasis has been on marine salmon farming, but it was only in the last decade that production really took off. Harvesting of salmon was only 300 tonnes in 2008 but had reached 10,000 tonnes by 2017 and was almost 44,000 tonnes in 2023. Icelandic firms have acquired good proficiency in farming Arctic char in land-based facilities, and production in recent years has been around 5,000 tonnes. Farming of rainbow trout has given way in recent years to salmon farming, which is more profitable. There are also ambitious plans for further land-based salmon and trout farming, with production expected to exceed 100,000 tonnes by 2032.

Figure 2.5: Aquaculture production 2019–2023. Tonnes. Source: Statistics Iceland



In 2023, aquaculture production totalled almost 50,000 tonnes, of which 41,000 tonnes were in sea cages, while land-based farms produced almost 9,000 tonnes. Salmon production amounted to 44,000 tonnes, with 41,000 farmed in marine cages and 3 000 on land. Production of Arctic char in cages on land totalled 5,000 tonnes, and 400 tonnes of rainbow trout were farmed in sea-cages. One firm in southwest Iceland produced 400 tonnes of Senegalese sole.

Figure 2.6: Aquaculture production in Iceland in 2023 by regions. Tonnes. Source: MAST.



Regulation and management

The Icelandic Waters ecoregion is located at the junction of the Mid-Atlantic Ridge and the Greenland-Scotland Ridge, where water masses of different origins, temperatures, and salinities mix. Most of the stocks in this ecoregion are found within Iceland's Exclusive Economic Zone (EEZ). They are thus managed by the Icelandic government, but fisheries of some shared stocks are subject to international negotiations and management through the North-East Atlantic Fisheries Commission (NEAFC) or by agreements with neighbouring coastal states, primarily Greenland, the Faroe Islands, and Norway. Other nations that utilise the shared stocks include the UK, the EU, and Russia.

The Ministry of Industries is responsible for the management of Icelandic fisheries and for the implementation of relevant legislation, issuing regulations for commercial licences each fishing year, and determining the total allowable catch (TAC) of each species. The fisheries of shared stocks are sometimes subject to international negotiations and national quotas, but Iceland has also set unilateral quotas. MFRI and ICES have provided fisheries advice to the Icelandic government. MFRI and ICES base their approach on integrating the precautionary approach (PA) to achieve maximum sustainable yield (MSY). Harvest control rules are currently in place for cod, haddock, saithe, ling, tusk, golden redfish, plaice, Atlantic wolffish, Icelandic summer-spawning herring, and capelin.

Since 1991, the Icelandic fisheries have been managed under a comprehensive ITQ system based on TACs and vessel-specific quotas. At first, the system did not include boats smaller than 6 gross registered tonnes (GRT), with a separate effort system for small boats, but since the 2006/2007 fishing season, all vessels have operated under the ITQ system. Currently, there are two kinds of fishing licences in place: a general licence and a hook-and-line licence, which is only open to vessels that are shorter than 15 m and smaller than 30 GRT. Those vessels are only allowed to use hooks or longline. No size restrictions apply to vessels holding general licences, and they can freely choose which gear to employ. In the quota system, a distinction is made between permanent quota share and the annual catch entitlements (ACE). Both quota shares and ACEs are transferable and divisible, but quota shares cannot be transferred from a vessel holding a general licence to a hook-and-line vessel. Since 2009, an open-access coastal demersal (mainly cod) fishery with a total catch cap has been in place during the months May–August. The fishery is open for all seaworthy boats, but handline is the only permitted gear.

Vessels registered in Iceland and fishing under the Icelandic management system are subject to a fishing fee, which is designed as a resource rent charge on landed catch. The fee is calculated as kilogram of live weight catches and differs by species. The fees are generally based on catch and price data, but with two important exceptions: the value for cod and haddock is based on Icelandic fish-market prices, and prices from the Norwegian Fisheries Agency are used to determine the fees for Norwegian herring, mackerel, and blue whiting.

In 2024, ICES analytically assessed the most important stocks in the Iceland ecoregion and evaluated them against harvest rate, MSY, and PA reference points (MFRI, 2024). As shown in Table 2.2, fishing pressure and stock size were both estimated relative to MSY or management/harvest control rule (MGT). Green represents a stock with fishing mortality below the recommended limits and a size greater than the bounds set by the policy followed. Red represents a stock that was fished above those limits or whose stock was below those limits.

For most of the species, the mean spawning stock biomass (SSB) was above the β_{trigger} , which is a biomass reference point that triggers a cautious response, but below that level for beaked redfish, deep pelagic beaked redfish, Greenland halibut, and Norwegian spring-spawning herring. Eight stocks in the ecoregion have current fishing mortality rates above scientific limits: haddock, ling, Icelandic slope beaked redfish, deep pelagic beaked redfish, Greenland halibut, Norwegian spring-spawning herring, mackerel, and blue whiting.

Table 2.2: Status of the most important stocks in Icelandic waters. Source: MFRI

Stock description	Fishing pressure		Stock size	
	MSY/MG	PA	MSY/MG	PA
Demersal				
Cod in Division 5.a				
Haddock in Division 5.a				
Saithe in Division 5.a				
Atlantic wolffish in Division 5.a				
Golden redfish in subareas 5, 6, 12, and 14				
Ling in Division 5.a				
Tusk in Subarea 14 and Division 5.a				
Greenland halibut in subareas 5, 6, 12, and 14				
Greater silver smelt in Subarea 14 and Division 5.a				
Plaice in Division 5.a				
Beaked redfish in ICES subareas 5, 12, and 14 (deep pelagic stock)				
Beaked redfish in ICES subareas 5, 12, and 14 (shallow pelagic stock)				
Beaked redfish in ICES Division 5a and Subarea 14 (Icelandic slope stock)				
Blue ling in Subarea 14 and Division 5.a				
Pelagic				
Blue whiting in subareas 1–9, 12, and 14				
Capelin in subareas 5 and 14 and Division 2.a west of 5°W				
Herring in Division 5.a, summer-spawning herring				
Norwegian spring-spawning herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a				
Mackerel in subareas 1–8 and 14, and in Division 9.a				
High				
Middle				
Low				

There are no important stocks in the Icelandic ecoregion that are currently underutilised, but some stocks are depressed. Since 2012, there has been a landing ban on Atlantic halibut and mandatory release of viable halibut, and the biomass of spotted wolffish is also very low. Both these species are registered as bycatch. Stocks of invertebrates have shown a declining trend in biomass. Five of the eight inshore shrimp stocks have collapsed to an alarmingly low level, and the offshore northern shrimp stock has decreased by half since the mid-1980s. No commercial fishery is now allowed for Norway lobster, and the Iceland scallop stock collapsed in the early 2000s; no fishing is now permitted.

Marine aquaculture in Iceland is permitted only in designated zones in the Westfjords and Eastfjords. MFRI sets fjord-level carrying capacity and genetic-risk limits, which determine the maximum number of fertile salmon that is allowed in cages in each fjord. Sea-cage farms must hold an operating license and fish health approval from the Food and Veterinary Authority (MAST), and an environmental operating permit from the Environment and Energy Agency (UST).

Foreigners may invest in Icelandic aquaculture; indeed, Norwegian firms hold majority ownership in three of the four largest marine aquaculture firms.

Marine aquacultural firms pay harbour fees, and environmental fees, in addition to a harvest (resource) fee of 0.5–4.3%, depending on international sales prices of Atlantic salmon. The harvest fees of rainbow trout are half those of salmon.

Processing and Value Chain Overview: Iceland

The fisheries sector in Iceland is characterised by large, vertically integrated firms that operate vessels, as well as land-based processing facilities and sales and marketing units, which are often based both in Iceland and abroad. The firms may operate fresh-fish trawlers, freezing trawlers, and longliners. They usually hold quotas in many demersal species, which enables them to take advantage of the flexibility inherent in the Icelandic management system and adjust their catches to the needs of their processing plants. Processing is often quite specialised, and fish of the "wrong" size and species may be offloaded to the country's wet fish markets, from which the firms may also source additional raw material. Most large firms also hold pelagic quotas and processing facilities for those harvests.

The value chain in Icelandic fisheries can be illustrated using the cod value chain in figure 2.7 (Knutsson et al., 2016). Harvesting is the first step in the chain, with catches either sold on domestic fish markets or processed. Fish sold in the market is then processed in Iceland or abroad and exported through the marketing divisions' services. The exported fish may be sold on foreign fish markets, processed, or sold directly to wholesalers, and even directly to retailers or firms in the hospitality industry (hotels, restaurants, canteens). Some of the fish sold on foreign markets or exported unprocessed will be further processed in facilities abroad and then sold to wholesalers, retailers, or hospitality firms.

Table 2.3: Fish processing by type and regions in 2023. Tonnes. Source: Statistics Iceland.

	Capital region	West	West-fjords	North-west	North-east	East	South	South-west
Other	590	214	217	0	1,719	624	3,230	640
Processed for container export	5,823	0	0	0	0	0	0	618
Filleting	2,790	0	34	0	934	3,408	1,067	1
Salted	1,707	12,191	604	117	3,364	247	755	17,099
Fresh, exported in containers	26,391	1,259	0	0	71	1,650	2,712	630
Fresh, iced fish exported by air	21,471	7,701	7,250	0	19,972	0	7,182	16,352
Freezing	38,858	9,908	14,475	11,376	61,786	149,824	111,680	23,350
Total	97,630	31,273	22,580	11,493	87,846	155,753	126,626	58,690

In 2023, a total of 924 harvesters (firms and individuals) paid ISK 10.1 billion (€ 68 million) in fishing fees. In addition, some operators may not have paid any fishing fees. Landings in that same year were registered in 57 harbours.

Around 200 firms are engaged in seafood production, and processing occurs at 58 locations. In many cases, processing is part of a vertically integrated firm. The concentration in the processing industry has been especially pronounced in the production of fishmeal and fish oil. In 2023, reduction took place in 14 locations, almost all in the east and south of Iceland.

It is difficult to ascertain the production capacity of the Icelandic processing sector. One of Iceland's largest firms, Samherji, opened a new state-of-the-art processing facility in Dalvík, northern Iceland, in 2020, where it produces chilled and individually quick-frozen cod and haddock products. The processing plant has a capacity of 12 tonnes per hour and was set up to process 15–18 thousand tonnes per year (Sjálfvirkni, 2020). Samherji has another processing plant in Akureyri with a similar capacity, and in 2024, the two plants together processed more than 36 thousand tonnes. Another large firm, Síldarvinnslan, operates a processing plant in Neskaupstaður, eastern Iceland, that produces up to 700 tonnes of frozen pelagic products per 24 hours (Vinnsla, n.d.). In 2025, there were 10 large reduction plants in operation in Iceland with a combined capacity of 11,500 tonnes per 24 hours (Sindri B. Sigurðsson, 2025).

Trade flows of Aquatic food: Iceland

Imports for human consumption

Iceland imported 74,500 tonnes (live weight) of seafood for human consumption in 2023. Two-thirds of the fresh and frozen fish were imported from Greenland, Norway, and the Faroe Islands. The most important products were fresh, whole ling from Greenland, which accounted for 18,400 tonnes of the 55,000 tonnes imported from the Nordic countries, and 7,500 tonnes of fresh, whole capelin and 8,000 tonnes of frozen shrimp, which were imported from Norway.

Table 2.4: Imports of seafood for human consumption in 2023. Tonnes (live weight).
Source: Statistics Iceland

	Nordic	Other	Total
Fresh, frozen, salted, dried	55,072	18,831	73,903
Seaweed and other algae	22	1	23
Prepared or preserved	118	511	629
Total	55,212	19,343	74,556

Imports of Marine Ingredients and Feed

Iceland imported 54,600 tonnes of fish for reduction, with nearly all coming from the Nordic countries, probably to a considerable degree from vessels from the Faroe Islands, Greenland, and Norway, which landed that year 108,500 tonnes of fish in Icelandic ports. The catch was almost entirely made up of capelin and blue whiting, which were processed into fish oil and meal.

Iceland also imported 10,000 tonnes of fish oil, with only a couple of hundred tonnes originating from the Nordic countries. In addition, Iceland imported 128,500 tonnes of fishmeal, of which 102,000 tonnes were from the Nordic countries.

Table 2.5: Imports of fish for feed or feed in 2023. Tonnes. Source: Statistics Iceland

	Nordic	Other	Total
Fish for reduction, waste	54,598	41	54,639
Fish oil	179	9,809	9,988
Fishmeal	101,768	26,782	128,550
Total	156,545	36,632	193,176

Exports for human consumption

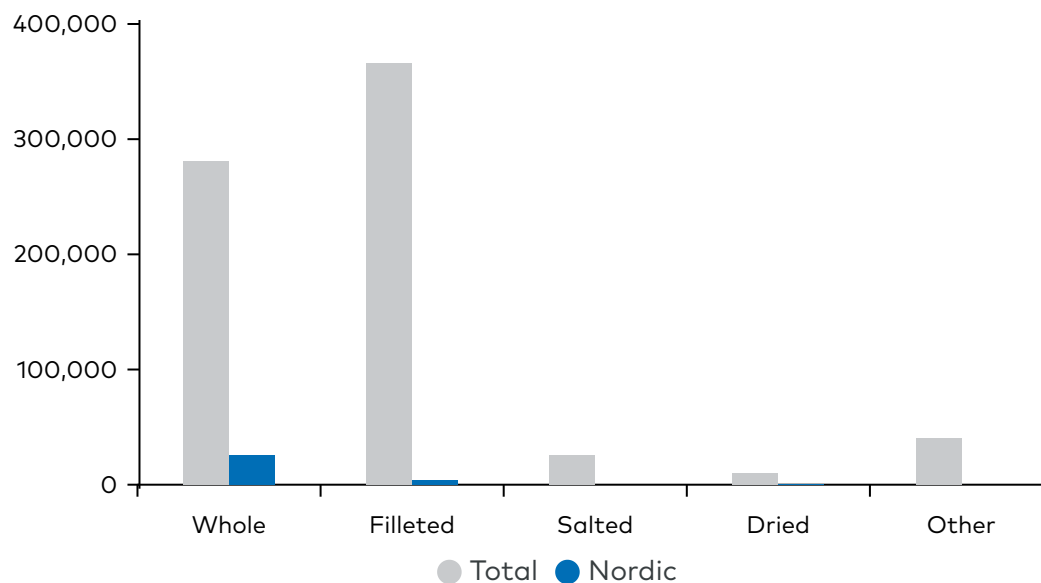
Exports of fresh, frozen, salted, and dried products totalled 723 400 tonnes (live weight), of which buyers in the other Nordic countries purchased 42,000 tonnes. Exports of other products intended for human consumption included 13,500 tonnes of prepared or preserved fish and crustaceans, of which 3,400 tonnes were exported to Nordic countries, and 4,700 tonnes of seaweed and other algae for use in, for instance, beverages, pharmaceuticals, and cosmetics.

Table 2.6: Exports of seafood for human consumption in 2023. Tonnes (live weight). Source: Statistics Iceland.

	Nordic	Other	Total
Fresh, frozen, salted, dried	42,211	681,154	723,365
Seaweed and other algae	3,530	1,181	4,711
Prepared or preserved	3,377	10,147	13,524
Total	49,119	692,482	741,601

From figure 2.8 we see that the largest share of the fish, not reduced to fishmeal and oil, is exported whole, either chilled or frozen. In 2023, this amounted to 280,700 tonnes, with chilled, frozen, or lightly salted fillets making up 366,100 tonnes. Salted and dried products totalled 36,000 tonnes, with other products making up 40,000 of the 723,365 tonnes exported in that year.

Figure 2.8: Icelandic exports of seafood by product groups in 2023. Fishmeal and oil excluded. Tonnes. Source: Statistics Iceland.



Exports of Marine Ingredients and Feed

Iceland exported 145,600 tonnes of fishmeal, 50 000 tonnes of fish oil, and 31,500 tonnes of other products. About two-thirds of the fishmeal was exported to Nordic buyers, and 33,000 tonnes of fish oil. Although the Nordic countries are therefore in general not a large market for Icelandic seafood, much of the fish meal and oil was exported to Norway and Denmark.

	Official statistics		
	Nordic	Other	Total
Fish for reduction, waste	1,151	30,395	31,546
Fish oil	32,704	17,202	49,906
Fishmeal	94,231	51,321	145,553
Total	128,087	98,918	227,005

Table 2.7: Exports of fish for feed or feed in 2023. Tonnes. Source: Statistics Iceland.

Aquatic food available for consumption in Iceland

In 2023, total Icelandic catches for human consumption amounted to 712,400 tonnes. Catches of the main pelagic species have been weighted with the percentage processed for reduction. Aquaculture production totalled 49,900 tonnes and imports 74,500 tonnes. The total was therefore 836,900 tonnes. Subtracting total exports, there were 95,300 tonnes available for the population of 380 thousand living in Iceland at that time. This is about 248 kg per capita per year.

Table 2.8: Total amount of seafood available for consumption in Iceland in 2023. Tonnes (live weight).

	Tonnes	kg/capita/year
Capture fishery	712,425	1,857
Aquaculture	49,945	130
Imports	74,556	194
Total supply	836,926	2,181
Exports	741,601	1,933
Available for consumption	95,325	248

In that same year, there were 855 500 tonnes fish available for feed and fish meal, or 2,230 kg. per capita. Taking exports into account, the amount available for consumption amounted to 628,500 kg, or 1,638 kg per capita.

Table 2.9: Total amount of seafood available as feed in Iceland in 2023. Tonnes

	Tonnes	kg/capita/year
Capture fisheries	662,351	1,726
Imports	193,176	503
Total supply	855,527	2,230
Exports	227,005	592
Available for consumption	628,522	1,638

Challenges, threats, and opportunities

Over the last fifty years, the Icelandic fisheries have evolved into a highly efficient industry that competes in markets worldwide, and the aquaculture sector is likely to follow in its cousins' footsteps and establish a strong position in international markets. However, both sectors face environmental, economic, and political challenges and threats that can affect their competitiveness.

Warmer ocean temperatures have, in recent years, changed the distribution and fishing areas of some important demersal species, such as haddock, golden redfish, ling, monkfish, and lemon sole. Migration patterns have also changed for large Northeast Atlantic pelagic stocks such as blue whiting, Norwegian herring, and mackerel, and capelin now feeds further north in summer (MFRI 2024). Further rises in temperature could shift the distribution of some important species, such as capelin and haddock, further north, with serious repercussions.

Norwegian herring, mackerel, and blue whiting stocks are all exploited by the coastal states in the Northeast Atlantic, as well as the EU. Total catches have regularly exceeded ICES recommendations because all the nations involved have been unable to reach agreement on total catches, quota allocations, and access to each other's EEZs. This overfishing has both reduced the long-term viability of the stocks and prompted MSC to revoke its certification.

Recent developments in international trade have seen increasing tariffs and trade restrictions as countries have reverted more towards protectionism. This can have dire consequences for small fishing countries like Iceland, which rely on open international markets.

Fish processing in Iceland faces intense competition from firms in low-wage countries in Europe, many of which are EU members (Friðbertsson, 2025). The large, vertically integrated firms that dominate Icelandic fisheries operate modern, well-equipped processing plants that enable them to exploit economies of scale, but this option may not be feasible for smaller firms. There is considerable risk that exports of unprocessed catches will increase, which could both reduce the number of processors in Iceland and reduce the quantity of raw material available for the larger firms.

As expected, consolidation has increased in the Icelandic fisheries since the introduction of the ITQ system. Profits have risen, and many have gained from selling their quotas. These developments have caused considerable resentment. Although fishing fees and coastal fishing have been introduced, the main characteristics of the ITQ system have remained the same, but the fishing industry has learned that it must tread cautiously under this uncertain political environment.

Iceland offers excellent angling for salmon and trout, and although marine aquaculture has been permitted only in fjords with no major fishing rivers, some lesser rivers are not far from some of the sea-cage sites. Angling stakeholders have strongly opposed the recent expansion of aquaculture, primarily due to the risks of genetic mixing and escapees, and have also voiced broader environmental and ethical concerns (Icelandic Wildlife Fund, n.d.).

The aquaculture industry has noted that the Icelandic tax model can become a heavy burden because it is levied on revenue rather than profits, and that it is unpredictable because the harvest tax is a function of global rather than firm-level prices (Grønvik et al., 2024).

While few opportunities exist to further utilize the fish stocks currently harvested in Icelandic waters, some possibilities may emerge for exploiting mesopelagic species. Emerging species, such as bluefin tuna, may also create certain opportunities. In the processing industry, some avenues remain for increasing value through modernization and innovation. Further growth in marine aquaculture is also on the cards, and substantial investment plans are in place for land-based aquaculture.

3. Faroe Islands

Introduction

The Faroe Islands represent one of the most fisheries-dependent economies globally, with wild-capture fisheries and aquaculture forming the foundation of national exports (95% of goods export, Statistics Faroe Islands (n.d.)) and economic development (25% of GDP from fisheries, aquaculture, and fish food processing (Statistics Faroe Islands (n.d.))).

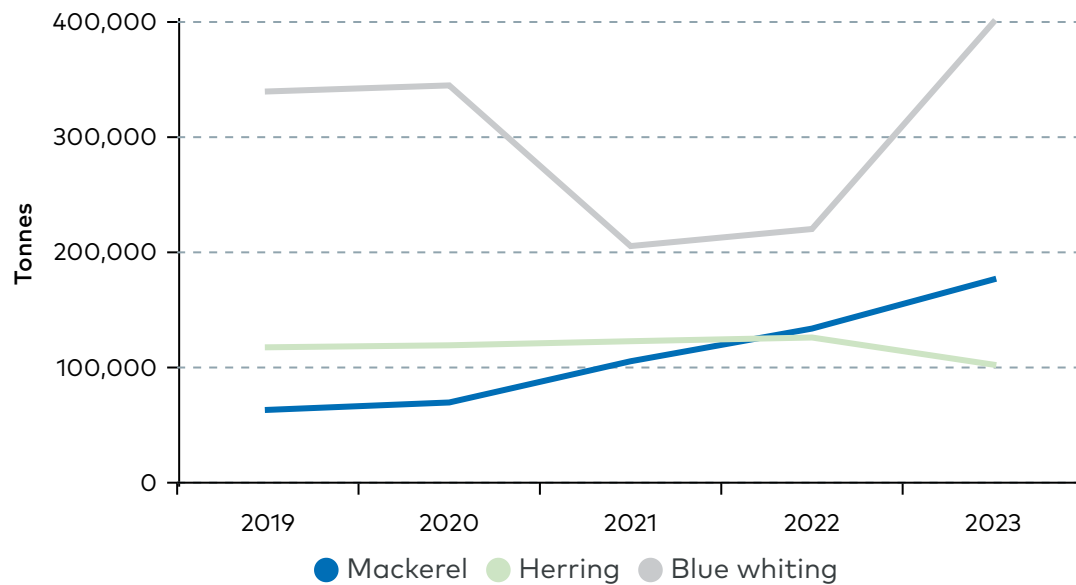
The Faroese seafood sector operates within a distinctive governance framework that combines effort-based regulation for local demersal species with quota-based management for economically dominant pelagic fisheries. Although challenges arise from fluctuating stock conditions, incomplete international agreements, and environmental constraints, the sector remains robust and internationally competitive. Aquaculture continues to expand under a well-defined regulatory regime, while processing capacity and vertically integrated business structures enhance the industry's ability to add value and access global markets. Together, these elements position the Faroese seafood sector as a specialized and resilient component of the North Atlantic food system.

Primary production

Capture fishery

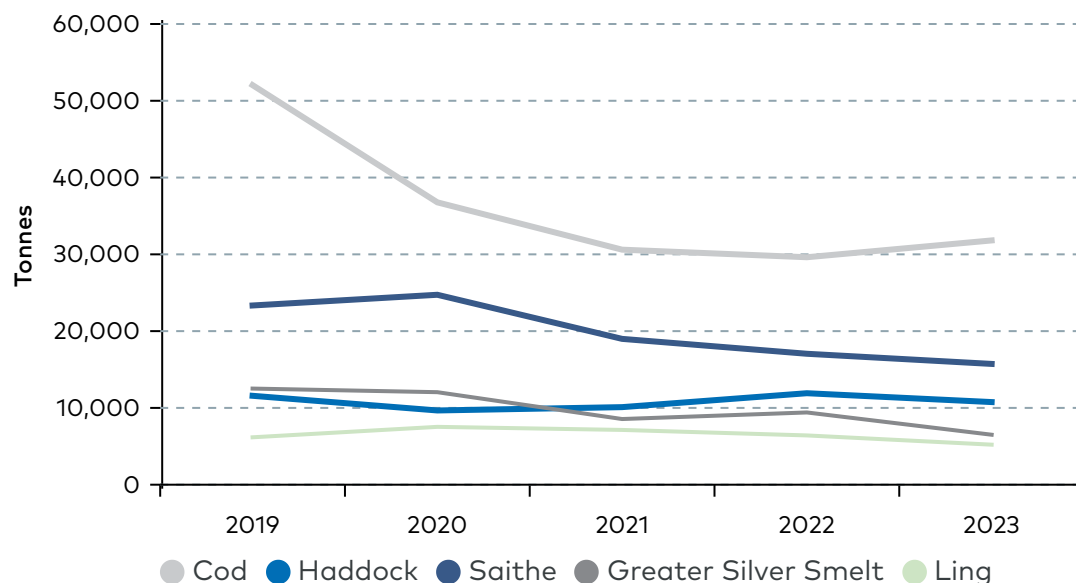
Pelagic species dominate the wild capture fisheries in the Faroe Islands. In recent years, catches of the main pelagic species, blue whiting, mackerel, and herring have made up 80-85% of the quantity of total catches. In 2023, catches of blue whiting amounted to 400 000 tonnes, with catches of mackerel and herring 176 and 102,000 tonnes respectively. Catches of blue whiting fluctuate considerably between years, as shown in Figure 3.1, and mackerel catches increased year-to-year in 2019–2023. Herring catches have remained more stable.

Figure 3.1: Catches of the main pelagic species 2019-2023. Tonnes. Source: Hagstova Føroya.



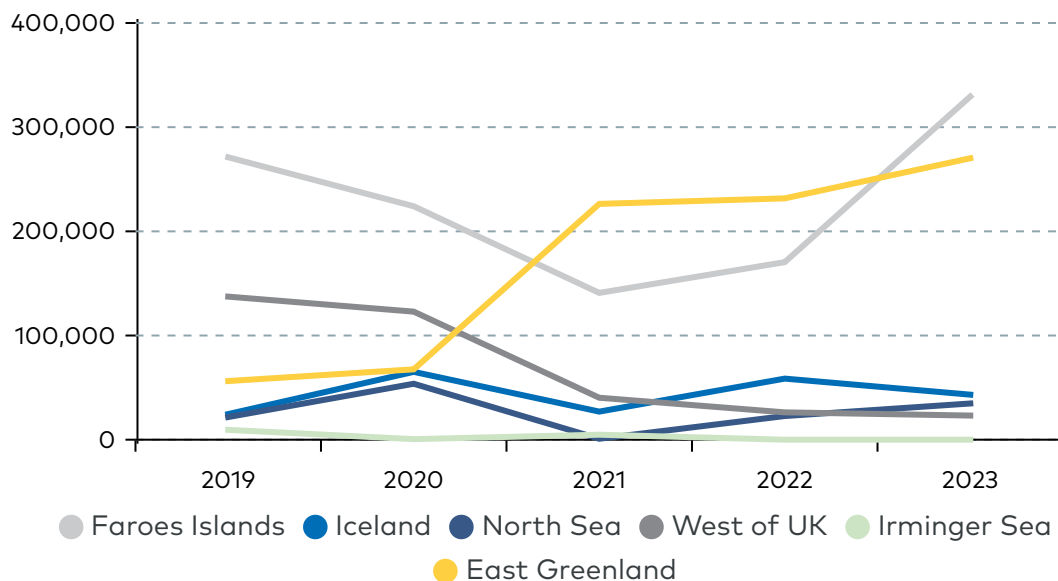
The combined catches of the main demersal species have dwindled in recent years, from 105,600 tonnes in 2019 to 70,000 tonnes in 2023. Cod remains the most important demersal species, but catches decreased by 40% over the period. Saithe catches have also decreased by 40%, from 23 to 16,000 tonnes.

Figure 3.2: Catches of the main demersal species 2019-2023. Tonnes. Source: Hagstova Føroya.



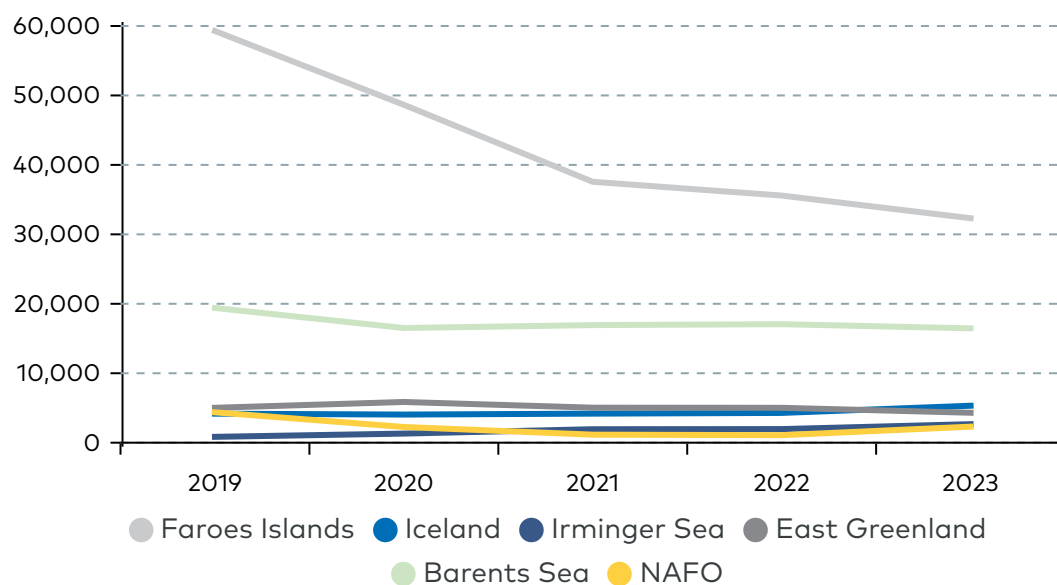
Through bilateral agreements with other countries in the North Atlantic and participation in NAFO and NEAFC, the Faroe Islands have access to fishing grounds outside their own EEZ. This is of special importance for the pelagic fisheries, as the three large stocks – blue whiting, herring, and mackerel – migrate between international waters and the EEZs of the North Atlantic nations. Having access to fishing areas is crucial so that the stocks can be harvested at minimum costs and when the quality of the raw material is best. As revealed in Figure 3, pelagic catches by fishing areas vary considerably between years. In 2019–2023, 30–50% of the total harvests of these three pelagic stocks were caught within the Faroese EEZ, but the fishing grounds east of Greenland, off Jan Mayen, and in the Norwegian Sea were also important in those years.

Figure 3.3: Pelagic catches by area 2019-2023. Tonnes. Source: Hagstova Føroya.



The Faroese freezing trawlers operate mostly in two fishing areas: in the Barents Sea and Svalbard, and in the NAFO area east of Canada and the Flemish Cap. Cod and shrimp make up most of the catches in the Arctic, but cod dominates in the NAFO area, with shrimp catches only registered in 2021. As revealed in Figure 3.4, catches of the main demersal species – cod, haddock, saithe, and ling – in Faroese waters have declined from 60,000 tonnes in 2019 to 33,000 tonnes in 2023, but remained relatively stable in other fishing areas.

Figure 3.4: Catches of the main demersal species by area 2019-2023. Tonnes.
Source: Hagstova Føroya.



In 2023, Faroese catches totalled 792,000 tonnes, of which pelagic catches amounted to 701,000 tonnes, demersal catches to 82,000 tonnes, and scallop, prawn and other crustacean catches to 8,000 tonnes.

Table 3.1: Faroes catches in 2023. Tonnes. Sources: Hagstova Føroya.

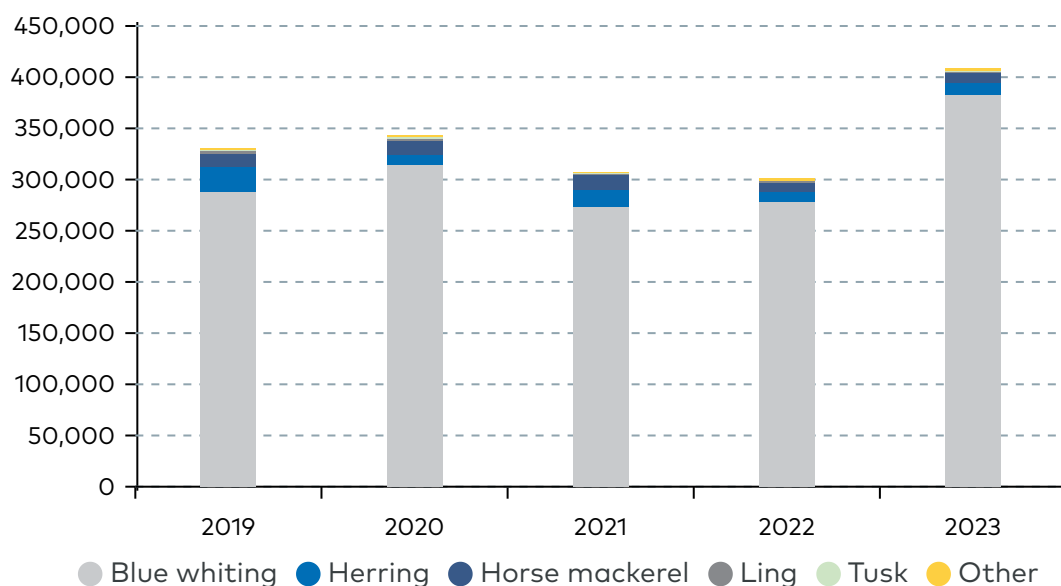
Demersal		Pelagic		Crustaceans	
Atlantic redfish	1,158	Atlantic herring	102,481	Northern prawn	2,481
Angler	1,442	Atlantic mackerel	176,443	Queen scallop	5,306
Tusk	2,152	Blue whiting	399,692	Other	33
Greenland halibut	3,773	Capelin	22,110		
Ling	5,213	Other	740		
Argentines	6,507				
Haddock	10,761				
Saithe	15,729				
Atlantic cod	31,812				
Other	3,729				
Total	82,276	Total	701,466	Total	7,820
All species					791,561

Statistical sources in the Faroe Islands do not indicate which catches were processed into fishmeal and fish oil, but in 2023 landings at Havsbrún, which is the dominant Faroese reduction company, totalled 408,000 tonnes, whereof landings of Blue whiting amounted to 267,000 tonnes (Sjókovin, 2024; Sjókovin, n.d.). Half of the mackerel catches were used for reduction, and 13,000 tonnes of herring, as well as 41,000 tonnes of cut-offs, i.e. by-products such as heads, bones, and skin, that are left after filleting or processing of demersal catches. In what follows, it is therefore assumed that 408,000 tonnes of the total Faroese catches were intended for feed and 383,000 tonnes for human consumption.

Faroese vessels also frequently land in foreign harbours, especially those engaged in the pelagic fisheries, which frequently take place in foreign jurisdictions or international waters. In 2021, pelagic vessels landed 70,000 tonnes in foreign harbours, 51,000 in 2022, and 177,000 in 2023.

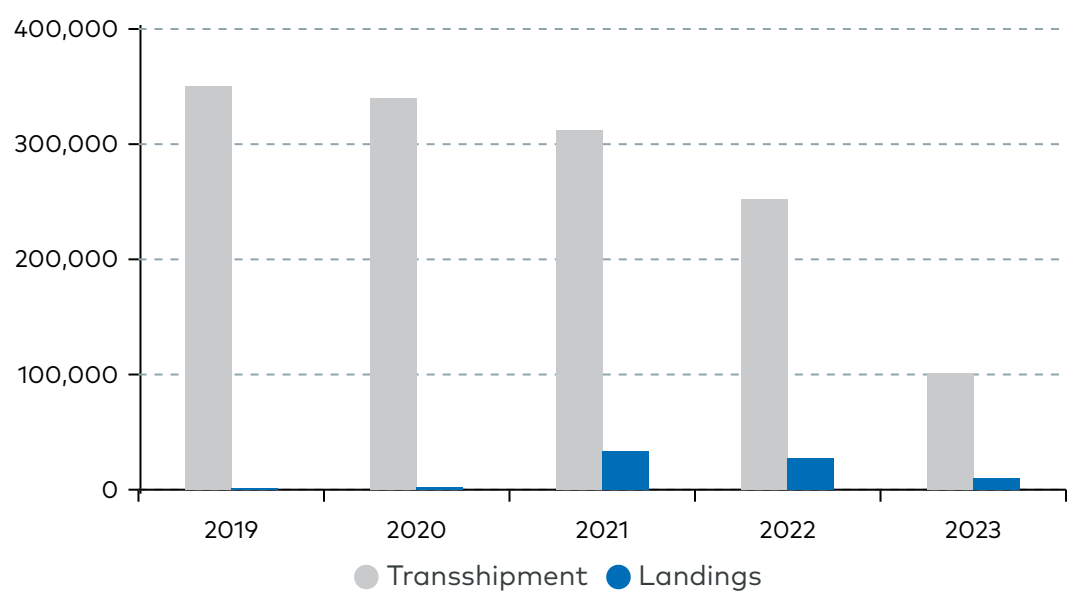
Foreign vessels often register catches in Faroese waters. In 2019-2023, these catches were 300-400,000 tonnes annually, mainly blue whiting, which accounted for 87-94% of the total catch.

Figure 3.5: Foreign catches in Faroese waters 2019-2023. Tonnes. Source: Hagstova Føroya.



The Faroe Islands and Russia have maintained a long-standing bilateral fisheries agreement, which has been renewed annually despite the Russian invasion of Ukraine in 2022. The nations have mutual access to fishing in each other's jurisdictions and have reciprocal access to each other's harbours for fishing-related activities. However, since 2023 access for Russian vessels has been restricted and is now only allowed for vessels engaged in fisheries under the bilateral agreements. These activities include crew change, bunkering, provisioning, landing, and transshipments. In 2019, Russian transshipments totalled 350,000 tonnes and landings 1,500 tonnes, but transshipments have declined since and, in 2023, decreased by two-thirds. Landings, on the other hand, have varied from year to year.

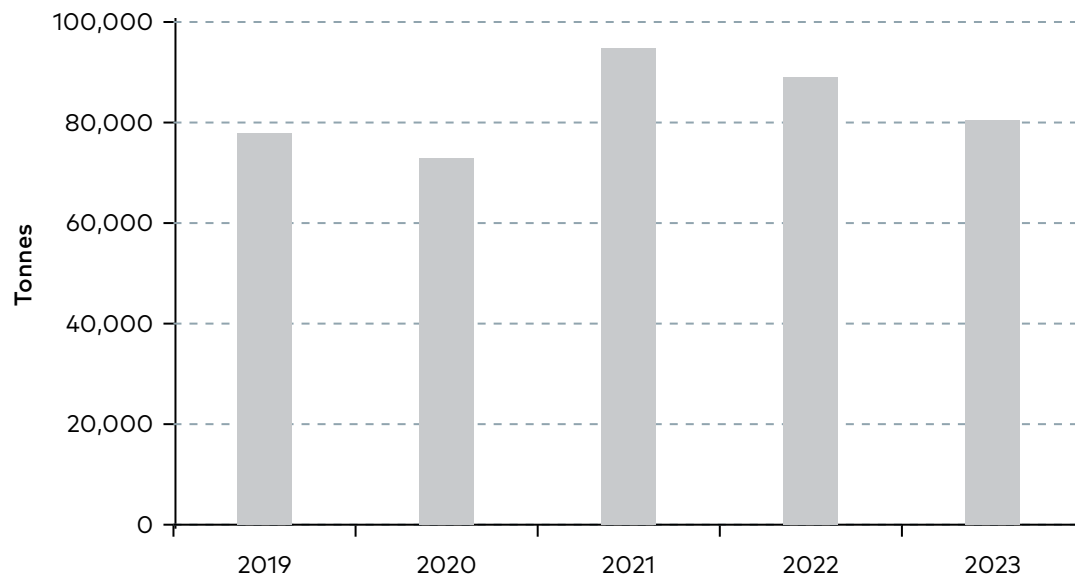
Figure 3.6: Russian transshipments and landings in Faroese ports 2019-2023. Tonnes. Sources: Hagstova Føroya.



Aquaculture production

In 2023, Faroes aquaculture produced 80,462 tonnes of salmon (gutted weight). Production of salmon has increased sixfold in the last 30 years, from 15,000 tonnes in 1996 to 95,000 tonnes in 2021.

Figure 3.7: Aquaculture production in Faroe Islands 2019-2023. Tonnes. Source: Hagstova Føroya.



Regulation and management

The Faroese fisheries governance is characterized by two fundamentally different management regimes. Local demersal species, most notably cod, haddock, and saithe, are regulated through the national fishing days system. This system allocates a defined number of allowable fishing days to different vessel groups, aiming to control total fishing effort rather than specifying fixed catch volumes. It is revised annually based on scientific assessments. Although important for local fleet segments and coastal communities, today the fishing-days system accounts for only around one-fifth of the total value of Faroese landings (Faroese Fisheries Inspection, n.d.).

By contrast, the bulk of Faroese fisheries revenue derives from pelagic species, including mackerel, Norwegian spring-spawning herring, and blue whiting. These pelagic fisheries are managed through total allowable catches negotiated in coastal-state forums, in which the Faroe Islands participate as an independent party. Another important sector is demersal fisheries in other countries' waters, often traded for pelagic fisheries. National quota allocations determined in these negotiations and trades are distributed among Faroese vessels and companies in accordance with domestic regulations. As these agreements deliver approximately 80% of the total landing value, either directly or indirectly, international agreements play a decisive role in shaping annual harvest opportunities and commercial expectations.

Aquaculture is governed through a licensing system, with each farming site subject to environmental assessments, veterinary controls, and strict reporting requirements. Production is dominated by Atlantic salmon, and regulatory authorities closely monitor lice levels, disease risks, escape prevention, and the ecological carrying capacity of fjord systems. The Faroe Islands are the fifth-largest aquaculture producer in the world (Bjørndal and Mordalo, 2023). In contrast to wild-capture fisheries, aquaculture production is more shaped by site availability, biosecurity standards, and market conditions than by stock-based harvest limits.

Recreational and personal-consumption fishing plays a relatively minor role in the Faroese context. It is regulated through gear restrictions, minimum sizes, and certain seasonal protections, although overall catch volumes are small and do not meaningfully affect stock dynamics.

The condition of Faroese fish stocks varies across species groups. Local demersal stocks such as cod and haddock have experienced periods of low biomass in recent decades and are often considered fully exploited or, in some years, overexploited, depending on recruitment patterns and environmental conditions. Local saithe has generally shown greater stability than other demersal species but is still monitored closely due to interannual variability. The structure of the fishing-days system reflects the need for adaptive management in response to these fluctuations.

Pelagic stocks, which account for most of the country's landings, tend to be in healthier condition but remain subject to political and ecological uncertainty. While many pelagic stocks are assessed as fully exploited, their management is complicated by the absence of long-term binding agreements. The most important species for the Faroe Islands is the mackerel. And most coastal states have reached an agreement for mackerel as of 2026; however, total catches for the year still exceed biological advice, rendering the stock effectively overexploited. Changing oceanographic conditions have also altered migration routes, sometimes affecting access for Faroese vessels or shifting the distribution of catch opportunities among coastal states.

In addition to these major species, several emerging or underutilized resources, such as mesopelagic fishes, deep-sea species, and low-trophic aquaculture resources, including macroalgae, have attracted recent interest. Although these resources are still in the early stages of assessment and commercialization, they represent potential avenues for future diversification.

Processing and Value Chain Overview: The Faroe Islands

Processing activities in the Faroe Islands are closely aligned with the geography of landings and aquaculture operations. Filleting and fresh-frozen production of demersal fish are concentrated at a few locations around the islands. In Klaksvík, Gøta, and Skopun, there are today active demersal fish processing plants. Pelagic processing, including large-scale freezing and value-added operations, is primarily located in Fuglafjørður, Kollafjørður, and Tvøroyri, which have infrastructure suited to high-volume landings and rapid throughput. Salmon harvesting, filleting, and packing facilities are situated around the islands, with the largest facility located in Glyvrar. Fuglafjørður also hosts one of the region's most significant fishmeal and fish oil facilities, which processes trimmings and pelagic species into marine ingredients for the aquaculture industry.

The industry relies on a combination of domestic and foreign inputs. Local and international labour, wild-capture landings, farmed salmon, energy, and port facilities form the core of domestic contributions, while foreign inputs include feed ingredients, specialized machinery, packaging materials, and, in some processing plants, seasonal labour. The Faroe Islands' small population and high processing volumes mean that international labour and supply chains are important for maintaining operations.

Trade flows of Aquatic food: Faroe Islands

Imports for human consumption

Total imports of fish for human consumption in 2023 amounted to 69,800 tonnes (live weight), whereof 43,000 were imported from the Nordic countries.

Table 3.2: Imports of fish for human consumption in 2023. Live weight (tonnes).
Sources: Hagstova Føroya.

	Nordic	Other	Total
Fresh, frozen, salted, dried	41,931	27,351	69,282
Prepared or preserved	1,46	771	1,917
Total	43,077	28,122	71,199

Imports of Marine Ingredients and Feed

Imports of fish for waste, fish oil, and fishmeal totalled 71,300 tonnes, whereof 61,400 tonnes were imported from the Nordic countries.

Table 3.3: Imports of feed from aquatic food in 2023. Tonnes. Sources: Hagstova Føroya.

	Nordic	Other	Total
Fish for reduction, waste	50,249	9,926	60,175
Fish oil	3	0	3
Fishmeal	11,159	0	11,159
Total	61,411	9,926	71,337

Exports for human consumption

Exports of fish for human consumption totalled almost 485,144 tonnes in 2023 (live weight), whereof 95,662 tonnes were exported to the Nordic countries.

Most of the fish was exported whole, either fresh or frozen, or almost 318 000 tonnes, predominantly headed and gutted. Exports of fresh, chilled, or frozen fillets amounted to 110,000 tonnes, and 56,000 tonnes were exported as other products.

Table 3.4: Exports of fish for human consumption in 2023. Live weight (tonnes). Source: Hagstova Føroya.

	Nordic	Other	Total
Fresh, frozen, salted, dried	95,489	389,352	484,841
Prepared or preserved	173	129	302
Total	95,662	389,352	485,144

Exports of Marine Ingredients and Feed

Exports of fish for reduction, fish oil, and feed from aquatic food totalled 215,200 tonnes in 2023, of which 174,400 tonnes were exported to the Nordic countries.

Table 3.5: Exports of feed from aquatic food in 2023. Tonnes. Source: Hagstova Føroya.

	Nordic	Other	Total
Fish for reduction, waste	115,275	13,932	129,207
Fish oil	19,628	1,699	21,327
Fishmeal	39,531	25,135	64,666
Total	17,434	40,766	215,200

Aquatic food available for consumption Faroe Islands

The total supply of aquatic food for human consumption in the Faroe Islands was 533 500 tonnes in 2023. Subtracting exports, about 48,000 tonnes were available for the Faroese population in 2023. With a total population of nearly 55,000, this corresponded to a per capita consumption of 889 kg per capita in 2023.

Table 3.6: Total amount of seafood available for human consumption in the Faroe Islands in 2023. Tonnes (live weight).

	Tonnes	kg/capita/year
Capture fisheries	383,323	7,038
Aquaculture	80,462	1,477
Imports	69,754	1,281
Total supply	533,539	9,796
Exports	485,144	8,908
Available for consumption	48,395	889

Using data from Havsbrún as a proxy for the amount of seafood processed into fishmeal and fish oil, there would have been 264,400 tonnes available as feed in 2023, taking into account both imports and exports. That would have corresponded to a per capita consumption of 4,854 kg in 2023.

Table 3.7: Total amount of seafood available as feed in the Faroe Islands in 2023. Tonnes.

	Tonnes	kg/capita/year
Capture fisheries	408,238	7,496
Imports	71,337	1,310
Total	479,575	8,805
Exports	215,200	3,951
Available as feed	264,375	4,854

Challenges, threats, and opportunities

Faroese wild-capture fisheries face several structural challenges. The most significant is the lack of comprehensive and stable coastal-state agreements for blue whiting, mackerel, and herring. The absence of long-term deals complicates planning for fishing companies. Environmental variability also presents challenges, particularly for demersal stocks whose recruitment fluctuates sharply with changing ocean conditions. The heavy economic dependence on a small number of pelagic species increases vulnerability to stock shifts, market disruptions, and geopolitical developments that may affect access rights or trade flows.

Despite these challenges, there are notable opportunities. Underutilized species and mesopelagic resources offer possibilities for diversification if biological and economic feasibility can be demonstrated. Innovations in digital traceability, onboard processing, and by-product utilization offer avenues to increase the value derived from each tonne landed. Technological improvements, including more energy-efficient vessels and advanced monitoring systems, may enhance environmental performance and economic resilience.

Aquaculture faces its own set of constraints, particularly related to sea lice, diseases, and environmental carrying capacity limits in the Faroese fjords. As in other salmon-producing regions, dependence on imported feed ingredients exposes farms to global supply chain disruptions and price volatility. Escape risks remain a concern for wild salmonid populations and the sector's reputation. Nevertheless, aquaculture also offers significant opportunities. Improved site management and the development of exposed or offshore aquaculture technologies may expand production beyond current spatial limits. Low-trophic aquaculture, including macroalgae (seaweed), is produced by two companies in the Faroes and offers potential for environmentally sustainable growth and integration into circular production systems.

4. Denmark

Introduction

The Danish seafood value chain is located between the rich fishing grounds in the North Atlantic Ocean and large salmon farming in Norway, on the one hand, and the European market, on the other. While domestic fisheries and aquaculture exist, the intermediate part of the value chain, represented by processors and wholesalers using imported raw materials and taking advantage of well-established ties to customers across Europe, is most important in terms of jobs and contribution to GDP.

There is a Danish seafood value chain for human consumption and another for fish for reduction. The value chain for seafood for human consumption is supplied by Danish fisheries, Danish aquaculture, and imports. Processing takes place before a large seafood wholesale sector sells raw materials, semi-processed products, and processed seafood, especially for export but also for domestic consumption.

The value chain for fish for reduction is supplied by Danish and foreign fishers. All catches are processed into fishmeal and Fish oil, together with residues from the processing of seafood for human consumption in Denmark and neighbouring countries. Most fishmeal and fish oil are used in feed mixes for aquaculture produced by Danish fish feed firms, mainly exported, but to a minor extent also used in Danish aquaculture. Some amounts are also used domestically as feed for young pigs.

The contribution of the seafood value chain to gross value added (GVA) and employment is shown in Table 4.1. The fishery for reduction includes only large vessels (>40 m), which account for 84% of total catches. Hence, the remaining catch for reduction is included in the economic numbers in the value chain of seafood for human consumption.

Table 4.1: Key economic numbers for the Danish seafood value chain, 2023, numbers and DKK Million, current prices

	Firms (number)	Turnover (DKK Million) ³	EBIT (DKK Million) ⁴	Gross value added (DKK Million) ⁵	FT-employment (persons) ⁶
Seafood human consumption					
<u>Fishery¹</u>					
- Vessels < 18 m	254	575	-29	276	299
- Vessels 18-40 m	76	899	22	427	358
- Vessels > 40 m	<u>20</u>	<u>954</u>	<u>313</u>	<u>673</u>	<u>60</u>
- Fishery total	350	2,428	306	1,375	717
<u>Aquaculture</u>					
- Traditional pond farms	59	258	30	77	.
- Recirculated farms	62	786	24	178	.
- Marine farms	19	601	89	150	.
- Other	<u>36</u>	<u>47</u>	<u>0</u>	<u>25</u>	<u>.</u>
- Total aquaculture	176	1,692	143	431	406
<u>Processing factories²</u>					
- Salmon and trout	39	9,371	245	825	1,013
- Whitefish and flatfish	5	609	27	121	180
- Herring and mackerel	13	2,080	19	368	484
- Shrimp and mussels	11	1,426	623	771	197
- Mixed processing	<u>19</u>	<u>819</u>	<u>-91</u>	<u>48</u>	<u>216</u>
- Processing total	87	14,306	823	2,133	2,089
Total	613	18,426	1,271	3,939	3,212
Fish for reduction					
Fishery ¹	.	874	286	616	55
Fishmeal factories	2	3,538	384	608	176
Fish feed firms	<u>2</u>	<u>1,990</u>	<u>16</u>	<u>58</u>	<u>178</u>
Total	4	6,402	686	1,282	409
Total	617	24,828	1,958	5,221	3,621

¹: Fishery includes only commercial active vessels with an annual landing value of more than DKK 415 801, but both landings in Denmark and elsewhere. More than 98% of the total landing value originates from commercially active vessels. Some vessels target both fish for human consumption and reduction. 84% of the total landing value is caught by vessels >40 m, also targeting pelagic fish. The economic numbers for the fishery for reduction include only catches from vessels >40 m.

²: Processing factories all specialize in seafood and are grouped according to their main use of raw materials. The group "Herring and mackerel processing factories" included in the source Nielsen (2025) also includes fishmeal factories, but these are removed from the seafood for human consumption value chain and moved to the fish for reduction value chain, based on numbers from the annual accounts of the two active companies (Triple Nine Thyborøn A/S and FF Skagen A/S).

³: *Turnover* is the sum of the turnover of all companies. In more cases, there is double-counting, indicating that turnover exceeds total production value. The reason is that products are traded between Danish firms. That happens, e.g., in processing, where one Danish firm makes the first processing and sells to other firms that make the final product. It also happens in aquaculture, where one firm produces trout fry and sells them to marine fish farms.

⁴: *EBIT* is Earnings Before Interest and Taxes.

⁵: *Gross value added* is a measure of the contribution of the value chain to the Gross Domestic Product, calculated as turnover minus operating costs excluding salary costs, depreciation, and interest.

⁶: *Full-time employment* is for fisheries calculated as the number of working days on all vessels (onshore and offshore) divided by 220 working days per year, assuming 7.4 hours of work a day. For vessels with long fishing trips and around-the-clock fishing, full-time employment may be underestimated. For fishmeal factories and fish feed firms, the numbers include employment, not full-time employment.

Sources: For aquaculture Statistics Denmark (2025a), for fisheries, Statistics Denmark (2025b), for firms processing seafood for human consumption, Nielsen (2025), for fishmeal firms Triple Nine Thyborøn A/S (2024) and FF Skagen A/S (2024), and for fish feed companies BioMar A/S (2024) and Aller Aqua A/S (2024).

In the Danish seafood value chain, 617 firms operate, with a turnover of DKK 24.8 billion, an EBIT (profit) of DKK 2.0 billion, a gross value-added of DKK 5.2 billion, and full-time employment of 3 621. Hence, the seafood value chain contributes 0.18% to total Danish GDP and 0.14% to full-time employment. However, seafood sales from wholesale firms (importers, exporters, and domestic wholesalers), supermarkets, and fishmongers are not included in these numbers because 2023 data are unavailable. For 2020, Nielsen (2023) identified total gross value added at DKK 2.7 billion and total full-time employment in seafood activities across these three sectors at 3 924 full-time employees. Assuming the three sectors remain unchanged in size, adding downstream activities to the value chain increases the value chain's total contribution to 0.27% of GDP and 0.29% of full-time employment.

The value chain of seafood for human consumption contributes DKK 3.9 billion in gross value added and 3 212 full-time employees, and thereby covers 76% of 89%. The value chain for seafood for human consumption is supplied by fisheries, which generate DKK 1.4 billion in gross value added and employ 717 full-time employees, while aquaculture contributes DKK 431 million in gross value added and employs 406 full-time employees. In fisheries, vessels >40 m have the largest gross value added, while full-time employment is largest in medium-sized and small vessels. In aquaculture, recirculated farms and marine farms are the largest contributors to gross value added. However, processing is the main contributor with gross value added of DKK 3.9 billion and 2 089 full-time employees. In processing, about half of gross value added and full-time employment comes from salmon and trout, while a large contribution to gross value added also comes from shrimp.

The value chain for fish for reduction is supplied by fisheries with a gross value added of DKK 616 million and 55 full-time employees. These numbers include only activities of vessels >40 m that make up 84% of the landing value, since fishing for reduction is a side activity to fishing for consumption. Fish meal factories contribute a gross value added of DKK 608 million and employ 176 people, while the gross value added in fish feed firms is DKK 58 million and the employment is 178.

Gross value added per full-time employed person is largest in vessels >40 m, at DKK 11.2 million, followed by shrimp processing at DKK 3.9 million and fish meal factories at DKK 3.5 million. It reveals that these segments are efficient in terms of employment but also indicates that firms are capital-intensive.

Regulation and management

Danish fisheries are regulated as part of the Common Fisheries Policy ruled by the principle of relative stability, where each country receives a total allowable catch (TAC) of the EU's part of fish stocks, based on a fixed percentage. The EU part is fixed after negotiations with non-EU parties. The most important agreement for Danish fisheries is the Brexit agreement (United Kingdom and the European Union 2020), which specifies allocations of each TAC between the UK and the EU. Bilateral and multilateral agreements are also in place, fish-stock-wise, with, among others, Norway and the Faroe Islands. The Commission also applies a system of capacity limits based on gross tonnage and engine power. This system, however, does not impose any limitations on Danish vessels.

The Danish TAC for each stock is allocated to fishers under the individual transferable quota scheme, in which each fisher has the right to catch a share of the TAC for that stock. That accounts for demersal, pelagic, and reduction fisheries. It is possible to sell this right to other fishers both permanently and annually. Moreover, small vessels below 17 m have special arrangements in which a minor share of the TACs is held back and allocated freely to vessels that voluntarily join the arrangement and thereby abstain from selling quotas or quota shares to vessels outside the arrangement.

The most important waters for Danish vessels in terms of landing value are the North Sea from where 59% of the total value on DKK 3.2 billion originate (2019-2023), followed by Skagerrak (18%), Kattegat (5%), the Baltic Sea (5%), West of Scotland (4%) and Norwegian Sea (2%). In terms of zones, 74% of the landing value originated from the EU zone, 25% from other countries' zones, mostly the British zone, and 1% from international waters. Since Denmark is part of the Common Fisheries Policy, Danish fishing takes place in the EU zone; a separate Danish fishing zone doesn't exist. Hence, parts of Danish catches originate in the exclusive economic zones of other EU countries, such as Sweden, Germany, the Netherlands, and Poland. Catches of fishers from these countries also partly originate from the Danish extended economic zone.

Danish vessels land 77% in value terms in Denmark (2019-2023), 7% in other EU countries, mainly Sweden and the Netherlands, and 16% outside the EU, including Norway and the UK. In Denmark, 47% is landed in Northern Jutland and 24% in Central Jutland. The main harbours are Skagen, Hanstholm, Thyborøn, Hirtshals, and Hvide Sande. Mackerel landed in Norway is the most important species landed in foreign harbours.

Aquaculture production in Denmark requires a permit and is regulated because nutrient discharges negatively affect ecosystems in freshwater streams and lakes, as well as in coastal waters, when combined with runoff from agriculture and wastewater. Since the water environment is in good or very good condition only in

30% of catchment areas, a "Not good ecological state" prevails in 70% of the areas. Hence, spillover effects on the environment of many coastal waters exist, especially in the Baltic Sea and inner waters (European Commission 2025). Danish aquaculture is thus very strictly regulated. Aquaculture has traditionally been regulated by non-transferable feed quotas to limit discharges of nitrogen, phosphorus, and organic material. That regulation has, over the last decade, been combined with the voluntary option of choosing non-transferable output regulation. Such a choice is important because recirculating aquaculture systems have been developed that limit nitrogen and phosphorus discharges per kilo of farmed fish. Aquaculture in freshwater ponds is in Jutland, marine aquaculture is present in the inner Danish waters along the East coast of Jutland and at Southern Zealand, while mussel farming prevails in the Limfjord.

Seafood processing and wholesale are mainly located along the Northwest coast of Jutland, where fish are landed, although processing also occurs in other parts of the country, for example close to the large market area in Copenhagen. Given the large presence of intermediate seafood firms in Denmark between rich fishing grounds in the Northeast Atlantic Ocean and the EU seafood market, the ownership structure of processing and wholesale is complex. A number of firms in Denmark are owned by Danes, but a large part of the firms' activities is owned by Greenlandic and Norwegian firms. Moreover, seafood processing and wholesale companies in other countries are under Danish ownership. Especially at the main EU market, but also internationally.

Recreational fishing takes place along rivers and streams, on the coast, from shore, from small vessels, and in put-and-take lakes. Sport fishers, leisure fishers, and part-time fishers are regulated separately. Sport fishing requires an annual license. Leisure fishing is done from small dinghies and is limited to a few nets per person. Part-time fishing claim quotas, allocated from a minor part held back in the TACs. Part-time fishing contributes less than 2% of the Danish landing value. Hence, while sport, leisure, and part-time fishing may induce a substantial recreational value to the practitioners, the contribution to seafood security at the national level is negligible.

Supply of seafood from primary production is shown in Table 4.2.

Table 4.2: Primary supply of seafood in Denmark 2019-2023, quantity and value, current prices.

	Quantity (tonnes live weight)					Value (DKK Million)				
	2019	2020	2021	2022	2023	2019	2020	2021	2022	2023
Aquaculture¹										
Trout	33,693	32,955	28,477	26,741	24,624	830	820	727	818	786
Salmon	1,473	1,940	1,668	1,165	1,222	59	72	61	0	60
Blue mussels	7,333	6,317	8,485	8,522	6,210	41	25	41	38	32
Other	<u>1,282</u>	<u>1,416</u>	<u>2,059</u>	<u>1,496</u>	<u>1,066</u>	<u>90</u>	<u>85</u>	<u>137</u>	<u>177</u>	<u>88</u>
Total	43,781	42,628	40,689	37,924	33,122	1,019	1,002	967	1,034	966
Fishery										
Seafood for consumption²										
<u>Demersal fish</u>										
Cod	12,397	6,964	4,433	3,630	5,394	272	174	123	122	166
Plaice	14,453	13,676	10,701	7,631	7,108	263	214	190	180	165
Hake	3,099	3,804	3,346	3,585	2,973	70	73	85	89	84
Monkfish	2,894	1,996	2,141	2,132	1,955	90	58	65	72	65
Haddock	1,454	1,095	2,403	4,039	3,970	19	12	24	44	45
Turbot	470	468	537	489	416	33	28	43	49	41
Other	<u>13,865</u>	<u>11,238</u>	<u>9,233</u>	<u>7,759</u>	<u>6,948</u>	<u>231</u>	<u>178</u>	<u>185</u>	<u>186</u>	<u>155</u>
Total	48,631	39,242	32,794	29,265	28,764	979	738	714	743	721
<u>Pelagic fish</u>										
Herring	110,643	105,069	72,336	85,202	60,637	483	480	381	494	416
Mackerel	27,360	34,614	30,895	20,218	26,441	295	338	312	233	320
Other	<u>7,783</u>	<u>5,481</u>	<u>5,891</u>	<u>5,190</u>	<u>1,031</u>	<u>43</u>	<u>34</u>	<u>44</u>	<u>46</u>	<u>10</u>
Total	145,786	145,164	109,123	110,610	88,109	821	851	736	773	746
<u>Crustaceans/mussels</u>										
Nephrops	6,039	4,283	5,419	5,019	4,726	298	197	289	328	291
Deepwater shrimp	6,866	6,603	5,905	6,902	6,360	227	207	208	265	245
Common shrimp	1,393	1,163	995	1,062	1,255	32	38	39	57	65
Blue mussels	37,032	22,233	24,805	23,824	17,074	42	30	40	33	29
Other	<u>12,478</u>	<u>5,381</u>	<u>11,765</u>	<u>12,188</u>	<u>5,567</u>	<u>83</u>	<u>39</u>	<u>67</u>	<u>91</u>	<u>61</u>
Total	63,808	39,662	48,889	48,994	34,982	683	511	644	774	691
Other	1,693	1,568	16,510	9,141	1,639	45	48	90	66	39
Total for consumption	259,919	225,637	207,316	198,010	153,493	2,528	2,148	2,185	2,356	2,198
Fish for reduction³	378,344	506,749	259,025	260,056	340,865	737	996	582	612	987
Total fisheries	638,263	732,385	466,341	458,066	494,359	3,265	3,144	2,766	2,968	3,185
Total primary production	682,044	775,013	507,030	495,990	52,7481	4,284	4,146	3,733	4,002	4,151

¹: Net production excluding sales to other Danish farms.

²: While 121 different species were landed by Danish vessels, those included are those with the largest landing value in Denmark and elsewhere in 2023, selected to cover at least 90% of the total landing value. After selection, they are grouped into demersal fish, pelagic fish, and crustaceans/mussels.

³: Landings used to produce fishmeal and Fish oil of all species. The main species in 2023 were, in quantity terms, sandeel (34.7%), sprat (29.9%), and blue whiting (24.1%).

Sources: Danish Agricultural and Fisheries Agency (2025b).

Total seafood supply from primary production in 2023 is 527,000 tonnes, corresponding to DKK 4.2 billion. DKK 966 million is aquaculture production, DKK 2.2 billion is wild-caught seafood for human consumption, and DKK 987 million is fish for reduction.

Trout is by far the largest species farmed, originating both as portion-sized portions of 200-400 grams per fish from freshwater ponds and larger sizes from marine farms. Salmon is also produced in recirculated aquaculture systems, and blue mussels are farmed. Total quantities farmed are reduced by 24% in the 2019–2023 period, while production values remain stable.

Fish for reduction include species such as sprat, sandeel, blue whiting, and Norway pout. Landing fluctuates due to fishing on low-year classes with varying recruitment. Prices are increasing over the 2019–2023 period, following the scarcity of supply and increased demand for feed in global aquaculture.

The total supply of seafood for human consumption in value is allocated equally between demersal fish, pelagic fish, and crustaceans/mussels in 2023. The most important species are herring, mackerel, nephrops, deepwater shrimp, cod, and plaice. Quantities fall in the period 2019–2023, both for demersal and pelagic fish, while they vary for crustaceans/mussels.

The status of the main fish and shellfish stocks for Danish fisheries is presented in Table 3. The current stock level is compared to the stock level that provided the largest possible catch in the long run (the Maximum Sustainable Yield, the MSY-level), and the current fishing pressure is compared to the fishing pressure providing the largest possible catch in the long run.

Table 4.3: Status of main stocks for Danish fisheries in terms of biological stock status and fishing pressure, 2023.

Species/stock	Danish catches from stock 2023 ¹		$F \leq F_{MSY}^2$	$SSB \geq MSY$ $B_{trigger}^2$
	Quantity (tonnes)	Value (DKK million)		
Herring North: Sea, Skagerrak, Kattegat	67,301	462	Not good	Good
Mackerel: Northeast Atlantic	28,209	341	Not good	Not good
Nephrops: Skagerrak, Kattegat	4,454	274	Good	
Blue whiting: Northeast Atlantic	87,119	252	Not good	Good
Sprat: North Sea, Skagerrak, Kattegat	86,855	252		Good
Sandeel: Central western North Sea	85,160	247		Good
Cod: North Sea, Skagerrak	2,998	92	Not good	Not good
Deepwater shrimp: Skagerrak, Norw. Depth	2,224	86	Good	Not good
Plaice: North Sea, Skagerrak	3,306	77	Good	Good

Notes:

¹: Quantity of catch of Danish vessels on each stock and the value of the catches at the average price of total landings of the species (not the exact stock).

²: For fishing pressure, a green box indicates that current fishing mortality (F) is smaller than the fishing mortality corresponding to the Maximum Sustainable Yield, while a red box indicates larger fishing mortalities. For stock status, a green box indicates that the current spawning stock biomass (SSB) is larger than the spawning stock biomass corresponding to the trigger value, a precautionary threshold value below which management action, in form of a reduction in fishing pressure, is triggered.

Sources: International Council for Exploration of the Sea (2025) and Danish Agricultural and Fisheries Agency (2025b)

For the nine fish and shellfish stocks shown, five are above the trigger values, three are below, and the reference points are undefined for nephrops in Skagerrak and Kattegat. The current fishing pressure is above MSY for four stocks, below MSY for three, and undefined for two. Hence, a simultaneous good status of both stock and fishing pressure only prevails for one stock, plaice in the North Sea and Skagerrak. Hence, the biological foundation for Danish fisheries is under pressure. A poor status, either for stock levels or fishing pressure, prevails across demersal, pelagic, and shellfish species.

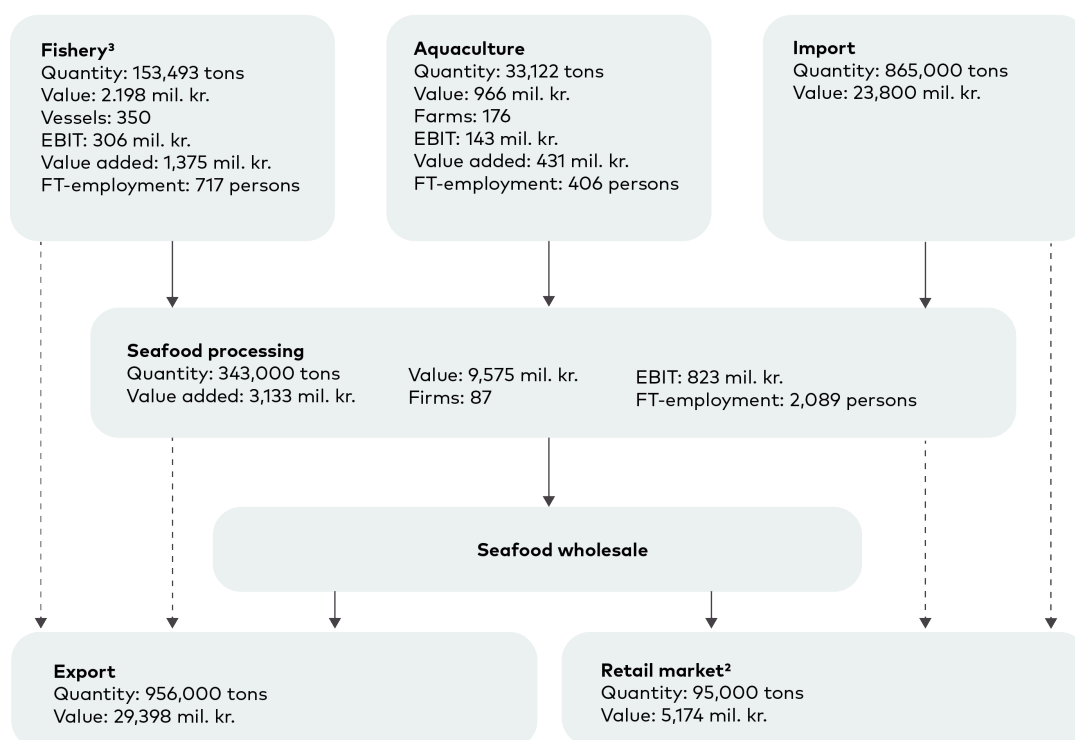
The status of cod stocks in both the Western and Eastern parts of the Baltic Sea is not shown because fishing over the last 5-6 years has largely stopped following recurrent advice to set zero quotas. The bad status of the cod stocks results from a mixture of more pressures, including environmental pollution, earlier severe overfishing and changing water temperature following climate change (Möllmann et al 2021; Bossier et al 2021; Froese et al 2022). The implication is that the large-scale historical fishing in the Baltic Sea has almost disappeared.

Trade flows of Aquatic food: Denmark

The Danish value chain for seafood for human consumption

The structure of the Danish value chain for seafood for human consumption is identified using key numbers on quantities sold at different nodes of the chain. Economic numbers appear in Table 4.1, and all quantities are presented in live weight. The value chain is shown in Figure 4.1.

Figure 4.1: The Danish value chain for seafood for human consumption 2023, live weight¹. Values in current value terms. FT= full time. EBIT= earnings before interest and tax.



Notes:

¹: Quantities in live weight are known for fishery and aquaculture, while the quantities in live weight equivalents are calculated for seafood processing, import, and export using conversion factors from processed or traded weight to live weight. Conversion factors are inspired by the Food and Agriculture Organization of the United Nations (2025) but fitted to the Danish context. The same conversion factors are applied to all unprocessed products (live, fresh, and frozen) within each species group, and to all processed products (fillets, smoked, salted, dried, and final processed) within each species group. For unprocessed seafood products, the conversion factors are 1.30 for salmon/trout and whitefish/flatfish, 1.0 for pelagic fish, 1.0 for crustaceans/mussels, and 1.0 for others/mixed. For processed fish products, the conversion factors are for salmon/trout 2.0, for whitefish/flatfish 2.60, for pelagic fish 2.3, and for others/mixed 2.6. For processed products in the crustaceans/mussels group, the conversion factors are for shrimp 1.64, for cuttlefish 2.0, for nephrops/lobster 3.6, for mussels/other aquatic invertebrates 4.0, and for oysters/scallops 10.0.

²: The total quantity is identified in Table 4.6, while the total value is known per capita from Statistics Denmark (2023c).

Sources: Danish Agricultural and Fisheries Agency (2025ab), Nielsen (2025), and Statistics Denmark (2025a-e).

In 2023, 350 fishing vessels were commercially active with an annual landing value of more than DKK 415,801. Estimated full-time employment on those vessels is 772 persons, of which 717 fall in the segment of seafood for human consumption (allocated based on weighted landing values). Some vessels are specialized in fishing for human consumption, while others also target fish for reduction. Numbers for individual vessels are not available for 2023, but in 2020, 80% of the vessels specialized in fishing for human consumption. The remaining vessels both fished for human consumption and for reduction, except for two that specialized in fishing for reduction. The catch value for human consumption was DKK 2.2 billion, equally allocated between the three groups: whitefish/flatfish, pelagic fish, and crustaceans/mussels. The main species in value terms are herring, mackerel, nephrops, deepwater shrimp, cod, and plaice. 77% of the value is landed in Denmark from 2019 to 2023.

176 fish farms exist with a turnover of DKK 1.7 billion and a full-time employment of 406 persons. The production in 2023 is 33,122 tonnes, corresponding to a value of DKK 966 million. Turnover is larger than production value, among other things, due to the sale of fish fry for release into marine fish farms by Danish firms, which count in turnover but not in production. Rainbow trout is the dominant species. Both meat and the roe are important for trout from marine farms. Salmon, blue mussels, and oysters have gained importance in recent years, and tuna and pikeperch are also farmed. Farming in freshwater ponds is most important, with an annual turnover of DKK 1,044 million, while the turnover of marine farms is DKK 601 million. Farming in traditional freshwater ponds is declining, while farming in recirculating aquaculture systems with varying degrees of recirculation is increasing. Danish trout production is mostly exported, primarily in fresh, frozen, and smoked forms. The most important export markets are the areas with a tradition of eating freshwater fish in Central Europe, with Germany being the largest market.

In 2023, 87 seafood processing factories exist with a turnover of DKK 14.1 billion. Production is 343,000 tonnes live weight, corresponding to a value of DKK 9.6 billion. Turnover is larger than the production value, as the factories perform wholesale as a side activity. With a full-time employment of 2,089 persons, this part of the value chain contributes the largest employment. Processing of seafood in Denmark is detailed on groups of species and products in Table 4.4, together with import and export, both in total and specifying imports from Nordic countries and exports to Nordic countries.

Table 4.4: Processing, import totally and from Nordic countries and export totally and to Nordic countries of seafood for human consumption, 2023, quantity and current value.

Product and species ¹	Quantity (1,000 tonnes live weight)					Value (DKK million current price level)				
	Processing	Import Total	Import Nordic	Export Total	Export Nordic	Processing	Import Total	Import Nordic	Export Total	Export Nordic
Salmon and trout										
- Fresh, live	9	153	153	95	2	335	6,795	6,759	4,352	83
- Frozen	6	20	8	29	1	209	836	341	1,131	48
- Fillets	53	43	20	90	3	2,848	1,844	1,034	4,615	120
- Smoked, Salted, Dried	32	5	0	21	0	1,996	293	29	1,461	17
- Processed	3	3	0	10	0	119	120	13	440	22
Total	103	224	182	246	7	5,508	9,888	8,175	11,999	290
Whitefish and flatfish										
- Fresh, live	3	90	66	82	6	125	1,679	1,260	2,141	149
- Frozen	0	39	32	29	1	2	834	655	716	23
- Fillets	16	60	22	53	6	273	1,186	528	1,217	144
- Smoked, Salted, Dried	6	8	8	13	0	191	144	144	300	3
- Processed	0	24	3	47	4	6	377	45	881	74
Total	25	221	130	224	16	597	4,220	2,631	5,254	394
Pelagic fish										
- Fresh, live	1	99	81	73	63	11	662	485	782	684
- Frozen	7	8	7	13	0	113	96	83	174	4
- Fillets	9	2	1	10	1	59	21	7	76	8
- Smoked, Salted, Dried	1	1	0	9	2	26	10	3	66	11
- Processed	115	10	5	76	6	1,278	122	46	862	70
Total	132	120	95	181	72	1,488	910	624	1,960	777

Crustaceans and mussels										
- Fresh, live	4	2	1	21	7	106	136	40	659	280
- Frozen	0	74	60	77	13	0	2,960	2,203	3,380	581
- Fillets	0	0	0	0	0	0	0	0	0	0
- Smoked, Salted, Dried	3	4	1	12	3	83	60	15	416	126
- Processed	34	68	37	49	12	1,095	2,105	1,206	1,791	519
Total	41	149	99	159	35	1,284	5,261	3,463	6,245	1,505
Other and mixed										
- Fresh, live	7	34	22	20	12	16	482	324	591	91
- Frozen	2	52	40	55	5	85	2,004	1,510	2,312	56
- Fillets	5	25	6	29	8	36	458	84	506	82
- Smoked, Salted, Dried	1	16	16	17	1	41	160	147	268	17
- Processed	27	25	1	26	19	521	417	13	263	70
Total	42	152	84	147	45	699	3,521	2,078	3,940	317
Total										
- Fresh, live	23	379	323	291	90	593	9,753	8,869	8,524	1,287
- Frozen	14	192	147	202	20	409	6,729	4,792	7,713	712
- Fillets	83	131	49	183	18	3,217	3,509	1,653	6,414	354
- Smoked, Salted, Dried	42	34	25	72	6	2,337	667	337	2,510	173
- Processed	180	130	46	209	41	3,019	3,140	1,322	4,237	756
Total	343	865	591	956	174	9,575	23,800	16,972	29,398	3,282

Notes:

¹: Fresh and live products includes all codes in the Harmonized System under 0301 and 0302 and selected codes under 0306, 0307, 0308 and 0309, frozen products codes under 0303 and selected codes under 0306, 0307, 0308 and 0309, fillets codes under 3004, smoked, salted and dried products codes under 0305 and selected codes under 0306, 0307, 0308 and 0309, and processed products codes under 1604 and 1605. The group salmon/trout includes only codes of salmonids, the whitefish/flatfish group codes for cod, haddock, saithe, pollack, hake, whiting, ling, redfish, plaice, turbot, sole, lemon sole, monkfish, flounder, greater forkbeard, megrim and other flatfish, the pelagic group herring, mackerel, anchovies, sardine and horse mackerel, the crustaceans/mussels group all codes under 0306, 0307, 0308, 0309 and 1605, and the other/mixed group all other codes, both with other species and with a mixed content of species.

Sources: Statistics Denmark (2025d-e).

The value of domestically processed seafood is largest for salmon and trout, at DKK 5.5 billion (57%), followed by pelagic fish at DKK 1.5 billion (16%) and crustaceans and mussels at DKK 1.3 billion (14%). Processing is differentiated by product forms. Fillets are the largest with DKK 3.2 billion, followed by processed seafood with DKK 3.0 billion and smoked, salted, and dried products with DKK 2.3 billion. Packing, filleting, souring, pickling, smoking, canning, and ready meals products are sold, and activities include both packaging of unprocessed products, semi-processed products for further processing in other countries, and ready-made products for direct sale in supermarkets at export markets and in Denmark. The main individual processed items include salmon fillets, smoked salmon, souring of herring, mackerel in tomato, shrimp in brine, and peeled shrimp, single frozen (Statistics Denmark 2025e).

The import of 865,000 tonnes and DKK 23.8 billion in 2023 was brought as raw material for processing firms and for direct sales by both processing and wholesale firms. Raw materials (fresh, live, and frozen) accounted for DKK 16.5 billion (69%), fillets for 3.5 billion (15%), processed seafood for 3.1 billion (13%), and smoked, salted, and dried products for 0.7 billion (3%). Processing factories receive several species, with salmon, shrimp, and cod being the most important. 71% of the import value originates in the Nordic countries, with Norway being the largest supplier (DKK 8.0 billion), followed by Greenland (5.5) and the Faroe Islands (1.5). Imports account for 80% of the total quantities supplied by landings, aquaculture production, and imports. Salmon is mainly imported from Norway, but also from the Faroe Islands, shrimp from Greenland and Canada, cod and whitefish from several countries fishing in the Northeast Atlantic Ocean, while the "Other and mixed" category includes large quantities of Greenland halibut, mainly from Greenland, imported and directly exported mainly to China.

While statistics on seafood wholesale firms are unavailable for 2023, data from 2020 are available from Nielsen (2023). In 2020, 226 firms were registered in the branches of seafood wholesalers, fish importers, fish exporters, fish auctions, and centrals that collect and sort fish from fishers for the auctions. Full-time employment was 1,817 persons, and the turnover was DKK 21.0 billion. Like processing companies, wholesalers depend on imported seafood and on the resale of catches from Danish fishers.

The largest market for processors and wholesalers is the EU, accounting for DKK 19.6 billion, corresponding to 67% of total exports for human consumption. The simultaneous presence of both large seafood imports and large seafood exports indicates that Danish seafood processors and wholesalers have established a position in the intermediate part of the value chain as suppliers to the European seafood market, sourcing raw materials from the entire Northeast Atlantic Ocean. The distribution channels from fisheries in the Northeast Atlantic Ocean and salmon farming in Norway and the Faroe Islands, via Denmark, to the important

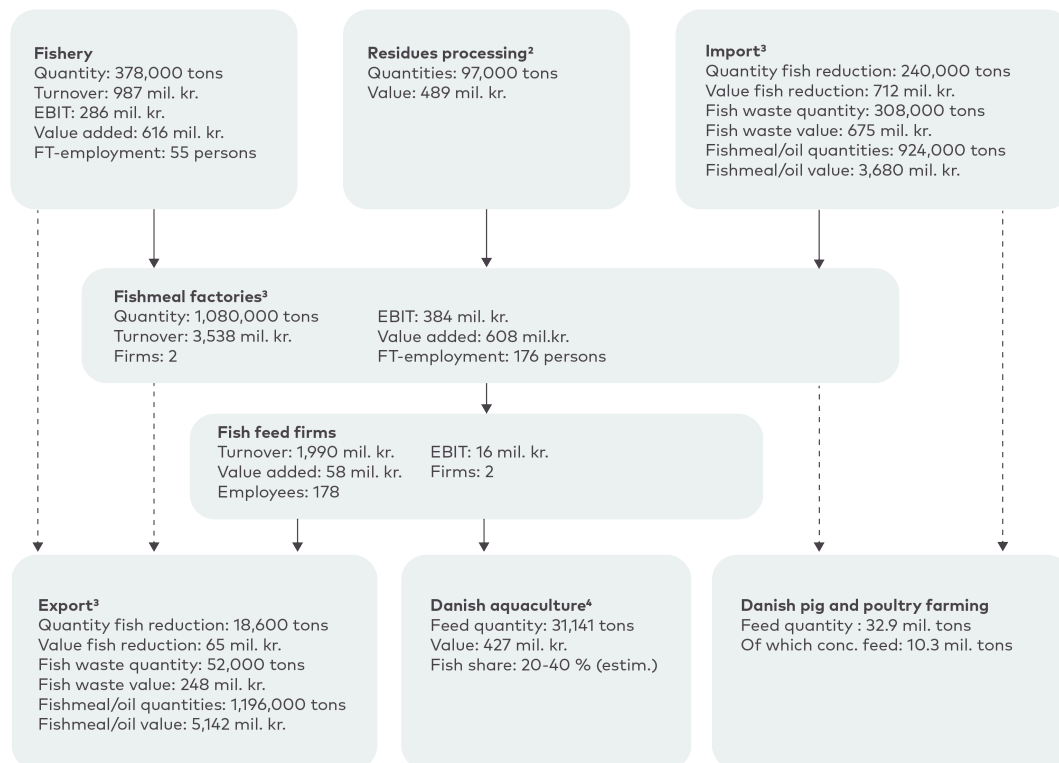
final markets in the rest of the EU and in the UK are well-functioning. Fresh fish typically reaches large wholesale markets, e.g., in Paris or Madrid, within less than 24 hours of landing. Germany is the largest buyer country (DKK 4.1 billion, 14%), followed by China (3.4), France (2.4), and Poland (2.2). Total exports to Nordic countries account for DKK 3.3 billion (11%).

Seafood retail sales in Denmark in 2023 are estimated at DKK 5.2 billion, based on per capita seafood consumption of DKK 870 (Statistics Denmark, 2023c). Seafood is mainly sold in supermarkets and by fishmongers. Nielsen (2023) estimates the market share of supermarkets in seafood sales in 2020 at 84% and of fishmongers at 16%. Moreover, the share of seafood in total turnover was found to be 2.8% in 2020, corresponding to an estimated 1 518 full-time employees working with seafood in supermarkets. Moreover, Nielsen (2023) found that 173 fishmongers were registered with 589 full-time employees. Sales from cars selling fish directly to consumers are not included. The demand from supermarket chains reveals consumer preferences, though supermarkets also impose additional requirements on their suppliers. Suppliers must guarantee delivery, prices, and quality, and must be able to provide traceability documentation and deliver certified products. In recent years, fresh fish have increasingly been sold through online ordering with delivery directly to consumers.

The Danish value chain for seafood for fish for reduction

The structure of the Danish value chain for fish for reduction is sketched in Figure 4.2, with key numbers showing quantities sold at different nodes in the chain. Economic numbers appear in Table 4.1. Quantities are presented in live weight, except for fish waste, which is only the wasted quantity.

Figure 4.2: The Danish value chain for fish for reduction 2023¹



Notes:

¹: The value chain includes fish feed produced and applied in Denmark. Import and export of fish feed mixed with plant-based ingredients and pet feed are not included. Quantities are calculated in live-weight equivalents, assuming that one kilo of fish for reduction yields both 220 grams of fishmeal and 60 grams of fish oil. With fishmeal and fish oil accounted for separately, it is assumed that half of the live weight goes to fishmeal and the other half to Fish oil.

²: Marine residues include mainly cuttings from processors of seafood for human consumption, known from group 051191 in the harmonized system.

³: Import of fish for reduction is landings of foreign fishers in Denmark and export Danish fishers' landings in foreign ports. Processing, import, and export of fishmeal and fish oil includes the groups 23012000, 23099010, 150410, and 150420 in the harmonized system.

⁴: The share of fishmeal and fish oil is both estimated to be 10-20% in feed for trout, summing to 20-40%.

Sources: Aller Aqua A/S (2024), BioMar A/S (2024), Danish Agricultural and Fisheries Agency (2025ab), FF Skagen A/S (2024), Statistics Denmark (2025abdef), and Triple Nine Thyborøn A/S (2024).

Danish vessels' total landings of fish for reduction in 2023 were 378,000 tonnes worth DKK 987 million. 350 commercially active vessels fished for human consumption and reduction. For 2023, numbers for individual vessels are not available, but in 2020, 20% of the vessels were fishing for reduction, while also engaged in fishing for consumption (Nielsen, 2023). The 25 largest vessels accounted for 81% of the total landing value of fish for reduction. Since the vessels both fish for consumption and for reduction, full-time employment is not known separately; based on landing values, it is roughly estimated at 55 persons. Catches are mainly sprat, sandeel, blue whiting, and Norway pout. Almost all is landed at the Danish fishmeal factories.

The sole application of fish for reduction is in the processing of fishmeal and fish oil in a co-production, where meals and oils are separated. Processing of fishmeal and fish oil in Denmark is shown in Table 4.5 together with landings of foreign fishers in Denmark (import) and of Danish fishers in other countries (export), of import and export of fish waste, fishmeal, and fish oil, both totally and with other Nordic countries.

Table 4.5: Processing, import totally and from Nordic countries, and export totally and to Nordic countries of fish for reduction, fish waste, fishmeal, and fish oil, 2023, quantity live weight and value.

Sources: Statistics Denmark (2025d-e).

	Quantity (1,000 tonnes live weight)	Value (DKK Million current prices)
Processing		
- Fishmeal	461	2,856
- Fish oil	619	2224
Total	1,080	5,080
Import totally		
- Fish for reduction	240	712
- Fish waste	308	675
- Fishmeal	152	933
- Fish oil	772	2746
Total	1,415	4,406
Import Nordic		
- Fish for reduction	162	506
- Fish waste	238	418
- Fishmeal	113	702
- Fish oil	349	1,011
Total	862	2637
Export totally		
- Fish for reduction	19	65
- Fish waste	52	248
- Fishmeal	370	2,353
- Fish oil	826	2,789
Total	1,264	5,444
Export Nordic		
- Fish for reduction	17	62
- Fish waste	36	100
- Fishmeal	197	1,220
- Fish oil	678	2,296
Total	928	3,678

Foreign fishers landed 240,000 tonnes of fish for reduction, corresponding to a value of DKK 712 million. Swedish, British, Norwegian, and Faroese vessels contribute the most. Fishers from the other Nordic countries contributed DKK 506 million (71%). Marine residues, mainly in the form of cutoffs from Danish and foreign processors of seafood for human consumption, also contribute as raw material in processing fishmeal and fish oil. Fish waste in 2023 from Danish factories was 97,000 tonnes, while 308,000 tonnes were imported mainly from Sweden, Norway, and Poland. Hence, fish waste has become an important additional raw material for processing fishmeal and fish oil, although being considered of lower quality and more expensive to process than fish for reduction. This development followed the closure of the large Danish fur industry during the COVID-19 pandemic in 2020, when fish waste was an important feed component. Hence, today, fishmeal factories buy marine residuals formerly used as mink feed.

In 2023, 152,000 tonnes of fish meal in live weight were imported for DKK 933 million, while 772,000 tonnes of Fish oil were imported for DKK 2.7 billion. The Nordic countries together accounted for 45% with Norway being the largest fishmeal and Fish oil supplier (DKK 406 million). Hence, 55% of the import value of fishmeal and fish oil originates outside the Nordic area, with the USA (DKK 377 million) and Peru (298) being the largest sourcing countries.

Two firms, Triple Nine A/S and Skagen FF A/S, with 176 employees in total, are registered as fishmeal factories. The co-production of fishmeal and fish oil amounted to 461,000 tonnes and 619,000 tonnes, respectively, in live weight. Fishmeal and fish oil are sold in large quantities to Danish fish feed firms, which produce aquaculture feed by mixing them with plant-based ingredients. Furthermore, 370,000 tonnes live weight of fishmeal and 826 000 tonnes of fish oil are exported, corresponding to a total amount of DKK 5.1 million. Salmon farming in Norway brought in DKK 3.4 billion (67%), followed by the UK with DKK 384 million (7%). The whole EU received DKK 720 million (14%), while Nordic countries together received 68%. Fishmeal and fish oil are also applied in feed mixes for pig and poultry farming in Denmark.

With 55% of imported fishmeal and Fish oil originating outside the Nordic area, with import of Fish oil being larger than domestic processing, with import of fishmeal being 41% of export, with 67% of export going to Norway and with Norwegian import of fishmeal and Fish oil from Denmark forming a substantial part of feed in salmon farming, a strong dependency of Norwegian salmon farming on fishmeal and Fish oil from sources abroad is revealed. Hence, Norwegian salmon farming is vulnerable to potential supply shortages of fishmeal and Fish oil sourced worldwide via Denmark. Moreover, around 70% of salmon feed is typically plant-based, consisting of raw materials such as soy and rapeseed. The plant-based materials and in particular soy are also mostly sourced outside the Nordic areas from countries like Brazil, the USA, and Canada, further adding to the vulnerability of salmon farming to the global sourcing of feed.

Aquaculture feed in Denmark is processed solely by the two firms BioMar A/S and Aller Aqua A/S. These two firms had a total of 178 employees in 2023 and are part of two Danish-owned groups that produce feed for aquaculture worldwide. Production data are not available, but their turnover is DKK 2.0 billion in 2023. Production is done by mixing ingredients for targeting different fish species, including salmon and trout. Feed mixes vary, but may consist of 20–40 percent fishmeal and fish oil, of which about half is produced from waste products. The rest may be plant-based products, such as soy and rapeseed. Worldwide, most fish oil and fishmeal are used as ingredients for aquaculture feed. Hence, fishmeal and fish oil can partly be substituted with plant-based products, although this may reduce the content of the healthy omega-3 fatty acids and micronutrients in the fish farmed. Since plant-based feed is cheaper than feed based on fishmeal and oil, feed with a higher content of fishmeal and fish oil is typically used in the last weeks before slaughter. This results in a high omega-3 fatty acid content in the finished product.

Fish feed is also sold to Danish aquaculture, which applied an estimated feed quantity of 31,100 tonnes in 2023. Fishmeal and fish oil are also sold in minor quantities as additives to poultry feed and feed for small pigs weighing less than 15 kg. One kilo of trout is typically raised based on 0.9–1.1 kilos of feed in freshwater pond farming and 1.1–1.3 kilos in marine farming. Hence, feed use per kilo is smaller in aquaculture than in pig- and poultry farming.

Aquatic food available for consumption in Denmark

There is no statistic on seafood consumption in Denmark, although it has been roughly estimated in a few studies. However, the main aim of these studies is not to provide an overview of fish consumption, which implies that the estimates are subject to considerable uncertainty. Hence, reliable knowledge on the consumption of seafood in Denmark doesn't exist.

Statistics Denmark (2023c) reports that, in 2023, per capita seafood consumption, including fresh, frozen, smoked, preserved, and processed seafood, amounted to DKK 870 (excluding consumption in restaurants, cantinas, etc.). This corresponds to a total retail sale of seafood of DKK 5.2 billion. Smoked, preserved, and processed fish and shellfish account for 61% of the consumption value, while fresh fish and shellfish cover 28%. The survey does not identify consumption volumes.

EUMOFA (2025) estimates for 2022 a per capita fish consumption in Denmark of 20–25 kg in live weight equivalents based on a residual calculation.

Due to limited knowledge, seafood consumption is estimated as the residual of total supply minus exports, acknowledging the uncertainties. Total supply comes from fisheries, aquaculture, and imports. Consumption is the total supply minus exports. The calculation is made by converting all quantities into live weight equivalents and is made for groups of species, based on the numbers above. Estimated quantities supplied in Denmark and quantities available for human consumption are identified in Table 4.6, in total and per capita.

Table 4.6: Estimated Danish total supply and human consumption of seafood in 2023.

	Primary production	Import	Total supply	Export	Consumption
Total quantities (1,000 tonnes)					
Salmon and trout	26	224	250	246	4
Whitefish and flatfish	29	221	250	224	26
Pelagic fish	88	120	208	181	27
Crustaceans and mussels	41	149	190	159	31
Other and mixed	<u>3</u>	<u>152</u>	154	<u>147</u>	7
Total	187	865	1,052	956	95
Quantities per capita (kg.)					
Salmon and trout	4.3	37.6	42.0	41.3	0.6
Whitefish and flatfish	4.8	37.1	41.9	37.6	4.4
Pelagic fish	14.8	20.1	34.9	30.4	4.5
Crustaceans and mussels	6.9	25.1	32.0	26.7	5.3
Other and mixed	<u>0.5</u>	<u>25.5</u>	26.0	<u>24.7</u>	1.3
Total	31.4	145.4	176.8	160.7	16.1

The total supply of seafood for human consumption in 2023 is estimated at 1,052,000 tonnes, of which 187,000 tonnes (18%) originate from domestic fisheries and aquaculture, while 865,000 tonnes (82%) are imported. Measured per capita, the average Danish seafood consumption in 2023 was 16.1 kg. per person in live weight. The crustaceans/mussels group with 5.3 kg is the largest, followed by pelagic fish with 4.5 kg and whitefish/flatfish with 4.4 kg. Per capita consumption of salmon/trout and other/mixed species is calculated to be smaller.

The total supply per capita is estimated 176.8 kg, implying that in the speculative case where the full supply is consumed domestically, seafood consumption could increase 10-fold. Moreover, in another speculative case in which trade occurs only between Nordic countries, per capita seafood consumption in Denmark could increase 8.4-fold, since 71% of imports originate from other Nordic countries.

While the finding of a secure Nordic and Danish seafood supply in times of crisis is robust, substantial uncertainty exists regarding the Danish per capita seafood consumption of 16.1 kg per person. The uncertainty is due to calculations being made on live weight, with varying conversion factors, and the exact product form not always being known. Secondly, domestic processing generates waste that may vary, leading to uncertainty. Third, since fish are used both for human consumption and for reduction, the exact amount applied for human consumption may, in some cases, be difficult to identify. Fourth, the harmonized system doesn't, in all cases, allow for identifying species and product forms, adding to the uncertainty of conversion factors.

While reduced international trade in times of crisis can substantially affect the economics of the Nordic and Danish fishing industry, the effect on Danish and Nordic self-sufficiency in seafood for human consumption is limited. Security in the Danish and Nordic seafood supply is robust due to the very large volumes supplied. However, the salmon farming industry, especially in Norway, is vulnerable to the global sourcing of the feed ingredients fishmeal, fish oil, and soy, where a substantial part of fishmeal and fish oil is imported via Denmark.

Challenges, threats, and opportunities

More developments may negatively affect Danish seafood supply, both for human consumption and for reduction, although it is not certain whether this will occur.

The first development is the poor biological state of the most important stocks for Danish fisheries, with stock sizes below and fishing pressure above the MSY level. That accounts for both demersal and pelagic fish, crustaceans, and reduction stocks. Based on the application of the precautionary principle in fisheries management, the implication may be reduced catches over periods of stock recovery.

Second, while the Brexit agreement is in force and settles quota allocation between British and EU fishers (United Kingdom and the European Union 2020), problems for Danish fishing in the British zone persist. Currently, a moratorium on bottom trawling is in force at the Dogger Bank as part of a bird protection regulation, where a substantial share of sandeel has historically been caught. Moreover, many marine areas in the British zone are under consideration for the closure of bottom trawling due to environmental and biodiversity protection. The closures may be decided on and introduced over the coming years, potentially affecting Danish catches of demersal and reduction species.

Third, TACs for cod in the Baltic Sea are largely zero, reflecting the poor biological state of both the western and eastern stocks. Since the causes of the poor biological situation are not fully known, it is unclear whether cod fishing will reappear.

Fourth, international management agreements are currently not in force for Atlantic-Scandic herring and mackerel. The implication is that quotas have been set larger than the biological recommendation for both stocks. For mackerel, the total quota across all coastal states has, on average, been more than 40% above the biological recommendation for the past 10 years (Bjorndal et al., 2022). The consequences are that both stock size and fishing pressure are not favourable. Provided that an agreement is made, the implication may be a quota reduction over the coming years. If an agreement remains unsettled, catch rates may also fall.

Fifth, the closure of several marine areas in Danish waters is either decided or debated. An area in the Danish inner waters covering 19% of the Danish zone was decided in July 2025 and will be implemented over the next two years (Danish Ministry of Food, Agriculture and Fisheries 2025). Moreover, as part of environmental protection considerations, the closure of bottom trawling is under debate to improve marine biodiversity in Natura 2000 bird and habitat protection areas, in wildlife reserves, and in the new protected areas under the European Marine Strategy Framework Directive (Biodiversity Council, 2024ab). If decided and implemented, reduced catches from bottom trawling result.

Finally, the Green Tripartite agreement has been agreed upon in Parliament to reduce nutrient discharges. It is currently under implementation in Danish agriculture (Danish Ministry of Environment 2024). Given that nutrient discharges from agriculture will be reduced in the coming years, it is unlikely that aquaculture will be allowed to increase discharges. And growth in traditional freshwater ponds and marine aquaculture necessitates greater nitrogen and phosphorus discharges. By that, growth in the coming years will be limited to recirculated aquaculture systems and bivalve farming, sectors with smaller earnings than freshwater pond farms and marine farms.

Although not all the above developments may come true, several separate trends point towards a reduced supply of seafood from Danish fisheries, while growth in aquaculture doesn't seem likely with the current nutrient regulation of agriculture.

5. Sweden

The Swedish case study first provides an overview of aquatic food production, regulatory frameworks, and current issues in the Introduction. The following chapters present 2023 data on production and trade flows, which are then used to analyse the availability of aquatic food in Sweden.

Introduction

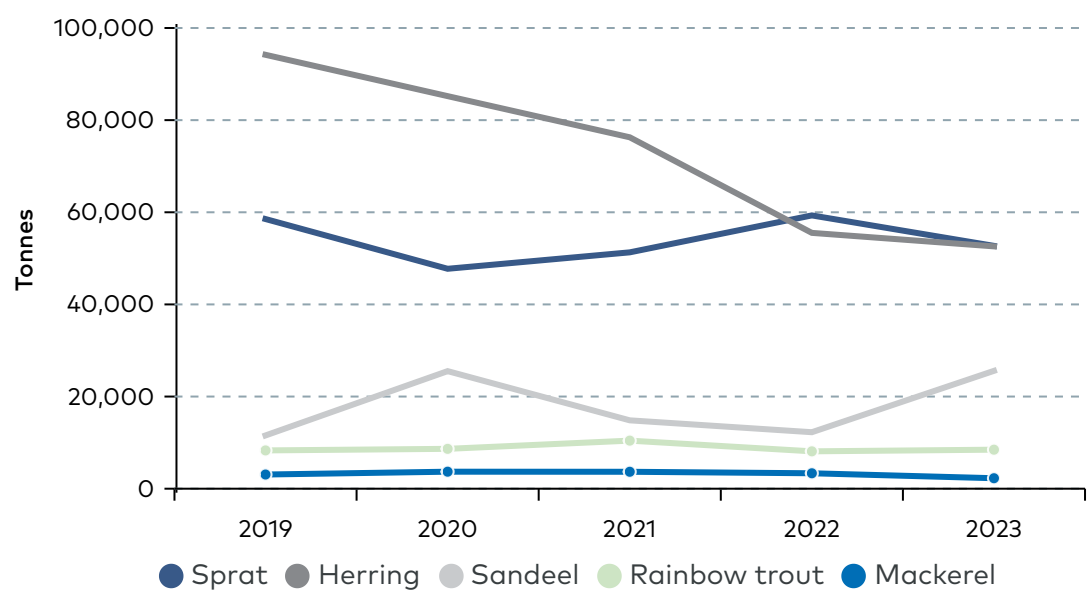
This chapter presents an overview of primary aquatic food production and the fish processing industry in Sweden. It also discusses the regulatory and management framework, as well as recent policy developments.

Primary production

The aquatic industry (including the primary sector and processing industry) is a small part of the Swedish economy, with around 1,500 firms and 2,000 employees in 2023. In 2023, the sector contributed 0.06 percent of GDP. The most important sub-sector in terms of the number of firms and value added was the sea fishing sector, with around 930 firms and SEK 940 million in value added. The processing sector was the largest employer, with 1300 employees in 2023. The aquaculture sector had 182 firms and 223 employees, whereas freshwater fisheries had 209 firms and 46 employees.

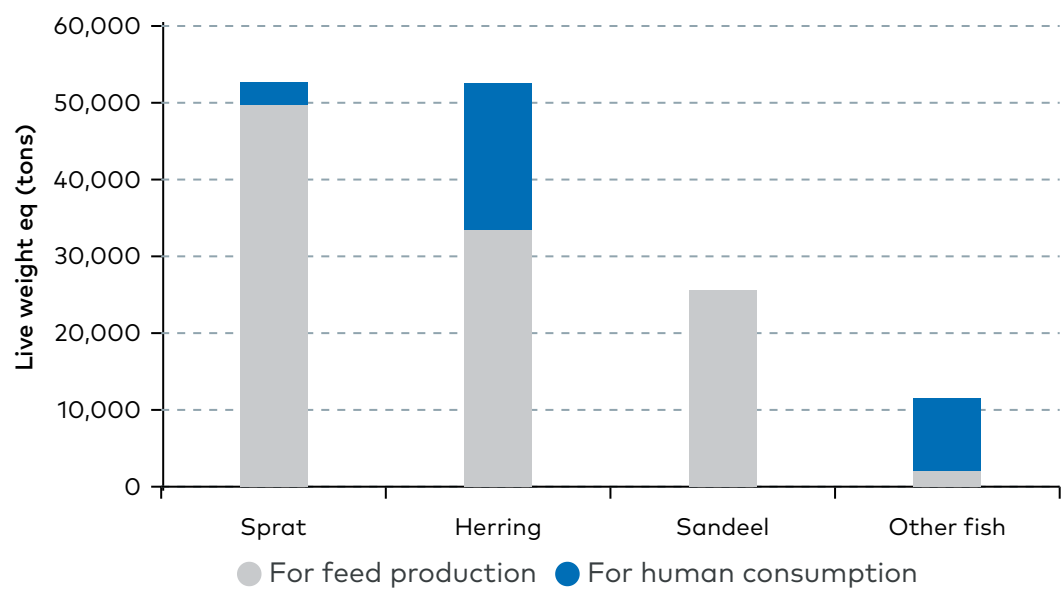
Figure 5.1 shows the five most important species in Sweden's primary aquatic production. In terms of volume (measured as live weight equivalents, LWE), Swedish fisheries are dominated by pelagic species. In 2023, herring, sprat, sand eel, and mackerel accounted for 82 % of the total production, with herring and sprat making up the majority. Rainbow trout from aquaculture accounted for 5% of the total. Since 2019, herring catches have declined, while no clear trends are evident for the other species.

Figure 5.1: Swedish aquatic production, five major species, tonnes (LWEs), 2019-2023. Sources: SwAM (2020, 2021, 2023), SBA (2024).



Most of the pelagic species are used for feed production. Figure 5.2 shows the most important species from sea fisheries, divided into fish for feed production and fish for human consumption. The share of each species caught for feed production is somewhat uncertain, so the figures should be interpreted with caution (SwAM, 2024a).

Figure 5.2: Swedish aquatic production, fish for consumption and feed production, tonnes (LWE) 2023. Sources: SwAM (2023). Note: Only catches from sea fisheries are included.



Sprat and sandeel are primarily used for feed production, whereas herring is also partially used for human consumption. In 2023, 36 percent of herring catches were estimated to be destined for human consumption. Swedish catches mainly come from the Baltic Sea (53 percent) and the North Sea (43 percent). Most of these catches are landed in foreign ports, primarily in Denmark; in 2023, 74 percent of Swedish catches were landed abroad. Domestic landings are concentrated along the west coast.

Although feed fisheries are important both in terms of volume and value, some species are economically significant despite accounting for only a small share of total catch volume. While statistics on aquaculture production are somewhat uncertain and should therefore be interpreted with caution, aquaculture accounted for 36 percent of the total value of Swedish aquatic production in 2023. The most important aquaculture species was rainbow trout, representing 26 percent of the total value. In addition, nephrops accounted for 11 percent of the value, and northern prawn for 5 percent, making them economically important species as well.

Regulation and management

Swedish fisheries are mainly regulated by the European Union's Common Fisheries Policy. Some minor species, such as vendace, pike perch, and perch, are regulated nationally. For the major species, such as sprat, herring, and sandeel, the Total Allowable Catch (TAC) is specified in EU regulations each year. Sweden usually receives quotas in the Baltic Sea and the North Sea (in EU, Norwegian, and UK waters).

In 2025, the Swedish quota for herring was 28 thousand tonnes (LWE) in the central Baltic Sea and 12 thousand tonnes in the Bothnian Bay. The quota for sprat was 27 thousand tonnes across the Baltic Sea as a whole. Other quotas in the Baltic were minor and included allowances for cod as bycatch, as well as quotas for Atlantic salmon and plaice (European Union, 2024).

In the North Sea, Sweden had several quotas for herring in 2025, including a quota for net fisheries in Skagerrak and Kattegat of 10 thousand tonnes, 4 thousand tonnes of herring in the North Sea, and 3 thousand tonnes of herring in the Norwegian Sea. The blue whiting quota was 16 thousand tonnes, mackerel of approximately 4 thousand tonnes in the North Sea, 11 thousand tonnes of sprat in Skagerrak and Kattegat, and 4 thousand tonnes of sandeel in the North Sea. Quotas are heavily traded between countries in the North Sea, meaning that actual national catches may be of other species than those specified in the original quotas (SwAM, 2025a).

Pelagic fisheries have been managed with a system of transferable quotas since 2009. Demersal fisheries (including quotas for Norway lobster, prawns, haddock, cod, whiting, and saithe) are managed with annual individual quotas, but a system of permanent, transferable quotas has been proposed and is currently under consideration (SwAM, 2024b).

Table 5.1 shows the status of the main stocks fished by Swedish sea fisheries in 2025.

Table 5.1: Status of the main stocks for Swedish fisheries 2025

* Spring spawning herring.

** Autumn spawning herring.

Species/stock	$F \leq F_{MSY}$	$SSB \geq MSY$ ($B_{trigger}$)
Herring: Central Baltic	Good	Not good
Herring: Bothnian Bay	Good	Not good
Sprat: Baltic	Not good	Good
Herring: Skagerrak, Kattegat, Southern Baltic*	Good	Not good
Herring: North-East Atlantic *	Good	Not good
Herring: North Sea, Skagerrak, Kattegat **	Not Good	Good

The central Baltic herring stock and the herring stock in the Bothnian Bay are both below the conservation reference point ($B_{trigger}$), which means that measures must be taken to ensure that the stock returns to its most productive level (the Maximum Sustainable Yield) (European Union, 2024). Fishing pressure (F) is still below the reference points that would yield the largest possible catch in the long run (the MSY level) for both stocks (ICES, 2025g, o).

For sprat in the Baltic, biomass remains above the conservation reference point ($B_{trigger}$), but the stock has decreased since 2021 (ICES, 2025n). In 2025, fishing pressure (F) was above the reference point, meaning that overfishing was taking place.

Fishing pressure was below the reference point that would provide the largest possible catch in the long run for two of the stocks fished off the west coast of Sweden (in Skagerrak, Kattegat, the Northeast Atlantic, and the Southern Baltic). For one of the stocks (autumn-spawning herring in Skagerrak, Kattegat, Southern Baltic, and North-East Atlantic fishing pressure was above the reference point. The biomass trigger point was, however, exceeded for two of the stocks, whereas one stock still had a biomass that was below the trigger point (ICES, 2025e, h, p).

Historically, cod (not included in Table 1) has been one of the most economically important species in Sweden. Currently, Baltic cod stocks are below biomass reference points, indicating that the stock's reproductive capacity is impaired and that there is a high risk of population collapse. Consequently, the targeted fishery for eastern Baltic cod has been closed since 2019, and for western Baltic cod since 2021 (European Union, 2024).

Recent policies

Recent policies affecting Swedish fisheries include a temporary extension of the trawl border in the Baltic Sea, implemented in 2025 (SwAM, 2025b) and a trawling ban in marine protected areas, to be introduced in 2026 (Swedish Government, 2025). Proposals for new marine spatial plans and a system of transferable quotas for demersal fisheries were put forward in 2025 and 2024, respectively. Furthermore, the Swedish government's recent work on its food strategy emphasizes aquatic foods as a key area for enhancing national crisis preparedness.

The proposed changes to marine spatial plans affect all major sea areas within Sweden's jurisdiction and are driven by the increasing demand for electricity and the need to create better conditions for offshore wind power development. The aim is to triple electricity production (SwAM, 2025c). Challenges related to the coexistence of offshore wind power, fisheries, and aquaculture are therefore expected to become a key issue in the coming years.

The Swedish government's work on a food strategy aims to increase domestic food production, including aquatic food production. For aquatic production, the Swedish Board of Agriculture has recently proposed a target to increase production by 60 percent by 2035 (measured by weight). This is to be achieved by increasing the use of pelagic fish as food rather than feed and by facilitating investments in aquaculture (SBA, 2025a).

Processing and Value Chain Overview: Sweden

Most Swedish catches from sea fisheries are not processed in Sweden; for example, there are no fishmeal factories in Sweden. Pelagic vessels land fish in Denmark, or herring and sprat from the Baltic is sometimes transported on lorries to Denmark (SBA, 2023). Swedish aquaculture farms process their fish both at stationary facilities at the farms and at facilities in other parts of the country and abroad, where Finland is a common processing destination (European Commission, 2025).

The fish processing industry is spread all over the country, with small businesses along the coast. Most catches landed in Sweden, however, are processed on the south and west coasts. The processing industry also imports a substantial part of its raw material (European Commission, 2025).

In 2023, 315 firms were registered as fish processing companies, of which 166 had fish processing as their main activity. These firms were often small, with the majority (85 percent) having fewer than 10 employees. The total number of employees (full-time equivalents) in fish processing firms was 1 300 in 2023 (European Commission, 2025).

Nearly half of the processing industry's total production costs consist of raw material costs (49 percent in 2023). Whereas smaller firms depend more on local landings, larger firms depend more on imports (mainly from Norway). The economic performance (net profit) was, on average, negative for the Swedish fish processing sector in 2023, with the most negative results for industries with more than 50 employees (European Commission, 2025).

Production and trade flows of Aquatic food: Sweden

In this chapter, we will estimate the amount of aquatic food available in Sweden by examining primary production and trade flows. As in other Nordic countries, we use 2023 for our data. First, we will investigate capture production and aquaculture production used for human consumption. Next, we will investigate trade flows, i.e., imports and exports. In a sensitivity analysis, we will investigate how the availability of aquatic food changes in three different potential scenarios. As above, we will present production in live weight equivalents (LWE). Trade flows are converted to LWE using the EU-mofa database.^[12]

Currently, several challenges hinder the production of reliable statistics on Sweden's trade in aquatic food. For example, data from Statistics Sweden (SCB) show that nearly 40 percent of Sweden's food exports in 2024 consisted of fish, crustaceans, and molluscs (SBA, 2025b). However, this figure is significantly overestimated, as it includes products that merely pass through Sweden without undergoing any processing—so-called quasi-transit trade. We adjust import and export statistics by removing quasi-transit trade, using additional information from Statistics Sweden (SCB). However, care should be taken when interpreting export data, as quasi-transits are reported only for imports. In addition, we lack information on quasi-imports from different countries, which necessitates the use of assumptions to estimate Swedish trade flows with each of the Nordic countries.

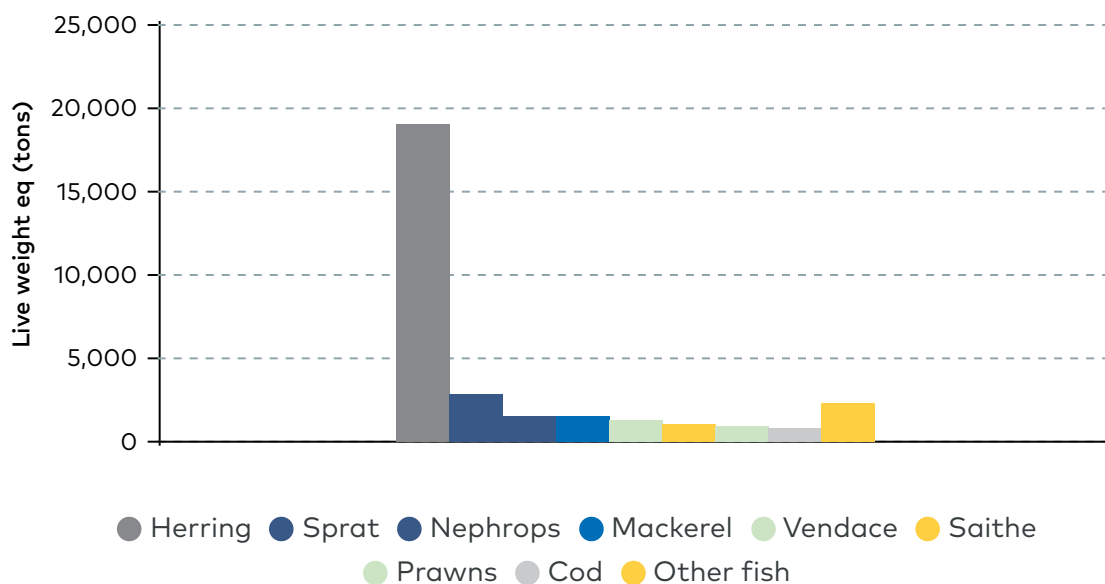
The categories used for the trade data calculations are the 8-digit codes in the CN Nomenclature used by Eurostat. The codes are all 8-digit codes in chapters 03, 1504, 1604, and 1605. Also, the 8-digit codes 05119110, 05119190, 230112000, 23099010 are used.

12. <https://eumofa.eu/metadata>, annex 7 conversion factors by CN_8 code.

Production

In 2023, a total of 31 thousand tonnes (LWE) of fish intended for human consumption were caught by Swedish vessels operating at sea. Figure 5.3 illustrates how this catch is distributed across species. Herring was the most important species, with 19 thousand tonnes caught in 2023.

Figure 5.3: Sea catches for consumption in 2023 (tonnes LWE).



In addition to catches from sea fisheries, there are also commercial catches from freshwater fisheries, although catches are small in comparison. Catches from freshwater fisheries amounted to 1,723 tonnes (LWE) in 2023. Catches of pike perch and crayfish dominated, with 480 tonnes of pikeperch and 240 tonnes of crayfish caught in inland lakes. Most catches came from Lake Vänern, Sweden's largest lake (SwAM, 2024a).

The total aquaculture production of fish in 2023 is estimated at 9,700 tonnes in whole live weight, of which 8,500 tonnes (approximately 97 percent) come from 39 facilities in Northern Sweden. Rainbow trout was the dominating species with a production of 8,400 tonnes in 2023. Mussel production amounts to 1,700 tonnes and is produced at 23 facilities in Southern Sweden (SBA, 2024). In total, there were thus approximately 11 thousand tonnes of live weight produce from aquaculture in 2023.

SwAM (2024c) estimates catch from recreational fisheries (catches not released) at 10,975 tonnes, of which 7,962 tonnes were caught in lakes and rivers and 3 000

tonnes along the coasts. However, the data are uncertain. If all primary production is combined, approximately 56 thousand tonnes (LWE) were produced in Sweden in 2023.

Imports

We estimate that total imports of aquatic food to Sweden in 2023 were approximately 251 thousand tonnes (LWE). We begin by taking a closer look at imports across different product groups (Figure 5.4).

Figure 5.4: Adjusted Swedish imports in 2023, product groups (KN-4), tonnes (LWE).

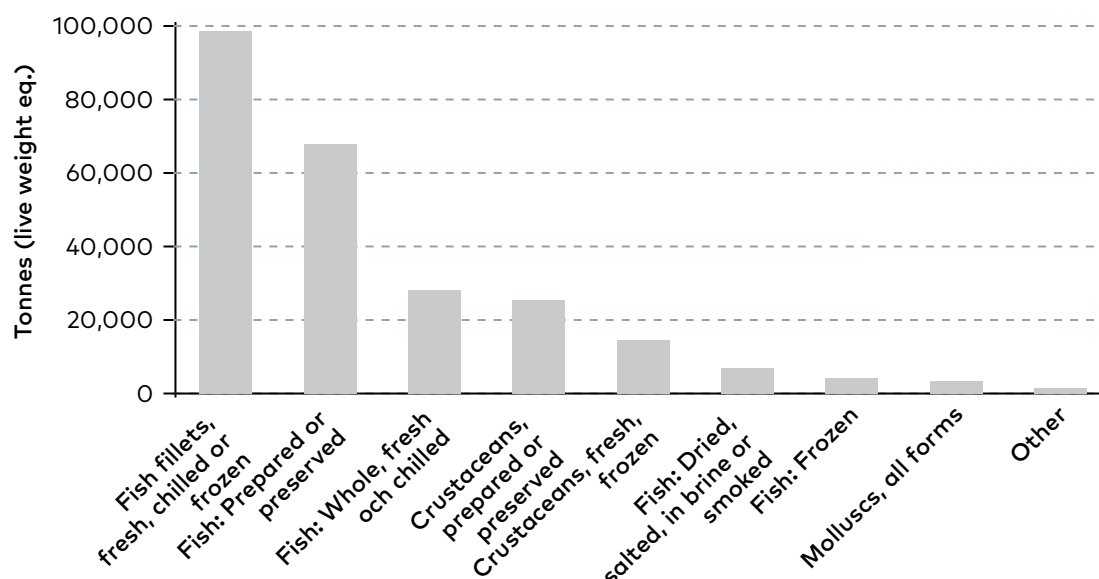


Figure 5.4 shows that imports of fish fillets are substantial, with nearly 100 thousand tonnes (LWE) imported into Sweden in 2023. In this category, the most common species are cod, salmon, saithe, Alaska pollock, and mackerel. For example, 18 thousand tonnes (LWE) of frozen cod fillets were imported, and 15 thousand tonnes (LWE) of frozen salmon fillets.

The product group "Fish: prepared and preserved" includes, among other things, breaded fish fillets of various kinds. Key species among these processed products are herring, Alaska pollock, tuna, mackerel, and salmon. This includes, for example, herring imported by the Swedish processing industry (so-called "barrel herring"), used to produce pickled herring (SBA, 2023). But there are also substantial imports of fish fillets coated with breadcrumbs or battered with no specification of the species. The calculated live weight equivalent of the prepared and preserved products amounts to 68 thousand tonnes.

Imports of whole fish (fresh/chilled) are also significant, with around 28 thousand tonnes (LWE). A large share of this category consists of salmon, but herring, cod, ling, haddock, and Atlantic halibut are also important. Prepared crustaceans largely consist of packaged shrimp (e.g., loose shrimp in containers weighing less than 2 kg). Other categories include smoked salmon (classified under "dried, salted, and smoked fish") and frozen cod (under "frozen fish"). The product groups shown as "other fish products" in the chart include various types of mussels, fish oil, and fishmeal.

Table 5.2 shows seafood imports from Nordic countries. Data on adjusted imports from individual countries are not available. However, we assume that quasi-imports originate in Norway, as the Swedish border is a major entry point for Norwegian seafood destined for the EU market. Consequently, all quasi-transits are deducted from imports coming from Norway.

Table 5.2: Imports of aquatic food to Sweden in 2023. Tonnes, live weight equivalents (fish for consumption).

*Note that this sum does not add up to the total estimated imports that are based on total trade statistics (which is 250 802 LWE-tonnes) presented above. Country-specific and total trade data have been gathered from Statistics Swedens website for this table.

Country	Imports (LWE-tonnes)	Share of imports
Norway	85,735	34%
Denmark	33,354	13%
Iceland	3,304	1%
Finland	655	0,3%
Faroe Islands	509	0,2%
Greenland	3	0,001%
All Nordic countries	123,560	49%
All Other Countries	125,739	51%
Total	249,299*	100%

A large share of Swedish seafood imports comes from Norway, accounting for 34 percent, followed by Denmark at 13 percent. Imports from other Nordic countries—namely Iceland, Finland, the Faroe Islands, and Greenland—are comparatively small. ^[13] Overall, approximately 51 percent of Swedish imports originate from countries outside the Nordic region.

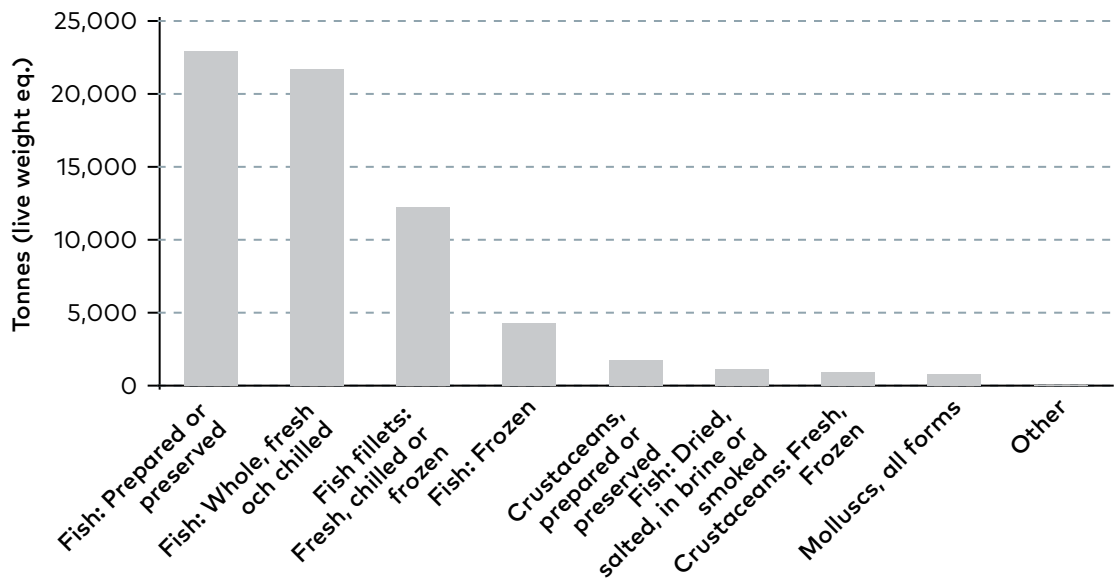
13. It is possible that imports from Nordic countries originate from countries outside of the Nordics or other Nordic countries. For instance, Greenlandic prawns could reach Sweden via Denmark.

Exports

As Swedish export statistics are also affected by quasi-transits, we remove them from the export statistics. However, adjusted export statistics are more uncertain as mentioned above. As above, we use EU-Mofa data as our primary source for converting to live weight. However, we apply several adjustments that we believe improve the estimates. Fresh and chilled salmon are removed from the exports, as this product is most likely Norwegian salmon destined for the EU market that has not been recorded as a quasi-transit for unknown reasons. Since most herring and sprat are used for feed production, we adjust the EU-Mofa conversion factors for these two species. Sand eel is also omitted from the calculation, as it is known to be used exclusively for fish feed.^[14]

In total, Swedish adjusted exports of aquatic food are estimated at 66 thousand tonnes (LWE) in 2023. Exports are thus significantly lower than imports and constitute 26 percent of the latter. Figure 5.5 shows how exports are divided among product groups. When transformed into live weight, prepared and preserved fish become the largest export group. Herring and mackerel are the most common species in this group.

Figure 5.5: Adjusted Swedish exports in 2023, product groups (KN-4), tonnes (LWE).



14. The conversion factors are based on SwAM (2024) and are 0,36 for herring, 0,05 for sprat and 0 for sand eel (assumably included in the category for other fish, fresh and chilled).

Also, fresh and chilled fish is exported from Sweden with herring (12,500 tonnes) and rainbow trout from aquaculture (5,000 tonnes) as the most important species. Also, sprat and freshwater fish (most likely pike perch) are exported to some extent.

Since data on exports minus quasi-exports by country are not available to us, we cannot present exact figures for exports to individual countries. Instead, we estimate exports to Nordic countries by subtracting total reported quasi-imports at the 8-digit level from each country's exports. This approach likely underestimates Swedish exports to each Nordic country but provides a lower bound on their volume.

Table 5.3: Estimated exports of aquatic food from Sweden in 2023. Tonnes (LWE).

Country	Exports LWE tonnes (estimate)	Share of exports
Denmark	15,466	24%
Norway	11,549	18%
Finland	5,659	9%
Iceland	76	0%
Faroe Islands	-	0%
Greenland	-	0%
All Nordic countries	32,749	50%
All Other countries	33,057	50%
Total	65,806	100%

Table 3 shows that the Nordic countries are key markets for Swedish exports of aquatic food, accounting for at least 50 percent of these exports. Denmark is the most important export destination; however, the estimate should be interpreted with some caution. Fresh and chilled herring constitutes a major share of exports to Denmark, accounting for 74 percent of the estimated export volume. The share of herring intended for human consumption is assumed to be 0.36. However, there is uncertainty about the amounts of herring used for food and feed (SwAM, 2024a).

Surprisingly, Norway is not only a major source of imported seafood but also an important destination for Swedish aquatic food exports. At least 18 percent of Sweden's aquatic food exports are destined for Norway. Approximately 38 percent of the estimated exports to Norway consist of prepared mackerel fillets. Some exports are sent to Finland, while very small volumes go to Iceland. There are no documented exports from Sweden to the Faroe Islands or Greenland. As exports to Nordic countries are likely underestimated, the results should be interpreted with caution.

Aquatic food available for consumption in Sweden

In this section, we try to calculate the availability of aquatic food in Sweden. Many figures are uncertain, and availability should not be confused with potential availability during a crisis. But as a starting point for a discussion about self-sufficiency and food safety, it may be informative.

Swedish commercial aquatic food production consists of catches by Swedish sea fisheries (31,000 tonnes in 2023), aquaculture production (11,000 tonnes), and production from inland fisheries (1,700 tonnes). Also, catches from recreational fisheries that are kept (11,000 tonnes) could be added to the production. It should be kept in mind, though, that the exact quantity for recreational fisheries is uncertain. Adding all the posts above, the total production of aquatic food is then approximately 56 thousand tonnes (see Table 5.4).

Table 5.4 presents production, trade, and the amount of aquatic food available for consumption^[15] in Sweden in a reference scenario (2023) and three potential scenarios. The second scenario assumes that catches from recreational fisheries are not included in production. The third scenario assumes that the production goal suggested by the Swedish Board of Agriculture is achieved. This could, e.g., be achieved by using all the herring currently used for feed production for food and by increasing aquaculture production by 150 percent. The fourth scenario assumes that trade restrictions (perhaps due to a crisis) will allow Sweden to import only from other Nordic countries. The fifth scenario can be seen as a combination of scenarios 2 and 3, where the trade restrictions are combined with increased production in Sweden that keeps the consumption level at the current consumption level (i.e., at the level of the reference scenario).

Table 5.4: Available aquatic food in Sweden, 2023. Thousand tonnes (LWE).

*Available for consumption in Sweden is Production+Imports-Exports. This is not equivalent to the real consumption since storage and waste is not accounted for.

Scenario	Production	Imports	Exports	Available for consumption	Self-Sufficiency Rate
1. Reference (2023)	56	251	66	241	23%
2. No recreational fishery	45	251	66	230	19%
3. Suggested goal	90	251	66	274	33%
4. Nordic imports only	56	124	66	114	49%
5. Sustained consumption	183	124	66	241	76%

15. The amount available for consumption differs from what is actually eaten (real consumption) since waste and storage is not accounted for.

In 2023, consumption in live weight equivalents was approximately 241 thousand tonnes in Sweden. Dividing this figure by the Swedish population gives 23 kg of aquatic food in live-weight equivalents per person in 2023. This is equivalent to approximately 440 grams per person and week. If 300 grams are needed per portion,^[16] each Swede would consume 1.5 portions per week. This is close to the estimate of Axelsson and Hornborg (2025), who report that consumption in 2023 was approximately 1.6 portions per person and week. However, it is far below the Nordic nutritional recommendations for eating fish 2.5–3.5 times per week. This is also lower than the rate in 2019 (1.9 portions per week) and lower than the Swedish National Food Agency's recommendation to eat seafood 2-3 times per week (European Commission, 2025).

If the suggested goal for Swedish aquatic production is achieved (scenario 3), consumption would increase (assuming no substitution of imports) to 274 thousand tonnes, equivalent to 26 kilos of live weight per person (assuming the population does not change). This would increase consumption to approximately 1.7 portions per person and per week (assuming we need 300 g per portion), which is still well below the Nordic nutrient recommendations for aquatic foods.

The fourth scenario reduces imports by approximately 50 percent if a crisis prevents imports from countries outside the Nordic region. This would decrease consumption to an estimated per capita intake of 11 kilos in live weight equivalents, representing a sharp decline and moving further away from the Nordic nutritional recommendations. It would also imply that the average Swede would only consume 0.7 portions of fish per week.

The fifth scenario assumes that Swedish production can offset the decline in imports, allowing consumption to remain at the level of the reference scenario. Production would need to increase by 130 percent, which is significantly higher than the 60 percent target proposed by the Board of Agriculture. Assuming it is difficult to increase catches from sea fisheries, this increase would have to come from two sources. One possibility is to use herring (or possibly sprat) currently allocated to feed production, but the majority of the increase would most likely have to come from aquaculture production.

Summary

The aquatic food sector in Sweden is small in economic terms. In 2023, the sector accounted for approximately 0.06 percent of GDP and comprised around 1,500 firms and 2,000 employees. Primary production is dominated by pelagic fisheries—especially herring and sprat—which together account for more than 80 percent of

16. Svensk Fisk (2005) ("Swedish Fish") estimate that 300 g of fresh fish is needed for a portion. This could of course depend on the type of species.

total catch volume. However, most pelagic fish are used for feed rather than human consumption. Aquaculture contributes a relatively small share of total volume but accounts for more than one-third of total production value, with rainbow trout as the dominant species.

Sweden's domestic production of aquatic food intended for human consumption in 2023 is estimated at approximately 56 thousand tonnes (live weight equivalents), including sea fisheries, aquaculture, inland fisheries, and retained recreational catches. Despite this production, Sweden is highly dependent on imports. Total imports of aquatic food amounted to roughly 250 thousand tonnes, while exports were about 66 thousand tonnes. As a result, domestic production covered only about 23 percent of total consumption. Per capita consumption was roughly 1.6 portions of aquatic foods per person per week, well below Nordic nutritional recommendations.

The sector operates under the EU Common Fisheries Policy, and several key fish stocks—most notably Baltic herring and cod—are below biological reference points, limiting the potential for increased capture fisheries. Recent policy developments include changes to trawling regulations, proposals for new marine spatial plans, and an increased emphasis on aquatic food within Sweden's national food strategy. The Swedish Board of Agriculture has proposed increasing aquatic food production by 60 percent by 2035, primarily through greater use of pelagic fish for human consumption and expanded aquaculture.

Scenario analyses indicate that while higher domestic production could moderately improve self-sufficiency, Sweden would remain heavily reliant on imports under normal conditions. In the event of trade restrictions limiting imports to Nordic countries only, consumption would decline substantially unless domestic production increased far beyond the suggested policy targets. Overall, increasing the self-sufficiency of aquatic food in Sweden will likely require significant expansion of aquaculture alongside careful management of marine ecosystems and competing uses of marine space.

6. Finland

Introduction

The Finnish seafood sector consists of around 217 aquaculture enterprises, approximately 2,100 marine commercial fishers, and nearly 1,700 inland fishers. The fish processing industry includes around 116 firms and 50 wholesale companies, though the sector remains small compared with other Nordic countries.

Fisheries account for only a very small share of the Finnish economy, representing 0.1% of the national gross domestic product (FAO, n.d.). Finland's entire coastline borders the Baltic Sea, a brackish and environmentally vulnerable marine system characterized by low salinity and reduced biodiversity compared with fully marine environments (Pettersen et al., 2025). Finnish fisheries encompass both marine and inland fishing as well as aquaculture, and the country also has a substantial recreational fishing sector.

While fisheries represent a minor share of Finland's national economy, they hold greater economic significance in Åland. The autonomous archipelago, consisting of around 6,500 islands, has a strong maritime identity closely tied to the blue economy. Although the sector may appear small in scale, both capture fisheries and aquaculture are important local industries, with aquaculture alone contributing an estimated 2–3% of Åland's GDP (Pettersen et al., 2025).

In the dataset used for the following analyses, figures for Finland and Åland are reported together and will therefore be treated as a single unit. In total, 5,084 people were employed in commercial fishing and fish production (primary sector) in 2023 (Luke, 2026).

Primary production

Finland's aquatic food production is based on both capture fisheries and aquaculture, supplemented by a substantial recreational fishing sector. Capture fisheries include marine fishing in the Baltic Sea and commercial inland fisheries, with pelagic species—particularly Baltic herring and sprat—dominating marine landings, while vendace and other freshwater species are most important in inland fisheries. Aquaculture production is small in volume compared with capture fisheries, but is economically significant and dominated by rainbow trout, produced mainly in sea and brackish waters, with a smaller share from freshwater farms. The following sections describe recent trends in catches and farmed production and distinguish between raw material used for human consumption and for reduction (meal and oil).

Capture fishery

There is a substantial recreational fishery, but where figures are collected only every even year. For the relevant year 2023, there are no estimated figures.

For recreational fishing, perch and pike are the most important species. In 2022, they made up over half of the total recreational catch.

Table 6.1: Commercial and recreational fishing in Finland in 2023. Tonnes. Source: Luke, 2026

Type of fishery	2019	2020	2021	2022	2023
commercial	141,526	117,659	102,375	91,798	94,456
recreational		31,291		34,062	
Total (tonnes)	141,526	148,950	102,375	125,860	94,456

Most of the commercial catch by Finnish fishermen is landed in Finland, but some is also landed in Estonian and Swedish ports. In recent years, there have been no landings by foreign vessels in Finland (personal correspondence with Luke, Finland).

Table 6.2: Commercial marine catch by Finnish fishermen in 2023, share of total. Source: personal correspondence with Luke representatives, January 2026.

Landing country	Baltic herring	Sprat
Finland	78%	40%
Estonia	13%	47%
Sweden	9%	13%

Table 6.3 presents total landings by Finnish vessels, including those by Finnish commercial fishers in Finland and abroad. In commercial marine fishing, Baltic herring and sprat made up 94% of the total marine catch in 2023. In inland commercial fishing, vendace is the most important species. Other significant species include pikeperch, perch, and crayfish.

Of the total catch of 94,456 tonnes in 2023, about 70,368 tonnes were landed at Finnish ports. The data do not indicate the share of fish intended for human consumption or reduction, but according to Setälä et al. (2024), more than half of the total herring catch ends up in fish meal production, either in Finland or abroad. This high share going to fishmeal and fish oil is partly since much of the herring in recent years has been too small for the food-grade processing industry. Only 5–25% of herring landings have met the required quality standards for human consumption, meaning that the remainder is largely directed to feed production (Setälä et al, 2024).

Luke has estimated that 18,634 tonnes of domestic Baltic herring and sprat were processed for human consumption in 2023. This implies that of the total domestic landings of 59,969 tonnes of Baltic herring and sprat 41,333 tonnes are available for meal and oil domestically. This implies that only 29,035 tonnes of the domestic catch in 2023 was intended for human consumption.

Table 6.3: Total commercial catch by Finnish commercial fishers, per species and species group. Source: Luke, 2026

Specie	2019	2020	2021	2022	2023
Pelagic	134,952	111,326	96,702	86,454	88,812
Baltic herring total	112,722	92,481	76,726	68,176	69,330
Landed domestically					54,077
Sprat total	16,080	12,502	14,774	13,487	14,725
Landed domestically					5,890
Other	6,150	6,343	5,202	4,791	4,757
Other	6,159	6,066	5,402	5,131	5,469
Perch	1,036	964	1,007	1,177	1,198
Roach, smelt, and other fish	1,565	1,159	1,021	895	1,102
Bream	824	952	815	877	909
Other	2,734	2,991	2,559	2,182	2,260
Salmonidae	274	236	233	181	146
Demersal and flatfish	141	31	38	32	29
Total catch	141,526	117,659	102,375	91,798	94,456
Total catch landed domestically					70,368
For reduction					41,333
For human consumption					29,035

Aquaculture production

In aquaculture, rainbow trout is the main species. It accounted for around 95% of all farmed food fish in 2023. Smaller amounts of European whitefish are also produced. About 78% of Finnish aquaculture production occurred in sea and brackish waters, and 21% in freshwater in 2023.

In Finland, the most important cultured species is rainbow trout raised in sea cages (Paisly et al., 2010).

Table 6.4: Finnish aquaculture production, tonnes. Source: Luke, 2026

In total, about 44 205 tonnes of the Finnish primary production in 2023 were available for human consumption.

Specie	2019	2020	2021	2022	2023
Aquaculture	15,300	15,050	14,400	16,280	15,170
Rainbow trout	14,200	14,290	13,550	15,250	14,430
European whitefish	790	580	690	800	660

Regulation and management

Finland's Fishing Act requires that fish stocks be kept in good condition and used in an ecologically, economically, and socially sustainable way. Multi-year management plans support healthy fish populations, allow natural life cycles, and protect the biodiversity of aquatic ecosystems.

Finland also uses various strategies and programs to support recreational and commercial fishing and to manage fishing waters. These initiatives identify key challenges and outline measures to reach desired outcomes. Species-specific strategies address the unique needs of each population and help Finland meet both national and international obligations.

The regulation of fisheries and aquaculture in Finland is shaped by a combination of national legislation and EU-level frameworks, notably the Finnish Fishing Act and the EU Common Fisheries Policy; Finland also complements EU provisions with national measures where relevant (Ministry of Agriculture and Forestry of Finland, n.d.). The Ministry of Agriculture and Forestry is responsible for overall fisheries administration, while regional implementation is carried out by the ELY Centres (Centres for Economic Development, Transport and the Environment). These centres manage tasks such as registering commercial fishers, administering Finland's share of EU catch quotas, and participating in monitoring and enforcement activities. Although the national Fishing Act (kalastuslaki) forms the core of domestic fisheries legislation, commercial fishing in marine areas is largely governed by the EU's Common Fisheries Policy, which sets species-specific quotas for herring, sprat, and salmon based on ICES scientific advice.

Commercial species that are subject to quotas are Baltic Sea salmon, cod, Baltic herring, sprat, and plaice (The Pro Fish Association, 2023)

The EU manages Baltic fisheries through science-based catch limits and regulations set under the Common Fisheries Policy, with advice from ICES and other expert bodies and final decisions by EU institutions. Herring and sprat are now the main, well-managed stocks, while cod has collapsed and is only allowed as bycatch. Differences in stock areas and quotas mean management and fishing patterns vary across the Baltic Sea (FAO, n.d.)

Finland has many inland waters suitable for commercial fishing, but private ownership and regulatory requirements can make access difficult for fishermen. Even so, inland fisheries have grown and now account for about 5% of the country's total commercial catch, a higher share than in many other coastal countries (FAO, n.d.)

In 2026, the status of the main commercially important fish stocks in Finnish waters of the Baltic Sea was evaluated against fishing mortality and biomass reference points under the maximum sustainable yield (MSY) framework. As shown in Table 6.5, fishing pressure is assessed relative to FMSY and stock size relative to the MSY biomass trigger (MSY Btrigger). Green indicates stocks with fishing mortality at or below FMSY and spawning-stock biomass above MSY Btrigger, while red indicates stocks that are either subject to fishing pressure above FMSY or have biomass below the trigger level. "Not defined" denotes stocks for which MSY reference points are not available and which are assessed using alternative precautionary or stock-specific reference points.

Among the assessed stocks, plaice in subdivisions 21–32 is in good status with both fishing pressure and stock size above MSY reference levels. Sprat is characterized by fishing pressure above FMSY but with biomass above MSY Btrigger, while central Baltic herring shows fishing pressure below FMSY but stock size still below the MSY trigger. Eastern Baltic cod remains in a depleted state, with spawning-stock biomass below safe biological limits and no defined MSY fishing mortality reference point. Baltic salmon in the Gulf of Finland is assessed under a precautionary, river-based framework rather than MSY, and is therefore not classified relative to FMSY or MSY Btrigger.

The Natural Resources Institute Finland (LUKE) monitors herring and sprat stocks annually using sonar surveys and catch samples. Coastal species such as pike-perch, whitefish, and perch are assessed from catches, with full stock assessments mainly for pike-perch in the Archipelago Sea. Salmon and sea trout stocks are monitored in rivers through surveys of spawning adults and juvenile densities (SYKE, n.d.)

Table 6.5: Status of main stocks for Finnish fisheries: stock status and fishing pressure. Source: ICES (2025a, 2025g, 2025j, 2025m, 2025n)

Species/stock	Fishing pressure	Stock size
	$F \leq F_{MSY}$	$SSB \geq MSY$ Btrigger
Eastern Baltic cod (SD 24–32)	Not defined	Not good
Central Baltic herring (her.27.25-2932)	Good	Not good
Sprat in subdivisions 22–32 (Baltic Sea)	Not good	Good
Plaice in subdivisions 21–32	Good	Good
Baltic salmon	Not defined	Not defined

Aquaculture in Finland is regulated through a strict permitting system. Production facilities require an environmental permit under the Environmental Protection Act if they use more than 2,000 kg of feed per year, with permit applications processed by the Regional State Administrative Agencies (AVI). Additional requirements may include a Water Act permit, and large-scale marine installations with an annual growth of at least one million kilograms are subject to a mandatory Environmental Impact Assessment (EIA). The tight regulatory framework is a key reason why aquaculture production remains lower today than in the early 1990s (Setälä et al., 2024).

Finland's Aquaculture Strategy aims to strengthen the sector's competitiveness while ensuring ecological, economic, and social sustainability. It seeks sustainable growth, including raising Mainland production to 20 million kilos and over €100 million in value, all within strict environmental limits (Ministry of Agriculture and Forestry of Finland, 2022).

Finnish aquaculture occurs both along the coast and in continental areas (inland freshwater systems). These include the brackish coasts of the Gulf of Finland, the Gulf of Bothnia, the Archipelago, and the Åland Islands (Paisly et al., 2010).

Åland regulates its own fisheries and aquaculture under the autonomy granted by the Åland Self-Government Act. As a result, most national development measures apply only to mainland Finland, while Åland's Government makes its own decisions on fisheries management. Åland also receives a designated share of Finland's EU fishing quotas and administers these independently. The region plays a major role in Finnish aquaculture. Although fisheries governance is autonomous, Åland participates in national coordination during crises, and preparedness in exceptional circumstances may fall under central government legislation. (Setälä et al., 2024)

Although Åland has autonomous competence over fisheries management and administers its own share of Finland's EU fishing quotas, the biological stock assessments and MSY reference points used in this study are those provided by ICES for the relevant Baltic Sea stock areas, which apply equally to waters around Åland and mainland Finland.

Tourist fishing is also regulated: There exists a fisheries management fee for all fishers (aged 18–69) in Finland, which gives the right to fish with one rod anywhere in Finland. There are exceptions; 1) fishing is prohibited in waters containing migratory fish, prohibited areas, and the Åland Islands, 2) there are no fees for angling with a hook and line, ice-fishing, or herring fishing with a rig, 3) the fisher needs a permit from the owner of the water when trolling with multiple rods, trap fishing, or crayfishing (Fishing in Finland, n.d.).

Processing and Value Chain Overview: Finland

Figure 6.1 provides an overview of how fishery and aquaculture products move through the Finnish seafood value chain. It illustrates the main pathways for domestic catches and aquaculture production, as well as imports, through processing and wholesale channels, before reaching different end markets such as retail, fishmongers, open markets, direct sales, food service (HO.RE.CA), and exports.

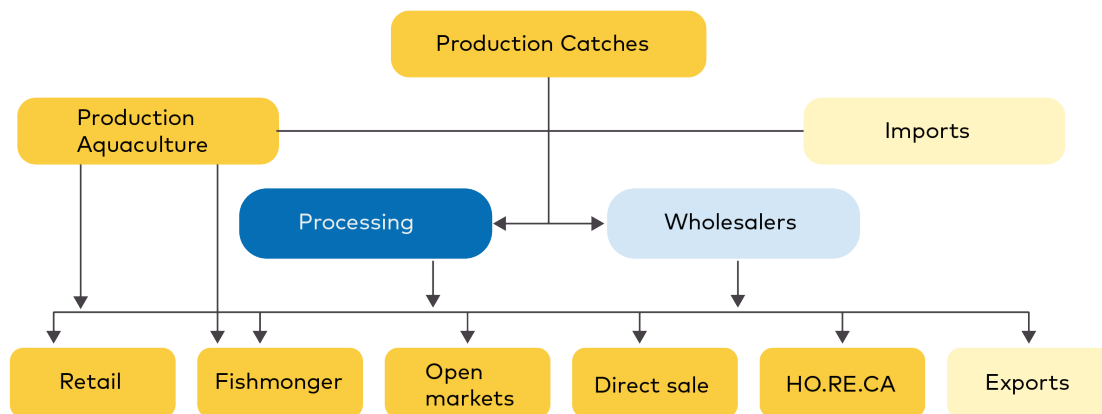
The Finnish fish processing sector is highly concentrated, with the ten largest companies generating 88% of the sector's total processing turnover and 85% of wholesale turnover, while concentration levels in primary production remain below 60%. Moreover, just five firms account for roughly half of Finland's combined fish processing and wholesale revenues, illustrating the structural dominance of a small number of large actors. These leading companies are distributed across different regions of the country rather than clustered in a single area, reflecting a geographically dispersed but commercially consolidated industry landscape (Setälä et al., 2024).

There were 116 fish processing enterprises in Finland in 2023 (Luke, 2026). Most of these were small- and medium-sized enterprises, but the largest companies accounted for the majority of products. Fish is also partially processed by wholesale companies that mediate its trade; there were 50 such wholesalers (Valve et al., 2022).

Finnish processors produced 55 605 tonnes of fish. More than half of this (57%) is domestic fish. The most important species in 2023 was Baltic herring (18,997 tonnes), where 98% was domestic. Imported salmon is the second-most-important raw material for fish processing (17,290 tonnes). Most of this salmon comes from Norway. Rainbow trout is the third most important species in Finnish fish processing, with 13,827 tonnes in 2023, of which 65% were domestic fish. Most of the imported trout is from Sweden.

Fish processing companies employed 975 people and fish wholesalers 503 people in Finland in 2020 (Valve et al., 2022).

Figure 6.1: The supply chain for fisheries and aquaculture products in Finland.
Source: EUMOFA (2026)



In 2023, the fishing fleet of Finland was 3,238 vessels, with a capacity of 15,096 gross tonnage. Most of the fleet is in the 0–11 m segment (98.2%). And nearly 75% use nets, followed by traps 22% (EUMOFA, 2026).

Finnish marine catches take place in the Bothnian Sea (68%), the Archipelago (17%), and the Gulf of Finland (9%). In addition, smaller quantities are caught in areas such as the East of Gotland and the Bothnian Bay (Luke, 2026).

The regions in catch statistics are defined by the residence of the fisherman or enterprise. Some Finnish fishers will also land their fish in other regions and abroad. However, it should not be unreasonable to assume a certain correlation between fishers residence and quantities. Thus, commercial fishing in Finland seems to be strongly concentrated in a few coastal regions. Marine fisheries dominate, with the largest catches taken in Southwest Finland (35,374 tonnes), followed by Åland (9,149 tonnes), Ostrobothnia (14,095 tonnes), North Ostrobothnia (13,088 tonnes), and Satakunta (10,400 tonnes). These regions account for nearly all marine landings. Inland commercial fishing is much smaller in scale and is most significant in South Savo, Lapland, North Karelia, North Savo, Kainuu, and Uusimaa, though each contributes under 1,000 tonnes.

The number of aquaculture facilities and professional fishermen shows a similar regional divide. Marine fish farms are heavily concentrated in Southwest Finland and Åland, which together account for most active marine farms. Inland regions such as Kainuu, South Savo, North Savo, and Lapland host many natural food pond farmers, reflecting the strong role of traditional pond-based rearing and juvenile production rather than large-scale commercial harvests. This explains why several inland areas have a relatively high number of registered aquaculture operators despite reporting little or no production volume.

Table 6.6: Farming and catch (tonnes) per region in 2023. Source: Luke, 2026

Regions	Farming		Commercial fishing		Total
	Inland	Marine	Inland	Marine	
Southwest Finland			1	35,374	35,375
Åland		5,970		9,149	15,119
Ostrobothnia		788	16	14,095	14,899
North Ostrobothnia			317	13,088	13,405
Satakunta			573	10,400	10,973
Uusimaa			199	7,265	7,464
Varsinais-Suomi		4,143			4,143
Not specified	1,746	890			2,636
Kainuu	1,075		220		1,295
South Savo			970		970
Lapland	407		339	54	800
North Karelia			503		503
North Savo			473		473
South Karelia			318		318
Päijät-Häme			295		295
Pirkanmaa			213		213
Central Finland			209		209
South Ostrobothnia			100	87	187
Southeastern Finland		150			150
Kanta-Häme			122		122
Kymenlaakso			7	60	67
Central Ostrobothnia			6		6
Total	3,228	11,941	4,881	89,572	109,622

According to Luke (2026) 217 fish farming enterprises operated in Finland in 2023 (covering both sea and inland areas). In 2023, Finland had 143 fish farms and 133 natural-food-pond farmers (LUKE, 2026)^[17]. These figures represent the number of farms engaged in each production line, and the categories are not additive because some enterprises may operate in more than one production type.

Marine fishers are most numerous in Ostrobothnia, North Ostrobothnia, Satakunta, Southwest Finland, and Åland, where the main commercial marine fisheries operate along the Bothnian Bay and the Archipelago Sea. Inland fishers, on the other hand, are concentrated in Lapland, North Karelia, South Savo, and North Savo, all of which have extensive lake systems and long-standing freshwater fishing traditions. Overall, these patterns highlight a clear structural divide: the coast supports large commercial fisheries and marine aquaculture, while inland regions are dominated by small-scale pond farming and freshwater fishing activities.

17. In addition, there are 106 Fry farms.

Table 6.7: Fish farms and fishers per region in 2023. Source: Luke, 2026.

Region	Fish farms		Fishermen	
	Food fish farms	Natural food pond farms	Marine	Inland
Central Ostrobothnia	0	0	112	12
Kymenlaakso	0	0	90	11
Lapland	9	6	66	219
North Ostrobothnia	0	0	495	158
Ostrobothnia	11	6	540	45
Satakunta	0	0	168	74
Southeastern Finland	3	10	0	
Southwest Finland	51	8	280	26
Uusimaa	3	3	149	48
Åland	25	0	206	
Central Finland	5	28	2	117
Kainuu	23	21	1	128
Kanta-Häme	1	8	3	21
North Karelia	4	4	3	240
North Savo	5	15	2	146
Pirkanmaa	0	0	2	115
Päijät-Häme	0	0	2	64
South Karelia	0	0	4	73
South Ostrobothnia	0	0	5	41
South Savo	3	24	3	171
Total	143	133	2133	1709

Processing

While nearly all deep-frozen, ungutted products are based on Baltic herring and sprat, most other end-products, such as fresh and frozen filets, smoked products, and ready-to-eat products, are based on salmon and rainbow trout.

Most Finnish caught Baltic herring, and sprat are too small for filleting, with only 5–25% of herring landings meeting food-grade requirements, meaning that domestic consumer-oriented fish processing depends heavily on imported fish rather than domestic pelagic species (Setälä et al, 2024)

Table 6.8: End-products in Finnish fish processing, by species in 2023. Source: Luke, 2026.

End-product (and species)	Tonnes (raw material)	Share of total
Fresh - fillet	21,388	38%
Salmon	13,637	
Rainbow trout	4,915	
Baltic herring and sprat	1,238	
Other	1,598	
Deep frozen - ungutted	16,615	30%
Baltic herring and sprat	16,511	
Other	104	
Smoked	5,677	10%
Rainbow trout	3,428	
Salmon	1,582	
Other	667	
Deep frozen - other	2,263	4%
Rainbow trout	1,953	
Other	310	
Deep frozen - fillet	2,107	4%
Rainbow trout	1,207	
Other	900	
Other	1,619	3%
Salmon	490	
Other	1,129	
Cold smoked	1,599	3%
Rainbow trout	1,193	
Other	406	
Ready-to-eat food	983	2%
Salmon	267	
Baltic herring and sprat	267	
Other	449	
Salted / Slightly salted	948	2%
Preserve	911	2%
Fresh - other	854	2%
Semipreserve	643	1%
Total	107,858	100%

Meal and oil

Finland's fish processing sector is characterized by strategic domestic production of fish meal and oil, primarily in specialized facilities at Kasnäs and Kaskinen (Setälä et al., 2024). This industry leverages the Baltic Sea's significant pelagic resources to enhance the national security of supply. Approximately 80% of the sprat and more than one-third of the herring caught by Finnish vessels were directed toward fish meal production in 2023 (Setälä et al., 2024). Of the total supply of Herring in Finland, about 22,600 tonnes are estimated to be available for domestic meal and

oil production (Luke, 2024). This localized processing infrastructure is critical because it enables the extraction of environmental toxins, such as dioxins, providing a safer domestic source of marine proteins and fats. Consequently, Finland has achieved a notable level of self-sufficiency in raw materials; more than 60% of raw materials are of domestic origin (Setälä et al., 2024).

The domestic fish feed industry competes with other producers of fish and livestock feed for raw materials. In 2021, nearly 1,450 million kilograms of feed for other production animals and about 17 million kilograms of pet food were needed in Finland (Setälä et al, 2024).

However, despite this robust domestic base for marine ingredients, the broader Finnish aquaculture industry remains heavily dependent on imports from the Nordic region and global markets. While Finland possesses significant production capacity, nearly half of the finished fish feed used in domestic fish farming is currently imported, with Denmark serving as the primary supplier. Furthermore, specialized start feed for fry weighing less than one gram is not produced within Finland, necessitating total reliance on imports for early-stage development. Even for feed manufactured domestically, the supply chain is vulnerable to global disruptions; essential additives such as vitamins and amino acids are largely sourced from Asian markets.

Trade flows of Aquatic food: Finland

Imports for human consumption

Finnish imports of aquatic food for human consumption are more than twice their own production. Fresh whole salmon from Norway accounts for nearly half of the imports in 2023. Salmon is also the most consumed species in Finland. Prepared herring is primarily sourced from Sweden (62%), followed by Denmark, Poland, and Norway. Sweden is also the largest supplier of fresh, whole trout to Finland. Other prepared species are sourced from a wide variety of countries, both Nordic (mainly Sweden with 19%), European (such as Germany, Spain, and Estonia), and overseas markets such as Thailand (11%) and Mauritius (7%). Tunas are the dominating species in this category (44%), followed by undefined species (32%), prawns, and whitefish species. Europe is the primary source of imports, accounting for 90%, of which 66% are from Nordic countries. Imports from Asia accounted for 6% in 2023.

Table 6.9: Imports for human consumption in 2023. Source: NSC/Eurostat, 2025

Products and species	Quantity (Tonnes live weight)		Value (1000 EURO)	
	Import total	Import Nordic	Import total	Import Nordic
Herring	4,363	3,463	13,099	10,771
Fresh whole/live	377	34	446	165
Frozen whole	21	20	108	94
Fillet	555	403	1 275	942
Prepared	3,254	2,889	10,897	9,315
Other	155	117	374	256
Salmon	51,533	49,837	339,678	329,364
Fresh whole/live	43,947	43,947	287,660	287,660
Frozen whole	95	92	128	114
Fillet	6,216	4,984	42,794	36,037
Prepared	250	194	1,568	1,205
Other	1,025	620	7,528	4,349
Trout	7,480	7,141	39,916	37,998
Fresh whole/live	6,457	6,426	34,605	34,399
Frozen whole	517	515	2,607	2,596
Fillet	37	3	211	28
Other	469	197	2,493	975
Sprat	587	238	2,545	1,187
Fresh whole/live	12		254	
Frozen whole	4		11	
Prepared	571	238	2,279	1,187
Other	46,327	12,642	163,855	59,185
Fresh whole/live	492	238	4,056	2,074
Frozen whole	3,814	1,190	22,010	8,297
Fillet	6,551	1,200	17,455	3,897
Prepared	33,022	8,794	103,069	36,161
Other	2,448	1,220	17,266	8,755
Total	110,290	73,321	559,094	438,504
Fresh whole/live	51,285	50,645	327,021	324,297
Frozen whole	4,452	1,817	24,864	11,101
Fillet	13,359	6,591	61,735	40,904
Prepared	37,097	12,114	117,813	47,867
Other	4,097	2,154	27,661	14,335

Imports of Marine Ingredients and Feed

Finland is self-sufficient in raw materials for its own fishmeal production, but imports other raw materials. The import dependency is 40% (Setälä et al., 2024). In addition, there are imports of products such as meal and oil for feed, where the majority (80%) comes from other Nordic countries (Norway (54%), Denmark (21%), and Sweden (5%). In addition, 15% comes from Estonia. When considering all the feed used in Finnish aquaculture, about half of the finished feed is imported (Setälä et al., 2024).

Table 6.10: Imports of marine ingredients and feed in 2023: Source: NSC/Eurostat (2025), and Luke (2026).

1. Other contains other fish for human consumption, such as fish liver oils and fish meal, and other fish not for human consumption.

Product categories	Quantity (tonnes product weight)		Value (1000 EURO)	
	Import total	Import Nordic	Import total	Import Nordic
Animal feed	57	52	407	29
Fish fats and oils	913	426	4,095	1,629
Fish meal	1,057	942	2,186	1,975
Fish waste	1,571	1,571	365	362
Other ¹	296	140	1,986	1,228
Total	3,894	3,131	9,039	5,223

Exports for human consumption

Excluding fish meal exports, the most important product in Finnish exports is fresh, whole salmon. This originates mainly from Norway and is to be considered re-exports to other European countries, such as Poland, the Netherlands, France, Lithuania, and Spain, among others, as well as some exports to Sweden. The second most important product in Finnish exports for human consumption is fresh, whole trout, of which about two-thirds is destined for Estonia and Lithuania. In 2023, 93% of exports for human consumption were destined for European countries, of which 7% for other Nordic countries.

Table 6.11: Export for human consumption in 2023. Source: NSC/Eurostat (2025).

Products and species	Quantity (Tonnes live weight)		Value (1000 EURO)	
	Export total	Export Nordic	Export total	Export total
Herring	11,006	0	7,351	4
Fresh whole/live	-			
Frozen whole	10,960		7,141	
Fillet	20	-	23	-
Prepared	26	0	187	4
Salmon	29,881	2,379	186,686	16,852
Fresh whole/live	28,869	1,572	178,667	10,803
Frozen whole	-	-	-	-
Fillet	677	588	5,071	4,334
Prepared	18	12	223	173
Other	318	206	2 725	1 542
Trout	3,213	494	18,005	2,810
Fresh whole/live	2,937	315	16,556	1,966
Frozen whole	79	22	448	97
Fillet	12	-	43	-
Other	184	158	958	747
Sprat	269	-	203	-
Fresh whole/live				
Frozen whole	267	-	192	-
Prepared	2	-	11	-
Other	1,397	287	19,378	3,324
Fresh whole/live	137	5	1 170	83
Frozen whole	821	66	733	26
Fillet	101	84	562	493
Prepared	145	13	3,416	194
Other	194	120	13,497	3,834
Total	45,767	3,160	231,623	24,295
Fresh whole/live	31,943	1,892	196,392	12,852
Frozen whole	12,127	87	8,515	123
Fillet	810	672	5,699	4,826
Prepared	191	26	3,837	372
Other	696	484	17,180	6,123

Exports of Marine Ingredients and Feed

Finland is a net exporter of feed products. While they in 2023 imported 3598 fish meal and/or oil, or other animal feed, they exported 8 417 tonnes of the same products. The main markets are Denmark (42%) and Estonia (25%).

A substantial part of the exported Herring and sprat is for reduction; however, the exact quantity is not known. Finnish trawlers land their catches directly in ports in Sweden and Estonia, from where the fish is transported to fishmeal factories in those countries or in Denmark. In addition, herring is frozen in Finland and exported as raw material for fishmeal and furanimal feed production in Denmark (Setälä et al., 2024). Thus, to estimate the share of exports of fresh and frozen whole Herring and Sprat for meal and oil, the destination market is considered; all exports to Sweden, Estonia, and Denmark are assumed to be for meal and oil, while the remaining is assumed to be destined for consumption.

Table 6.12: Exports of marine ingredients for feed in 2023. Source: NSC/Eurostat (2025), and Luke (2026).

Product categories	Quantity (tonnes product weight)		Value (1000 EURO)	
	Export total	Export Nordic	Export total	Export Nordic
Fresh whole Herring and Sprat	27,002	4,483	10,002	1,713
Frozen whole Herring	5,282	938	2,235	346
Animal feed	629		303	
Fish fats and oils	1,582	986	7,251	5,033
Fish meal	2,803	1,559	5,376	2,923
Fish waste	3,403	1,027	1,694	515
Other	36	3	293	75
Total	40,737	8,996	27,155	10,604

Aquatic food available for consumption in Finland

By adding imports to primary production and subtracting exports, the total availability of aquatic food for human consumption in Finland in 2023 is estimated at 108,756 tonnes. This corresponds to approximately 19 kilograms per capita per year.

Luke estimates fish consumption per capita and finds that in Finland in 2023, it was 11.9 kg/capita/year (Luke, 2026). FAO's apparent consumption figure is substantially higher, with 31.49 kg/capita/year (FAO, 2026). However, these consumption figures are not fully comparable because domestic fish is

reported mainly in filleted weight, while FAO uses live weight. In addition, domestic supply also includes recreational fishing (Luke, 2015). In 2023, nearly one-fifth of per capita consumption was from recreational fishing (Luke, 2026).

Table 6.13: Available for consumption in Finland in 2023, total and a selection of species. Tonnes, live weight. Source: own estimations based on Luke (2026) and NSC/Eurostat (2025).

	Primary production	Imports	Exports	Export share	Available for consumption
Total quantities (tonnes)	44,205	110,318	45,767	30%	108,756
Herring and Sprat	18,634	556	11,275	59%	7,915
Trout	14,430	7,480	3,213	15%	18,697
Other	11,141	102,282	31,279	28%	82,144
Quantities per capita (kg)	8	20	8		19
Herring and Sprat	3	0	2		1
Trout	3	1	1		3
Other	2	18	6		15

Currently, most domestic herring and sprat are too small for the industrial fillet lines. Expanding domestic herring canning capabilities is identified as a key opportunity to improve long-term storage and accessibility (Setälä et al., 2024).

When looking at what could be available for consumption, including all catches of Baltic herring and Sprat currently used in fish meal production, we find that the available fish reaches 31 kg/capita/year, which is also more in line with the above-mentioned FAO figures.

Table 6.14: Potentially available for consumption in Finland in 2023, total and a selection of species. Tonnes, live weight. Source: own estimations based on Luke (2026) and NSC/Eurostat (2025).

	Primary production	Imports	Exports	Export share	Available for consumption
Total quantities (tonnes)	109,626	110,318	45,767	21%	174,177
Herring and Sprat	84,055	556	11,275	13%	73,336
Trout	14,430	7,480	3,213	15%	18,697
Other	11,141	102,282	31,279	28%	82,144
Quantities per capita (kg/year)	19	20	8		31
Herring and Sprat	15	0	2	0	13
Trout	3	1	1	0	3
Other	2	18	6	0	15

Challenges, threats, and opportunities

This chapter summarizes the main challenges, threats, and opportunities currently facing Finland's fisheries and aquaculture sectors.

Climate change is significantly altering the Baltic Sea ecosystem, with rising water temperatures and a marked decrease in sea ice cover. For the fishing industry, this has already contributed to an extended trawl fishing season in northern areas, alongside shifts in species composition toward warm-water-associated species. For example, sprat shows higher recruitment following mild winters with little ice. At the same time, these changes pose risks to ice-dependent species such as the ringed seal, as well as cold-adapted fish species whose reproduction is negatively affected by warming conditions. Given the cumulative pressures in the Baltic Sea, including warming, eutrophication, and shifting species distributions, future sustainability will require adaptive management approaches to maintain resilient fish stocks and marine ecosystems (HELCOM, 2024).

The Finnish wild catch and aquaculture sectors face significant structural and environmental hurdles that limit their growth and resilience. Commercial fishing is constrained by an aging trawler fleet with an average age exceeding 30 years and by EU regulations that prohibit investment support for fleet modernization. Furthermore, coastal and inland fishing are severely impacted by increasing populations of seals and cormorants, which damage gear and reduce catch volumes, contributing to a decline in the number of active fishers. In aquaculture, strict environmental permit systems related to the eutrophication of the Baltic Sea remain the primary barrier to expansion, keeping production levels significantly lower than in the early 1990s (Setälä et al., 2024)

Although climate change presents considerable risks to the Baltic Sea, it also creates certain opportunities. Reduced ice cover extends the operational fishing season in northern areas, while shifting species distributions may increase the availability of warm-water-associated pelagic species, such as sprat, which show stronger recruitment in mild, low-ice winters. At the same time, successful nutrient reduction measures could improve oxygen conditions and strengthen ecosystem resilience, offering more stable conditions for both fisheries and aquaculture. Longer ice-free periods also expand the potential for recreational fishing and coastal tourism, while advances in processing technologies may enable greater use of underutilized domestic pelagic resources for human consumption, supporting Finland's long-term goals for self-sufficiency and food security (HELCOM, 2024).

Additionally, the industry is vulnerable to biological threats, such as fish diseases, where a lack of domestic vaccine production creates a critical dependency on international suppliers.

The seafood processing industry and the broader supply chain exhibit deep strategic vulnerabilities due to high market concentration and a heavy reliance on imports. Currently, the ten largest companies control 88% of the processing turnover, making the national supply chain highly sensitive to the stability of a few major actors.

Despite significant domestic landings of herring and sprat, the processing sector remains dependent on imported raw materials, primarily Norwegian salmon, because a large portion of the domestic catch is too small for modern filleting lines, with only 5–25% of herring landings meeting food-grade requirements (Setälä et al, 2024). Security of supply is further compromised by a reliance on global markets for critical inputs, including fish feed components (often sourced from Denmark), vaccines, and specialized technological equipment from Asia and other Nordic countries (Setälä et al, 2024). This dependency, combined with high sensitivity to energy price volatility and international logistical disruptions (Setälä et al, 2024), underscores the fragility of Finland's current seafood self-sufficiency.

There is a significant potential to enhance Finland's food security by optimizing the use of domestic pelagic species. The sources highlight that Baltic herring, Finland's most important fish resource, could be utilized for human consumption to a much greater extent than it is today. Currently, a vast majority of the herring and sprat catch is diverted to animal feed, but in crisis situations, these raw materials could be strategically redirected to the national food supply. Furthermore, Finnish waters contain abundant underutilized stocks—including sprat, smelt, and cyprinids such as roach and bream—that are ecologically sustainable and nutritionally valuable, offering a decentralized reserve of animal protein that remains largely untapped by the commercial food industry.

Although much of the recent herring catch has been too small for traditional filleting lines, the development of new processing methods and an efficient domestic canning line for underutilized species provides a foundation for future growth (Setälä et al., 2024).

Setälä et al. (2024) provide a comprehensive assessment of vulnerabilities and development opportunities in Finland's seafood sector and is recommended as a read for further information on the topic.

7. Greenland

Introduction

With Greenland spread over a very large area and long distances between cities, fishing takes place across a vast area. Since 95% of the population inhabits West Greenland from Upernavik to Nanortalik, most fishing occurs in Davis Strait and Baffin Bay, but it also occurs in East Greenland waters. Commercial fishing is largely absent north and northeast of Greenland due to sea ice for most of the year and the lack of settlement in these areas. Fishing takes place both in coastal areas with smaller vessels and in offshore waters with large trawlers equipped with onboard processing. Fishing in the Greenlandic zone is also conducted by foreign vessels under fishing agreements with the EU, Norway, the Faroe Islands, and Iceland. Foreign vessels typically don't land their production in Greenland. Moreover, Greenlandic vessels fish in Norwegian, Faroese, and Icelandic zones following these agreements.

While smaller coastal vessels land all their catches in Greenland, large offshore shrimp trawlers have processing onboard. These vessels process sea-cooked whole shrimp, cooked and finally packed onboard and directly exported when landed. The same applies to offshore vessels fishing for halibut and cod. Offshore vessels earn most of their revenue from sea-cooked whole shrimp processed onboard (Nielsen et al., 2017). However, to ensure jobs on land, offshore vessels are obliged to land a share of their catch for further processing at land-based factories in Greenland. This obligation is typically 25%.

Fishers must land in Greenland to the government-owned company Royal Greenland's or to private factories or wholesalers. Royal Greenland has a stated obligation to maintain landing opportunities locally. Royal Greenland is the largest processing and wholesale company, which also owns its own fishing fleet, with factories in several cities, as well as companies and sourcing, processing, and sales activities also in Denmark and several other countries. The largest private company is Polar Seafood, which also owns a number of vessels and land-based factories. It also operates in wholesale. Polar Seafood also prevails in Denmark and other countries. Moreover, a few companies own a large offshore vessel with onboard processing. Finally, a number of relatively small private processing and wholesale companies exist, founded on, among other things, Greenland halibut (*Reinhardtius hippoglossoides*, also known as halibut) and cod.

The seafood value chain revealed in this chapter include fishing of all Greenlandic vessels, both in Greenlandic waters and elsewhere. Catches of foreign vessels fishing in Greenlandic waters are also mentioned, but since typically not landed in Greenland not included in the value chain. The seafood value chain starting in Greenland is mostly for human consumption. However, Greenlandic fishing for capelin takes place in the Icelandic zone, in accordance with the capelin agreement with Iceland and Norway. Moreover, blue whiting is caught in the Faroese zone and in international waters. Both species are for reduction, but they are all landed directly in Iceland and at the Faroe Islands and never come to Greenland.

The overall contribution of the seafood value chain within the country is shown in Table 1, including all domestic fishing, processing, and wholesale activities. The most recent numbers are from 2022.

Table 7.1: Key economic numbers for the Greenlandic fishery, seafood processing, and trade, 2019–2022, current values. Notes:

¹: EBIT is Earnings Before Interest and Taxes.

²: Gross value added is a measure of the contribution of the value chain to the Gross Domestic Product, calculated as turnover minus operating costs excluding salary costs, depreciation, and interest.

Sources: Statistics Greenland (2026a).

	2019	2020	2021	2022
Turnover (DKK Million)	6,782	5,928	6,331	7,756
EBIT (DKK Million) ¹	819	26	566	840
Gross value added (DKK Million) ²	2,796	1,917	2,582	3,118
Employment (no. persons)	2,778	2,57	2,710	2,739

In 2022, the turnover of all domestic fishing, processing, and wholesale activities was DKK 7.8 billion, EBIT (profit) DKK 840 million, and gross value added (contribution to GDP) DKK 3.1 billion. The seafood value chain accounts for 13.9% of Greenlandic GDP, which amounts to DKK 22.3 billion, indicating that these activities are important to the Greenlandic economy. Further accounting for the revenue from resource rent taxation in fisheries in 2022 of DKK 480.6 million and correcting for the subsidy from Denmark to Greenland of DKK 3.9 billion, the seafood value chain contributes 19.5% of all economic activities in Greenland. In 2023, 275 fishing vessels were longer than 6 meters (Government of Greenland 2025).

The employment in fisheries registered in 2022 was 2,739 persons, corresponding to 14.8% of the total employment. Statistics Greenland (2026b) further identifies the total number of persons with main occupation in fishing, seafood processing, and seafood trade in 2023 to be 4,483 persons, corresponding to 15.3%. The Fisheries Commission (2021) identifies employment in seafood processing and trade as 1,560,

and the Government of Greenland (2025) states that the number of dinghy fishers in 2023 is 1,922, but further states that most of these have a main occupation in other sectors. Dinghies include vessels with an overall length of less than 6 meters.

Shrimp is the most economically important species, as shown in Table 2 for 2019.

Table 7.2: The shrimp value chain, 2019. values in nominal terms

Source: Fisheries Commission (2021).

	Firms (number)	Vessels/fac (number)	Turnover (DKK million)	EBIT (DKK million)	Employment (persons 2017)
Offshore shrimp vessels	5	9	1,300	398	336
Coastal shrimp vessels	20	20	732	146	244
Land-based shrimp factories	2	4	1,421	102	.
Total	27	33	3,453	646	580

Shrimp is the most economically important species, as shown in Table 2 for 2019. The turnover in the shrimp value chain is DKK 3.5 billion, corresponding to half of the total turnover (Table 1). EBIT forms DKK 646 million, corresponding to 79% of EBIT in the seafood value chain. Hence, shrimp is the most important part of the seafood value chain, comprising only 29 vessels and 4 land-based factories specializing in shrimp. The 9 large offshore trawlers have a permit allowing them to process 75% of their catch on board, while they are obliged to land 25%. Most of the 20 coastal shrimp trawlers land all their catches at the land-based factories, while a few of them have permits to produce 30% onboard. The largest employment in shrimp fishing is on offshore processing trawlers, with 336 employees, while on coastal shrimp trawlers below 80 gross tonnages (GT), there are 244 employees.

Halibut and cod are also important for offshore, coastal, and dinghy vessels. Typically, halibut and cod are targeted by the same vessels. Eight offshore processing vessels hold licenses for halibut, cod, and redfish in West and East Greenland, while two hold licenses for cod, haddock, and saithe in the Barents Sea, following the agreement with Norway. Coastal vessels targeting halibut and cod fish mainly in West Greenland in the Bay of Disco and in the Fiords of Uummannaq and Upernavik. In 2020, 160 licenses were issued for cod and 146 for halibut; however, many vessels hold licenses for both species. Also in 2020, dinghies were fishing in the same areas, with 1,129 licenses for cod and 1 057 for halibut.

Other fisheries also prevail. Offshore vessels are fishing for pelagic species, based on six licenses for capelin in the Icelandic zone, based on the agreement with Iceland, and herring, mackerel, and blue whiting in the Faroese zone and in international waters, based on the agreement with the Faroe Islands. These fisheries, however, are only seasonal side activities, carried out by the same offshore vessels that target halibut and cod most of the year.

The total employment in 2019 at land-based processing factories and wholesale companies is 1,560 persons (Fisheries Commission 2021). The largest activity of those is in the four shrimp factories, but employment also prevails in the many small landing places locally.

Regulations and management

Greenlandic fisheries are regulated independently. The regulation is based on total allowable catches (TACs), where TACs are fixed after accounting for a foreign share, where applicable. This concerns mainly Canada in the west and Iceland in the east. Moreover, a bilateral agreement is in place with the EU, granting quotas to EU vessels in Greenland in return for free access to the EU market and an annual payment from the European Commission. Furthermore, an agreement exists with Norway, allowing two Greenlandic vessels to fish in the Norwegian zone in the Barents Sea mainly for cod, in return for Norwegian vessels fishing in Greenland. An agreement also prevails with the Faroe Islands, exchanging fishing opportunities in each other's zones, and a trilateral agreement exists on capelin fishing in the Icelandic zone with Iceland and Norway.

The shrimp TAC is allocated to fishers under the individual transferable quota scheme, in which each company has the right to catch a specified share of the TAC. The rights are freely transferable, permanent, and annual, except that shrimp trawlers with a capacity below 80 GT cannot sell permanent rights or annual quotas to offshore vessels. This rule prevails in ensuring employment in the coastal fleet and on the land-based factories, where coastal vessels deliver their full catch.

The halibut fishery is also regulated by TACs. TACs are set separately offshore in the Davis Strait and the Baffin Bay, separately inshore in the three areas, the Bay of Disco, Uummannaq, and Upernavik, and a TAC is set for East Greenland. The inshore fisheries are regulated by individual transferable quotas for vessels above 6m, while dinghies have an Olympic fishery but can voluntarily choose to become part of the individual transferable quota system from 2025. Offshore vessels have no access to inshore areas. Offshore halibut fisheries are regulated by individual quotas allocated year by year both in East and West Greenland.

Cod fisheries are regulated by an inshore TAC for the whole area of West Greenland. A minor part is reserved for leisure fishing, with the remaining part for commercial fishers forming an Olympic fishery for licensed vessels, meaning all

vessels compete freely for their share of the total allowable catch. Cod fishing of offshore vessels is regulated by individual quotas allocated year by year, both in East and West Greenland. Pelagic fishery with offshore vessels is founded on individual quotas, also allocated year by year.

A further important element of fisheries management is the existence of specific fishing taxes to reallocate parts of the resource rents from the companies to the broader society. Specific fishing taxes prevail for shrimp, halibut, cod, haddock, saithe, redfish, and pelagic fish. The rates are differentiated and depend on the sales prices. For species with a sales price of more than DKK 12 per kg, the tax is 5.5% of the value. When prices increase, the percentage increase. A fixed rate per kg prevails for pelagic species, where sales prices are typically below DKK 12 per kg. The tax revenue collected was in 2022, with DKK 480.6 million, substantial, and helped to avoid other taxes.

The most important area for Greenlandic vessels in terms of quantities caught is West Greenland, from where 55% originates (2023), while 10% are caught in East Greenland waters. All capelin is caught in the Icelandic zone, following the tripart agreement; most blue whiting and around half of herring are caught in the Faroese zone, following the bilateral agreement with the Faroe Islands, while the other half of herring and all mackerel are caught in the international part of the ICES area. 3 769 tonnes of cod, and all haddock and saithe are caught in the Norwegian part of the Barents Sea, following the bilateral agreement with Norway on mutual fishing opportunities. Since almost all catches in the Icelandic zone, the Faroese zone, and in international waters are pelagic fish with low prices per kg, the dependency of domestic waters is higher in value than the percentages above indicate.

Catches of Greenlandic vessels appear in total in Table 7.3 and for offshore and coastal vessels in Table 7.4.

Table 7.3: Total catches of seafood by Greenlandic vessels in 2019-2023 in all waters, tonnes live weight.

Source: Statistics Greenland (2026d).

	2019	2020	2021	2022	2023
Seafood for cons.					
<u>Demersal fish</u>					
Cod	42,360	37,629	42,245	43,694	54,088
Halibut	45,841	42,816	45,393	45,363	45,202
Other	<u>4,552</u>	<u>4,263</u>	<u>3,838</u>	<u>2,516</u>	<u>3,998</u>
Total	92,753	84,708	91,476	91,573	103,288
<u>Pelagic fish</u>					
Mackerel	30,259	26,539	33,360	17,623	29,089
Herring	<u>3,190</u>	<u>3,201</u>	<u>2,864</u>	<u>6,164</u>	<u>7,333</u>
Total	33,449	29,740	36,224	23,787	36,422
<u>Salmon and trout</u>					
Salmon	0	32	41	25	34
Trout	<u>10</u>	<u>10</u>	<u>10</u>	<u>2</u>	<u>8</u>
Total	10	42	51	27	42
<u>Crustaceans/mussels</u>					
Shrimp	96,096	107,470	107,917	111,170	110,078
Other	<u>3,610</u>	<u>3,221</u>	<u>3,645</u>	<u>3,502</u>	<u>4,126</u>
Total	99,706	110,691	111,562	114,672	114,204
<u>Other</u>					
Lumpfish	7,599	8,985	4,548	4,896	5,640
Other	<u>2,020</u>	<u>1,745</u>	<u>1,762</u>	<u>2,375</u>	<u>2,138</u>
Total	9,619	10,730	6,310	7,271	7,778
Total	235,537	235,911	245,623	237,330	261,734
Fish for reduction					
Capelin	788	617	14,281	44,106	46,711
Blue whiting	<u>19,753</u>	<u>19,551</u>	<u>19,340</u>	<u>22,878</u>	<u>25,987</u>
Total	20,541	20,168	33,621	66,984	72,698
Total production	256,078	256,079	279,244	304,314	334,432

Table 7.4: Catches of seafood by offshore and coastal vessels in 2019–2023 in all waters, tonnes live weight.

	Offshore vessels					Coastal vessels and dinghies				
	2019	2020	2021	2022	2023	2019	2020	2021	2022	2023
Seafood for cons.										
<u>Demersal fish</u>										
Cod	22,006	19,315	28,285	28,206	31,061	20,354	18,314	13,960	15,488	23,027
Halibut	15,841	15,032	16,146	16,486	15,968	30,000	27,784	29,247	28,877	29,234
Other	<u>4,261</u>	<u>3,892</u>	<u>3,456</u>	<u>2,259</u>	<u>3,783</u>	<u>291</u>	<u>371</u>	<u>382</u>	<u>257</u>	<u>215</u>
Total	42,108	38,239	47,887	46,951	50,812	50,645	46,469	43,589	44,622	52,476
<u>Pelagic fish</u>										
Mackerel	30,259	26,539	33,360	17,623	29,089	0	0	0	0	0
Herring	<u>3,190</u>	<u>3,201</u>	<u>2,864</u>	<u>6,164</u>	<u>7,333</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	33,449	29,740	36,224	23,787	36,422	0	0	0	0	0
<u>Salmon and trout</u>										
Salmon	0	0	0	0	0	0	32	41	25	34
Trout	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>10</u>	<u>10</u>	<u>10</u>	<u>2</u>	<u>8</u>
Total	0	0	0	0	0	10	42	51	27	42
<u>Crustaceans/mussels</u>										
Shrimp	53,200	57,891	60,803	62,880	62,784	42,896	49,579	47,114	48,290	47,294
Other	<u>649</u>	<u>540</u>	<u>569</u>	<u>637</u>	<u>858</u>	<u>2,961</u>	<u>2,681</u>	<u>3,076</u>	<u>2,865</u>	<u>3,268</u>
Total	53,849	58,431	61,372	63,517	63,642	45,857	52,260	50,190	51,155	50,562
<u>Other</u>										
Lumpfish	0	0	0	0	0	7,599	8,985	4,548	4,896	5,640
Other	<u>1,820</u>	<u>1,690</u>	<u>1,549</u>	<u>2,042</u>	<u>1,758</u>	<u>200</u>	<u>55</u>	<u>213</u>	<u>333</u>	<u>380</u>
Total	1,820	1,690	1,549	2,042	1,758	7,799	9,040	4,761	5,229	6,020
Total	131,226	128,100	147,032	136,297	152,634	104,311	107,811	98,591	101,033	109,100
Fish for reduction										
Capelin	15	0	13927	43,849	46,431	773	617	354	257	280
Blue whiting	<u>19,753</u>	<u>19,551</u>	<u>19,340</u>	<u>22,878</u>	<u>25,987</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	19,768	19,551	33,267	66,727	72,418	773	617	354	257	280
Total production	150,994	147,651	180,299	203,024	225,052	105,084	108,428	98,945	101,290	109,380

Source: Statistics Greenland (2026d).

Total catches in 2023 of seafood for human consumption were 261,700 tonnes, with 152,600 tonnes coming from offshore vessels and 109,100 from coastal vessels and dinghies. Shrimp is the most important species in quantity terms with 110,000 tonnes followed by cod with 54,100 tonnes, halibut with 45,200 tonnes, and mackerel with 29,100 tonnes. Offshore vessels account for 57% of shrimp catches, and all of mackerel and herring catches. Coastal vessels and dinghies account for 65% of total catches of halibut, 43% of cod, and all lumpfish.

Catches of capelin and blue whiting total 72,700 tonnes. Most are caught by offshore vessels and landed for processing abroad in Iceland and the Faroe Islands.

Foreign vessels also fish in Greenlandic waters as shown in Table 5.

Table 7.5: Catches of foreign vessels in the Greenlandic zone in 2019-2023, tonnes live weight.

Source: Statistics Greenland (2026d).

	2019	2020	2021	2022	2023
Cod	4,126	4,651	5,737	5,439	5,651
Halibut	11,497	11,060	10,097	10,510	8,716
Other Demersal	4,985	5,114	3,604	2,727	2,229
Shrimp	4,079	5,946	4,695	6,843	6,891
Other	403	374	567	496	655
Total	25,090	27,145	24,700	26,015	24,142

In 2023, catches of foreign vessels formed 6.7% of total catches and 8.4% of catches for human consumption. Most of the catches of foreign vessels (63%) are caught in the waters of East Greenland. Data on catches allocated to countries is not available, but in 2023, TACs of 37,298 tonnes were allocated to foreign vessels. EU vessels, including Danish vessels, hold TACs for 25,904 tonnes in the Greenlandic zone, followed by Norwegian vessels (6,894 tonnes) and Faroese vessels (4 500 tonnes). No other countries hold TACs. EU vessels primarily hold TACs for capelin, shrimp, halibut and cod, while Norwegian vessels focus on TACs for shrimp, cod, halibut and redfish, and Faroese vessels hold TACs mainly for cod.

Statistics including all landings of Greenlandic vessels do not exist. The official Greenlandic landing statistics only include direct landings and not landing of seafood processed onboard offshore vessels and exported directly. Instead, it is included in the export statistics together with seafood landed in Greenland and exported, while the landing statistics include everything except for this direct export.

Landings formed 123,563 tonnes in 2023 when excluding seafood processed onboard offshore vessels and exported directly. The largest share of the quantity is landed in Ilulissat (22%), Sisimiut receive 17%, Nuuk 16% and Aasiaat 11%.

Landings in quantity and value in the period 2019–2023 are shown in Table 7.6.

Table 7.6: Seafood landings in Greenland by Greenlandic vessels in 2019-2023.

	Quantity (tonnes live weight)					Value (DKK million)				
	2019	2020	2021	2022	2023	2019	2020	2021	2022	2023
<u>Offshore vessels</u>										
Shrimp	14,618	17,495	20,383	20,274	16,347	123	144	168	176	133
Halibut	5,703	2,831	4,549	5,540	5,203	85	36	52	79	65
Cod	3,807	1,855	5,438	1,669	1,883	33	14	29	17	19
Other	143	160	326	413	495	0	0	1	1	1
Total	24,271	22,341	30,696	27,896	23,928	241	194	249	272	218
<u>Coastal vessels/dinghies</u>										
Shrimp	36,655	36,964	35,176	34,099	38,158	391	352	312	315	364
Halibut	29,935	27,759	29,225	28,757	29,268	588	542	547	601	645
Cod	20,350	18,294	14,251	15,438	23,020	136	105	67	100	158
Crabs	2,803	2,510	2,808	2,722	2,714	72	57	75	72	61
Lumpfish	7,596	8,976	4,547	4,893	5,640	42	46	23	27	38
Other	1,622	1,460	1,274	823	835	7	6	6	4	5
Total	98,961	95,963	87,281	86,732	99,635	1,237	1,108	1,030	1,119	1,270
Total	123,232	118,304	117,977	114,628	123,563	1,478	1,302	1,279	1,391	1,487

Source: Statistics Greenland (2026e).

The total landings in 2023 on 123,563 tonnes corresponds to DKK 1.5 billion, with DKK 1.27 billion (81%) delivered from coastal vessels and DKK 218 million (19%) from offshore vessels. The landing value for halibut on DKK 710 million is the largest, followed by shrimp with DKK 497 million and cod with DKK 177 million. Total quantities and values landed are almost stable over the 2019-2023 period, although a minor reduction in both is seen in 2020–2022 in the Covid-19 period.

The status of the main stocks for Greenlandic fisheries is presented in Table 7.7. Quotas are compared to the biological advice and considered sustainable (green box) if set at maximum at the advice, and stocks compared with the safe biological limits and considered within safe biological limits if not below (green box).

Table 7.7: Status of main stocks for Greenlandic fisheries, 2023.

Species/stock	Greenlandic catches (tonnes)	Quota compared to advice (%) ¹	Stock within safe biological limits ²
Shrimp West Greenland	106,566	100%	Yes
Shrimp East Greenland	2,786	343%	No
Halibut West Greenland offshore	12,607	112%	Yes
Halibut East Greenland offshore	3,361	100%	Yes
Halibut inshore Bay of Disco	11,435	243%	
Halibut inshore Uummannaq	8,250	190%	
Halibut inshore Upernavik	7,300	153%	
Cod East and Southwest Greenland offshore	27,292	219%	
Cod West Greenland inshore	11,017	185%	

Notes:

¹: The percentages measure the quotas for Greenlandic vessels compared to the biological advises from the International Council for Exploration of the Sea for East Greenland and from Northwest Atlantic Fisheries Commission for West Greenland. For stock where quotas are set in accordance with biological advises, the boxes are green, while for stocks where quotas are set higher than biological advises the boxes are red.

²: For stocks, a green box indicates that the current size of the stock is within safe biological limits, a red box that the stock size is below safe biological limits and a white box that reference points are not set for the stock.

Sources: For catches Statistics Greenland (2026d), for advice Greenland Institute of Natural Resources (2024) and for stock status Northwest Atlantic Fisheries Organization (2026) and International Council for Exploration of the Sea (2026).

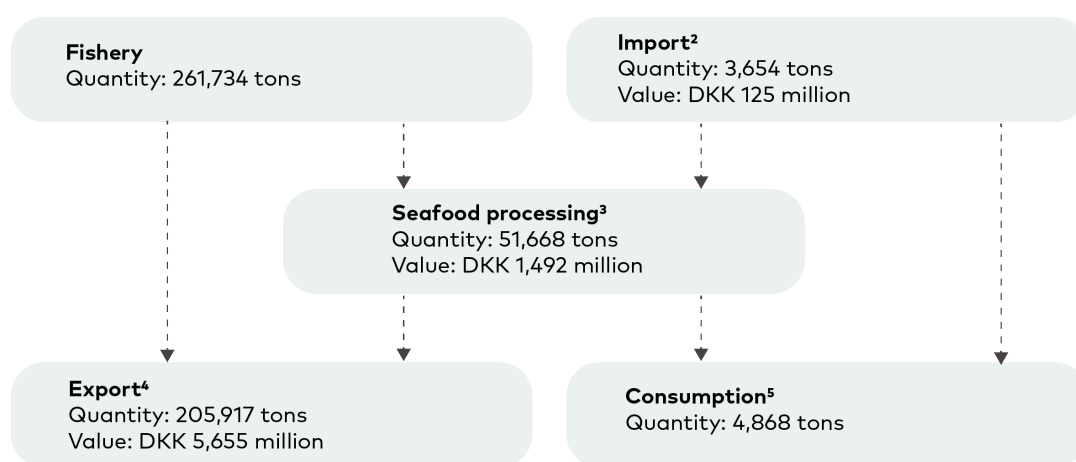
For the nine stocks of shrimp, halibut, and cod shown, shrimp in West Greenland is within safe biological limits, with quotas set according to the biological recommendation. This stock accounts for 56% of the total catches of the nine stocks and 41% of total catches for human consumption in 2023. Both offshore halibut stocks are also within safe biological limits. The quota in East Greenland is set in accordance with the biological recommendation, while the quota in West Greenland is set just above, but close to, the biological recommendation. For the remaining six stocks, the stock is only known for shrimp in East Greenland, where it is outside the safe biological limit. Reference points are undefined for the remaining five halibut and cod stocks. However, quotas are all set above the recommendation. The most difficult situation for shrimp occurs in East Greenland, where quotas are set more than three times higher than the recommendation. For cod inshore and offshore, quotas are set at 85–119% above the recommendation. For inshore halibut, quotas are set between 53% and 143% above the recommendation. The quota setting has prevailed for a longer period, reflecting a precautionary principle for the main shrimp stock in West Greenland, which is very important to the national economy, while the high quotas for inshore halibut appear to ensure employment.

Trade flows of aquatic food: Greenland

The Greenlandic value chain for fish for human consumption

The structure of the Greenlandic value chain for seafood for human consumption is identified via key figures. These are shown in Figure 7.1, along with quantities and values.

Figure 7.1: The Greenlandic value chain for seafood for human consumption 2023, live weight¹



¹: Quantities in live weight are known for fishery, while the quantities in live weight equivalents are calculated for seafood processing, import, and export using conversion factors from processed and traded weight to live weight.

²: Import is measured as Danish export to Greenland, since all import comes from Denmark. For import, the same conversion factors as for Denmark are applied.

³: Seafood processing is not registered, but includes exports known to be processed at land-based factories. These are peeled frozen shrimp, frozen fillets of halibut and cod, and dried cod. Processing onboard offshore production trawlers is not included.

⁴: Export is known from Statistics Greenland (2026f), with product forms being less detailed than in the import statistics based on Statistics Denmark (2026). The conversion factors used are 1.65 for peeled shrimp, 1.3 for J-cut halibut, 2.6 for fillets and dried cod, 2.6 for halibut fillets, and 1.0 for all other products.

⁵: The total quantity is identified based on an average per capita consumption of 86 kg, based on 2010-2013 as the latest years with available statistics (Food and Agriculture Organization of the United Nations 2018).

Sources: For catches Statistics Greenland (2026d), for import Statistics Denmark (2026), for seafood processing and export Statistics Greenland (2026f), and for consumption Food and Agriculture Organization of the United Nations (2018).

In 2023, 275 vessels and 1,922 dinghies fisher were registered. Specialized shrimp fishing with 9 offshore production trawlers and 20 coastal trawlers is of the greatest economic importance, while the combined offshore fishery with 8 large production trawlers targeting halibut and cod, and seasonal pelagic fishing, follows. Inshore combined fishing in West Greenland after halibut and cod is undertaken by around 150 vessels and by up to 2,000 fishers using dinghies. The total catches for human consumption are 261,700 tonnes. Of these, 123,563 tonnes are landed in Greenland for a value of 1.5 DKK billion, while the rest is directly exported. The direct export is 46,437 tonnes of shrimp, corresponding to 74% of their shrimp catch, 29,178 tonnes of cod (94%), and 10,765 tonnes of halibut (67%). Values for these are not available, as they are registered in the export statistics alongside exports via land-based facilities. For coastal vessels, halibut landings are most important, valued at DKK 645 million, followed by shrimp at DKK 364 million and cod at DKK 158 million.

The import of seafood for human consumption is 3,654 tonnes for a value of DKK 125 million in 2023. Table 7.8 shows the import of groups of species and products.

Table 7.8: Greenlandic import of seafood, 2023, quantity and value¹.

	Quantity (tonnes live weight)	Value (DKK million current price level)
<u>Salmon and trout</u>		
- Fresh, live	28	2
- Frozen	22	1
- Fillets	18	1
- Smoked, Salted, Dried	51	3
- Processed	<u>13</u>	<u>1</u>
- Total	132	7
<u>Whitefish and flatfish</u>		
- Fresh, live	1	0
- Frozen	0	0
- Fillets	6	0
- Smoked, Salted, Dried	26	1
- Processed	<u>69</u>	<u>1</u>
- Total	103	3
<u>Pelagic fish</u>		
- Fresh, live	0	0
- Frozen	0	0
- Fillets	3	0
- Smoked, Salted, Dried	2	0
- Processed	<u>179</u>	<u>4</u>
- Total	185	4

<u>Crustaceans and mussels</u>		
- Fresh, live	2,481	89
- Frozen	144	4
- Fillets	0	0
- Smoked, Salted, Dried	3	0
- Processed	<u>157</u>	<u>3</u>
- Total	2,784	97
<u>Other and mixed</u>		
- Fresh, live	1	0
- Frozen	135	6
- Fillets	49	1
- Smoked, Salted, Dried	18	1
- Processed	<u>245</u>	<u>6</u>
- Total	448	14
<u>Total</u>		
- Fresh, live	2,512	91
- Frozen	301	11
- Fillets	77	3
- Smoked, Salted, Dried	99	6
- Processed	<u>663</u>	<u>15</u>
- Total	3,652	125

1. Danish export to Greenland is applied to measure Greenlandic imports. This implies that imports in the form of landings by non-Greenlandic and non-Danish vessels in Greenland are not included. Total imports to Greenland of unprocessed seafood in 2023 were, according to Statistics Greenland (2026f), DKK 42 million, and total imports of processed meat and seafood were DKK 136 million. Hence, landings of foreign fishers in Greenland can at most be small.

Source: Statistics Denmark (2026).

The largest import item from Denmark is fresh shrimp landed by one Danish vessel that fishes in the Greenlandic zone, based on the agreement between Greenland and the EU. The total value is DKK 89 million (71%). The remaining import, spread across product forms and species, is presumed to be mainly for domestic consumption. Landings may also be made by fishers from the EU, Norway, and the Faroe Islands that fish in the Greenlandic zone (see Table 7.5), but numbers are not available. It is, however, presumed that such landings are small, since it may pay off to land elsewhere.

Landing facilities are available in most harbours where processing may or may not take place. The four largest factories receive and process raw material of shrimp, by boiling, peeling, and packing them as a single frozen product. The four shrimp factories are located in Ilulissat, Sisimiut, Nuuk, and Aasiaat. Landings of halibut are spread across many harbours. Royal Greenland Ltd. has an obligation to buy fish in all harbours along the coast, including small places. Halibut processing is

widespread in several harbours, with the largest Royal Greenland factory in Ilulissat. Polar Seafood also processes, among others, in Nuuk and Aasiaat, while another private company, Halibut Greenland, has a factory also in Ilulissat. Halibut are mostly J-cut or processed for fillets and frozen. Landings of cod are also received in several harbours along the coast, although further south than halibut. Fillets and dried cod are produced. While a processing statistic doesn't exist, the export statistics reveal that the main processing item is frozen peeled shrimp (DKK 1.0 billion), followed by frozen cod fillets (DKK 270 million) and frozen halibut fillets (DKK 161 million) (Statistics Greenland (2026f)).

In 2023, export of seafood for human consumption formed 205,900 tonnes of live weight and DKK 5.7 billion, corresponding to 90% of the total export value. This number is known from the officially published statistics from Statistics Greenland (2026e). However, it is assessed that the export statistics are subject to uncertainty. In particular, the values are presumed to be underestimated because most exports are recorded as internal transactions within the government-owned company Royal Greenland. Royal Greenland is present in both Greenland and Denmark and has a special arrangement under the Double Taxation Agreement between Greenland and Denmark (Danish Ministry of Taxation 2026), which allows the company to operate across the two countries. The implication is that estimated, presumably low, values are reported to the statistics. This value chain organization is described in more detail in Nielsen *et al* (2017). In Table 7.9, export data from Statistics Greenland (2026f) are detailed by species and product, and the values from those statistics are used directly.

Table 7.9: Greenlandic export, 2023, quantity and nominal value¹.

Source: Statistics Greenland (2026f).

	Quantity (tonnes live weight)	Value (DKK Million)
<u>Total</u>		
- Seafood for human consumption		5,655
- Fish for reduction	-	214
- Non-seafood	-	<u>636</u>
- Total		6,504
Seafood for human consumption		
<u>Shrimp</u>	-	-
- Frozen whole	52,376	1,699
- Peeled frozen	<u>31,619</u>	<u>1,022</u>
- Total	83,995	2,721
<u>Cod</u>		
- Frozen whole	26,035	532
- Dried/salted	2,344	39
- Frozen fillets	<u>11,821</u>	<u>270</u>
- Total	40,201	841
<u>Halibut</u>		
- Frozen whole	36,284	1,389
- Frozen fillets	<u>5,884</u>	<u>161</u>
- Total	42,168	1,550
<u>Other</u>		
- Scallops	97	7
- Crabs	1,581	127
- Lumpfish roe	1,101	41
- Haddock whole/fillets fresh/frozen	323	11
- Redfish whole/fillets fresh/frozen	990	19
- Saithe whole/fillets fresh/frozen	334	6
- Herring whole fresh /frozen	6,665	42
- Mackerel whole fresh/frozen	28,070	276
- Other fish products	<u>393</u>	<u>14</u>
- Total	39,554	543
Total	205,917	5,655

Shrimp is the largest export item, accounting for DKK 2.7 billion (48%), followed by halibut with DKK 1.6 billion (27%), cod with DKK 841 million (15%), and mackerel with DKK 276 million (5%). For shrimp, frozen whole is the most important product form, accounting for DKK 1.7 billion, mostly consisting of shrimp processed onboard offshore vessels and exported directly, while the remaining part is shrimp with shell.

For halibut, DKK 1.4 billion (90% of the species' exports) is frozen whole, typically J-cut, while for cod, frozen whole accounts for DKK 532 million (63%) and frozen fillets for DKK 270 million (32%).

The total export of DKK 6.5 billion, according to Statistics Greenland (2026f), is destined for Denmark (DKK 5.2 billion), Iceland (DKK 545 million), Norway (DKK 223 million), the Faroe Islands (DKK 45 million), and unknown countries (DKK 536 million). According to Statistics Iceland (2026), DKK 103 million of Iceland's exports consist of capelin and blue whiting, while exports of seafood for human consumption are largely non-existent. The export to Norway consists of DKK 40 million in direct exports from two vessels fishing for cod, haddock, and saithe in the Barents Sea under the bilateral agreement with Norway (Statistics Norway 2025). The export to the Faroe Islands is DKK 64 million, with cod and other groundfish accounting for the largest share (Statistics Faroe Islands 2026).

Although the statistics don't specify countries of export separately for seafood for human consumption, at least 80% and presumably more is exported to Denmark. But Denmark is only the first destination. Most of the export to Denmark is re-exported. Statistics Greenland (2026f) reports that Danish exports of seafood for human consumption of Greenlandic origin in 2023 were DKK 4.5 billion. The largest market is China, receiving DKK 2.6 billion, followed by other EU countries with DKK 451 million and Norway with DKK 197 million. The difference between Danish imports and exports from Greenland is either consumed in Denmark or processed and possibly re-exported from Denmark. Hence, China is the largest final export market for Greenlandic seafood products. Of the total registered Greenlandic seafood exports for human consumption of DKK 5.7 billion, 46% are exported to China. While the Greenlandic export value is underestimated (Nielsen *et al.*, 2017), the Danish export value reflects the real value, so this share is overestimated. In any case, China appears as a very important market for Greenlandic seafood.

Seafood consumption in Greenland is not known but presumed to be high. It consists of both supermarket purchases and purchases at local markets for fish, seals, and whales. A large share of consumption comes from own catches on dinghies. The Food and Agriculture Organization of the United Nations (2018) estimates that per capita consumption is 86kg of live weight of seafood, corresponding to a total domestic consumption of 4 868 tonnes.

The Greenlandic value chain for fish for reduction

The Greenlandic value chain for fish for reduction is short and only includes fishing. No processing exists. The catches of fish for reduction in 2023 were 72,418 tonnes, with two-third being capelin and the rest blue whiting. Capelin are caught in the Icelandic zone, following the tripartite agreement with Iceland and Norway. 32,283 tonnes of capelin (DKK 91 million) are landed in Iceland, as are 5 985 tonnes of blue

whiting for DKK 12 million. Moreover, landings of fish for non-food use at the Faroe Islands were 26,401 tonnes and DKK 119 million, presumably with most being blue whiting. Export of fish for reduction forms a total of DKK 214 million (Statistics Greenland 2026e). Fish waste appears as a side-stream from the processing of seafood for human consumption, leading to exports of DKK 14 million to Denmark in 2023 (Statistics Denmark 2026).

Aquatic food available for consumption in Greenland

There is no statistic on seafood consumption in Greenland. The consumption can be calculated for Greenland, as for the other Nordic countries, as the sum of catches, aquaculture production, and imports minus exports, with all items converted to live weight using conversion factors. However, due to a lack of detail in the published export statistics on product groups, it is not possible to convert to valid live-weight equivalents.

The Food and Agriculture Organization of the United Nations (2018) uses the same methodology to calculate what remains of catches and aquaculture production after accounting for foreign trade for domestic human consumption across all countries worldwide in 2010-2013. In Greenland, the annual per capita consumption of seafood is estimated at 86 kg in live-weight equivalents. This indicates very high per capita seafood consumption in Greenland. With the population of Greenland in 2023, that corresponds to a total domestic seafood consumption in 2023 of 4,868 tonnes. This consumption can be compared with the total export of 205,917 tonnes live weight, implying that in the speculative case where the full supply is consumed domestically, seafood consumption can increase 42-fold. However, given the calculation method based on uncertain conversion factors, consumption is subject to substantial uncertainty. The number is also some years old.

Bjerregaard and Ottendahl (2024) conducted a questionnaire study of eating habits in the Greenlandic population in 2018 and found that each person, on average, eats 33.8 grams/day of seafood products and further 19.7 grams/day of marine mammals (seal meat and whale meat). That corresponds to a per capita seafood consumption of 12.3 kg. per year and a per capita consumption of marine mammals of an additional 7.2 kg. per year. These numbers are measured in edible final prepared seafood and don't account for waste in preparations, implying that numbers in live weight equivalents are substantially higher. The results for 2018 are compared with a similar study conducted in 2005–2010, and it is found that seafood consumption remained constant (33.0 grams/day in 2005–2010), while consumption of marine mammals decreased by one-third between the two studies (from 30.4 grams/day). Moreover, the study identifies the frequency of seafood consumption and finds that 32% of respondents eat seafood 2 or more times per week, while 24% eat marine mammals 2 or more times per week. The study concludes that eating habits are changing toward traditional Western foods.

The wide range of per capita consumption indicates considerable uncertainty. Reliable, up-to-date knowledge about seafood consumption in Greenland doesn't exist. However, the limited import data indicate that seafood consumption mostly consists of locally available species.

While reduced international trade in times of crisis can substantially affect the economics of the Greenlandic fishing industry, the effect on Greenlandic and Nordic self-sufficiency in seafood is small. Security in the Greenlandic and Nordic seafood supply is robust due to the very large volumes supplied. However, in times of crisis, it may pose a challenge that a substantial share of seafood is exported to one country, China. While it is possible to export to other countries if the Chinese market is not available, prices are expected to be reduced. That may be especially true for halibut, given the strong demand in China.

Challenges, threats, and opportunities

More developments may potentially affect the Greenlandic seafood supply, although it is not certain whether this will happen.

The first development that affects future catches is the biological state of the fish and shellfish stocks, both in terms of whether the stock sizes are within safe biological limits and whether quotas are set in accordance with biological recommendations. The most important West Greenland shrimp stock is within safe biological limits, and quotas are continuously set in accordance with recommendations. Together with the individual transferable quota regulation, stability is ensured through proper vessel economy and the stable delivery of raw materials to land-based factories, while the specific fishing tax ensures a substantial and stable contribution to the Greenlandic economy.

The situation in the inshore halibut fisheries in the Bay of Disco, Uummannaq, and Upernavik differs, with quotas for all three stocks being set above biological recommendations. While large catches and employment prevail in the short run, they are not biologically sustainable in the long run. The implications can include reduced catches, both consistently and during periods of stock recovery, as well as the risk of stock collapses. The same situation, with quotas set above biological recommendations, prevails in the cod fisheries, both inshore and offshore.

Second, the agreement between the European Commission and the Government of Greenland specifies fishing opportunities of EU vessels in Greenlandic waters, as reflected in the catches in Table 5, allocated for a payment to the Government of Greenland and free access of all Greenlandic seafood products at the EU market (European Union, Government of Greenland and Government of Denmark 2021, European Commission Directorate-General for Maritime Affairs and Fisheries 2024). The agreement allows, on the one hand, exports to the EU without tariffs and provides a subsidy to the Greenlandic economy, and, on the other hand, transfers quotas in Greenlandic waters to EU vessels.

The third development that may affect future catches is climate change, driven by rising marine temperatures. Although potentially more important in the long run than in the short run, this has already been observed. For example, mackerel from the Northeast Atlantic stock have appeared in East Greenland waters in quantities of commercial importance since 2011, leading to 75,194 tonnes caught by Greenlandic vessels in domestic waters in 2014 (Bjorndal et al., 2026). Although no mackerel have been registered as caught in Greenlandic waters since 2019, it reflects that stock abundances are sensitive to changing temperatures. Hence, increasing water temperature may positively affect the abundance of seafood stocks and, in turn, lead to the immigration of new species adapted to higher temperatures. The potential implication is an increase in total seafood biomass, thereby boosting future catches. It may, however, also lead to reduced abundances of species currently inhabiting the area, which are better suited to today's temperatures. Finally, reduced sea ice coverage in the future may provide better access to fishing grounds. That may further increase catches but also reduce the option of long-line fishing from the ice.

Fourth, while no aquaculture currently exists, it offers an opportunity to increase seafood supply. Many marine areas are potentially relevant for cage farming, and the infrastructure for seafood processing and sale is already well-functioning, although both floating ice and pack ice, as well as the need for complex regulations, may pose challenges. Given today's complete absence of an aquaculture industry, its development may take years.

Finally, since a considerable share of exports is destined for one country, China, the domestic seafood value chain will be substantially affected in the hypothetical case where this is no longer possible. Export to China is largely limited to frozen, unprocessed shrimp and halibut, but with large quantities of both. Although both species can be sold in other countries in such a situation, it will be at reduced prices. Especially in a transition period in the short run, and especially for halibut, due to high Chinese demand as a substitute for Patagonian toothfish, which is in low supply and an endangered species (Nielsen et al., 2017).

Given that only some of the above developments may come true, and that the trends point in opposite directions, they don't provide an unambiguous picture of the future development in the supply of seafood.

8. Nordic synthesis: Crisis preparedness in the Nordic Aquatic food Industry

Introduction

The global framework for trade, security, and international cooperation has changed dramatically. Where the world was once characterised by increasing globalisation, specialisation, and deep interdependence between countries, several major economies have moved in the opposite direction. Trade conflicts, geopolitical tensions, and war have contributed to this shift, challenging established supply chains and weakening international institutions.

For small, open economies such as the Nordic countries, this development creates new forms of vulnerability. Even long-standing and traditionally stable security arrangements, including those underpinning European and transatlantic cooperation, have come under pressure. As a result, there is a growing need to assess how well the Nordic region is prepared to manage different types of crises, not only those related to defence, but also those affecting access to food and other critical resources.

Against this evolving situation, food preparedness has gained renewed strategic importance. And in this context, aquatic foods are particularly relevant in a Nordic setting, as the region is one of the world's largest producers of marine resources, and seafood is among the most globally traded and trade-dependent food commodities (Anderson et al., 2018).

The Nordic region holds substantial aquatic food resources and benefits from a strong internal trade network, providing a solid foundation for crisis preparedness. Large production volumes, surplus-producing countries, established logistics, and considerable aquaculture biomass constitute meaningful buffers that could support regional food supply under disrupted conditions.

At the same time, preparedness is limited by several structural vulnerabilities. The aquatic food system is tightly embedded in global value chains: Nordic vessels depend on access to non-Nordic fishing grounds, aquaculture relies heavily on imported feed ingredients, significant processing takes place outside the region, and more than 80% of seafood exports are destined for markets beyond the Nordics. These global linkages expose the region to geopolitical tensions, trade restrictions, logistical disruptions, and decisions made by multinational actors

beyond national control. Biological and regulatory challenges, including weak stock status, unresolved quota-sharing arrangements, and reliance on shared management with Russia, further constrain the system's flexibility in a crisis.

This report, therefore, highlights both the Nordic region's access to aquatic foods and the importance of Nordic cooperation in crisis situations. At the same time, it sheds light on the vulnerabilities created by a highly globalized seafood sector, across the entire value chain, from harvest and aquaculture to processing, logistics, trade, and feed inputs. In addition to these trade-related vulnerabilities, the preparedness of the Nordic aquatic food system is also shaped by internal structural and biological constraints, which are further discussed later in this chapter.

In this report, 'crisis' refers to situations in which normal trade flows are disrupted, reducing the Nordic region's ability to import or export aquatic foods or key inputs for their production of aquatic food. The analysis focuses on the trade and supply implications of such disruptions, not on the underlying geopolitical causes. More specifically, the report considers acute, short-term shocks to trade flows rather than prolonged crises that would fundamentally alter market structures or firm viability. This means that we assess the immediate implications for availability and supply, without analysing longer-term economic effects such as insolvency or sector restructuring. The aim is to delineate preparedness challenges associated with sudden disruptions in access to markets and inputs, rather than the wider macroeconomic or geopolitical developments that could trigger such crises.

This synthesis chapter addresses the project's core research question:

"How is the Nordic aquatic food system structured, and which factors influence the region's preparedness in a crisis situation?"

In the end, we illustrate two scenarios:

- (i) situations where trade can occur only within the Nordic region, and
- (ii) situations where trade occurs with allied European countries.

Structure of the Nordic aquatic food system

Primary production patterns

The Nordic region is one of the world's most important producers of aquatic foods, which comes from both capture fisheries (wild-caught fish and shellfish) and aquaculture (farmed species).

However, primary production is unevenly distributed. Norway, Iceland, Greenland, and the Faroe Islands are major global producers and exporters, whereas the most populated countries, Denmark, Finland, and Sweden, depend heavily on imports in domestic processing and to meet domestic demand. However, including primary production for reduction, Denmark is to be considered a significant primary producer, even larger than Greenland.

Table 8.1: Primary production in each country in 2023 (tonnes live weight).

Country	For human consumption	For reduction	Total primary production
Norway	3,136,890	456,447	3,593,337
Iceland	762,370	662,351	1,424,721
Faroe Islands	463,785	408,238	872,023
Denmark	186,615	378,000	564,615
Sweden	44,580	110,989	155,569
Finland	44,205	41,333	85,538
Greenland	261,734	72,418	334,152
Total	4,900,179	2,129,776	7,029,955

Norway exports large volumes of whole fish (fresh or frozen) for processing abroad. Although domestic processing is modest compared to the country's extensive primary production, the Norwegian processing sector is still one of the largest in the Nordic region and thus plays a significant role in regional processing capacity.

Iceland is characterized by large, vertically integrated firms that combine harvesting, processing, and marketing; processing occurs across many locations, with strong regional concentration and specialized facilities, including reduction capacity.

The Faroe Islands' processing operations are aligned with landings and aquaculture operations, with identified clusters for demersal processing, pelagic processing, and salmon facilities. In addition, the Faroe Islands have a significant production of fishmeal and fish oil.

Denmark retains important processing and wholesale functions, but much primary processing has been outsourced over the past decades. Danish companies increasingly operate abroad, and foreign companies hold significant ownership stakes in Danish processing facilities.

Similarly, Sweden and Finland are countries where processing industries are smaller and rely heavily on imported raw materials for products demanded by consumers, including imports from within the Nordics.

Greenland solely produces frozen products from wild-capture fisheries, and its processing capacity is oriented toward export markets, mostly served by two large vertically integrated firms.

Trade flows

Intra-Nordic trade plays an important role- in regional supply. Iceland and the Faroe Islands source nearly three-quarters of their seafood imports from other Nordic countries, while Finland and Denmark obtain slightly more than two- thirds. Sweden imports around half from within the region, whereas Norway is the least dependent, with roughly one- quarter of its imports originating from Nordic partners. Export patterns show the opposite: only around 16% of total Nordic seafood exports remain within the region, meaning that more than four- fifths rely on markets outside the Nordics. Norway alone exports 2.7 million tonnes to non-- Nordic- destinations (88% of its total exports), and Iceland sends 94% of its exports outside the region. These figures show that there is substantial intra-Nordic- exchange, especially for imports, but exports still rely heavily on European and overseas markets.

Nordic countries are also highly interconnected in the exchange of marine ingredients. In several cases, more than half of both imports and exports of reduction materials occur within the region. Norway, which is the dominant aquaculture producer and thus a major importer of fish meal and fish oil, sources around 70% of its marine ingredient imports from Nordic partners, while Iceland and the Faroe Islands obtain more than 80%. Export flows show similar concentrations: the Faroe Islands direct roughly 81% of their reduction exports to Nordic markets, and both Norway and Iceland export more than half of their volumes within the region. Overall, 74% of Nordic imports and 60% of Nordic exports of marine ingredients remain within the region, underscoring the high degree of intra-Nordic dependence in feed-related value chains.

While these trade patterns show how Nordic countries exchange both seafood and marine ingredients, they do not reveal how much aquatic food each country ultimately retains for domestic use. Because national availability depends on the net effect of all flows, both Nordic and non-Nordic, we next present the total raw-material balance for each country. This baseline shows how much aquatic food remains domestically after accounting for all imports and exports.

Table 8.2, therefore, presents the total availability of aquatic food in each country, defined as primary production plus imports minus exports. The availability analysis in this synthesis relies exclusively on primary production for human consumption (capture fisheries and aquaculture) as recorded for 2023, combined with harmonised trade adjustments described in *Data and methods*. It does not include non-food uses, recreational or tourist fishing, subsistence catches, or other country-specific additions discussed in some national chapters. Where national chapters examine broader or alternative scenarios, the parameters may differ; the synthesis scenarios are limited to the comparable, cross-Nordic baseline defined above.

Table 8.2: Availability of aquatic food in each country in 2023 (tonnes, live weight).

Country	Primary production	+Total imports	=Total supply	-Total exports	=Residual: Availability of aquatic food
Norway	3,136,890	251,501	3,388,391	3,123,732	264,659
Iceland	762,370	74,556	836,926	741,601	95,325
Faroe Islands	463,785	69,754	533,539	485,144	48,395
Denmark	186,615	865,000	1,051,615	956,000	95,615
Sweden	44,580	250,802	295,382	65,806	229,576
Finland	44,205	110,318	154,523	45,767	108,756
Greenland	261,734	3,654	265,388	205,917	59,471
Total	4,900,179	1,625,585	6,525,764	5,623,967	901,797

Taken together, these production, processing, and trade patterns, along with the resulting raw-material balances summarized in Table 8.2, determine how much aquatic food actually remains available in each Nordic country. The next section examines this domestic availability in per capita terms, also measured in live-weight equivalents.

Using a harmonised method applied across all Nordic countries, we estimate that around 30 kg of aquatic foods per capita were available to Nordic consumers in 2023. This figure is subject to considerable uncertainty related to data quality, live-weight conversion uncertainty, product classification, and stock changes; see *Data, methods, and limitations* for details. Availability varies substantially by country, reflecting differences in production, processing, and trade integration. For context, FAO's regional estimate for the same year is of a similar order (approximately 34 kg per capita), although data sources and conversion methods differ (see *Data and methods* for details) (FAO, 2026). This baseline provides the reference point for the scenario analysis that follows.

External flows and dependencies

Nordic seafood systems are deeply embedded in production outside the Nordic region, processing, and market structures. Large volumes of Nordic raw material are sent to European processing hubs such as Poland and the Netherlands, while notable volumes are routed to Asian facilities, especially in China, which serves as a large export market, e.g., for Greenland, and a major processing hub. Nordic countries also source key inputs from non-Nordic suppliers: Norway imports frozen whitefish from Russian vessels for domestic production, while the aquaculture sector in Norway and Finland depends heavily on global suppliers of feed ingredients and additives from Brazil, the United States, Canada, and Asian markets. Access to European ports, cold-chain infrastructure, and transport corridors further ties the Nordic system to external logistics networks. These external linkages are a structural part of how the Nordic aquatic food system operates and form the backdrop for the preparedness constraints discussed in the next section.

It is important to note that this dependence on imported feed ingredients is already recognised as a strategic vulnerability. For example, the Norwegian government has launched a dedicated mission on sustainable feed, with a national objective to increase the share of domestically sourced feed ingredients to 25 percent by 2034 (Research Council of Norway, 2025). Current national strategies, therefore, seek to strengthen domestic and regional production of key feed inputs

Factors that strengthen Nordic preparedness

The Nordic region's aquatic food system has some strengths that enhance crisis preparedness. First, overall production volumes are high, with substantial outputs from both capture fisheries and aquaculture. This scale provides a broad raw-material base that can be redirected if market conditions change, and it reduces the risk that short-term fluctuations in any single segment will compromise regional supply.

Second, several Nordic countries are net surplus producers of aquatic foods for human consumption. This surplus, particularly in Norway, Iceland, the Faroe Islands, and Greenland, creates a buffer that can be directed towards domestic and intra-Nordic needs if external markets or transport routes come under pressure. In practical terms, it means that a significant share of Nordic production could be retained within the region without reducing domestic availability.

Third, the region's large production volumes make it reliant on global systems along the value chain from inputs through processing to trade. While this creates certain vulnerabilities, a broad international market presence can buffer a partial crisis by allowing trade to be shifted to alternative destinations if parts of the market close.

Fourth, aquaculture biomass serves as a short-term reserve. While biological and welfare limits prevent rapid, indefinite scaling, standing biomass in salmon and other farmed species offers some flexibility in harvest timing. This can smooth short-term supply shocks, support predictable deliveries to processors and retailers, and mitigate volatility when wild capture landings are seasonally low or logistically delayed, or if wild fish chains come under pressure.

Fifth, strong intra-Nordic trade flows underpin regional resilience. Established logistics-, processing relationships, and wholesale networks allow raw materials and finished products to move efficiently between countries, helping to balance mismatches between where fish is produced, vacant processing facilities, and where consumers are located. In Norway, national freezing and storage capacity is sufficient to smooth out seasonal fluctuations, and domestic transport capacity is considered adequate to redirect seafood from export to domestic consumption (Grünfeld et al., 2023).

Sixed, long-term resilience may also be strengthened through national strategies aimed at reducing dependency on external inputs. Examples include Norway's goal of increasing the share of domestically sourced feed ingredients to 25% by 2034, and Sweden's proposal to expand domestic aquatic production by 60% by 2035 through targeted investments and better use of pelagic resources.

Finally, technological developments and a more efficient use of existing raw materials offer additional scope to increase supply. Improved processing of side streams and species that are currently used mainly for reduction, such as small Baltic herring, could broaden the range of products available for human consumption. In a severe crisis, diverting some pelagic fish from reduction to food use could raise edible supply, but would simultaneously constrain salmon feed availability.

Factors that constrain Nordic preparedness

Globalisation in the Nordic aquatic food system

The Nordic region's large production volumes imply that the system is closely tied to global processing chains and markets. There is a high degree of globalization along the value chain, from primary production through secondary processing to trade. Nordic vessels frequently land catches in foreign ports, foreign vessels land at Nordic ports, and much of the processing takes place outside the region. Moreover, seafood is the food category with the highest global trade share (Anderson et al., 2018), making the sector particularly exposed should access to external markets be disrupted (Jennings et al., 2016; Ababouch et al., 2023). If producers were unable to sell their products externally or were forced to sell large volumes domestically or within the Nordic region at significantly reduced prices, production would not be maintained at current levels. In such situations, many actors would reduce activity or cease fishing, farming, processing, and trading altogether. While the scope of the project does not allow quantification of these effects, the dependence on export markets must be acknowledged as a key factor influencing Nordic crisis preparedness (Straume et al., 2024; Asche et al., 2022; Guillen et al., 2018).

The primary sector of the Nordic seafood industry is closely integrated into global value chains, both through operations in distant waters and a substantial dependence on international inputs. Nordic fishing vessels operate to a large extent outside their own economic zones; for example, 19% of the Norwegian catch in 2023 was taken in international waters (such as Antarctica and the Irminger Sea), while 11% was harvested in British and European zones. These dependencies may increase the primary sector's vulnerability during crises.

Similarly, Greenlandic vessels catch all their mackerel and half of their herring in international waters, in addition to catching cod, haddock, and saithe in the

Norwegian part of the Barents Sea. Icelandic vessels caught 400,000 tonnes of pelagic fish in international waters in 2023, Faroese freezer trawlers operate as far away as the NAFO area east of Canada, while a substantial share of Danish catches appears from British waters. In Norway, frozen whole fish, particularly cod and saithe, originating from Russian vessels, are used as input in the Norwegian processing industry. Within aquaculture, reliance on imported feed ingredients is one of the largest systemic vulnerabilities to Nordic food preparedness. As much as 92% of the raw materials used in Norwegian salmon feed are currently imported, with plant-based proteins and oils largely sourced from countries outside the Nordic region, mostly from Europe but also from overseas markets such as Brazil, the United States, and Canada.

Although Finland has some domestic production of marine ingredients, the Finnish aquaculture industry nevertheless relies on importing half of its finished fish feed (mainly from Denmark) and sources critical additives such as vitamins and amino acids from Asian markets. This extensive integration means that the Nordic region's ability to be self-sufficient in aquatic food production ultimately depends on the stability of global supply chains. The production stage of the Nordic food system is characterised by extensive globalisation that goes far beyond commodity trade. This is evident in complex cross-border ownership structures and the strategic relocation of processing activities to markets outside the Nordic region.

The Danish processing and wholesale sector illustrates this dynamic. While many companies are Danish, a significant share of activities is owned by Norwegian and Greenlandic parent companies. Similarly, Norwegian companies today hold majority ownership in three of the four largest aquaculture firms in Iceland.

Greenlandic giants such as Royal Greenland and Polar Seafood operate not only domestically but also run processing facilities in several other countries, such as Denmark, Canada, and Germany. Moreover, a substantial share of value addition of Greenlandic products, largely halibut and shrimp happen after sale outside the Nordic region, such as in China

A large share of Nordic seafood is exported as whole, unprocessed fish for value-adding processing in lower-cost countries or hub markets (Kuempel et al., 2024; Asche et al., 2022; Straume et al., 2024). In Norway's case, large volumes of whole unprocessed fish are sent to European processing hubs such as Poland and the Netherlands, while notable volumes are also routed to Asian facilities, particularly in China, for secondary processing before entering consumer markets.

The production inputs of the aquaculture sector are also highly globalised. Feed producers located in Denmark, such as BioMar and Aller Aqua, operate global production networks, while the Norwegian feed industry is dominated by international firms, with only one of the five largest (Polarfeed) under Norwegian ownership.

Seafood is the most highly traded food category in the world. In the Nordic region, more than 80% of total production from countries such as Norway and Iceland is exported to markets outside the region, with the majority going to the European market. At the same time, a not-insignificant part is destined for overseas markets; Norway, for instance, exports roughly one-third of its output.

For the largest producer nations, markets outside Europe are important. For Greenland, China is a very large market, primarily for shrimp and Greenland halibut. Similarly, China is the most important overseas processing market for Norwegian fish, such as mackerel and cod. This market concentration creates economic vulnerability. If access to the Chinese market were restricted, it would lead to significant price drops and require large-scale redirection of Nordic seafood products to alternative markets.

Denmark is a significant importer of raw materials for its own processing industry; the majority of raw materials for human consumption originate from Nordic countries, but the reduction industry depends heavily on overseas markets.

This dependence illustrates how political instability or sanctions affecting countries outside the Nordic region can directly impact industrial capacity and product flows within the region.

This means the Nordic production system is highly exposed to global demand and logistics fluctuations. This extensive globalisation means that Nordic food preparedness is inseparably linked to geopolitics and factors beyond regional control. Although the Nordic region theoretically has a substantial surplus of fish, the commercial system and industrial capacity are structured to serve global markets rather than regional self-sufficiency. In a crisis, preparedness would be challenged by four critical factors:

- 1) Loss of decision-making control and capacity: The globalisation of ownership and the relocation of processing activities create a risk that decisions in a crisis may be guided by the interests of multinational corporations rather than national needs. If global processing hubs were to become unavailable, the Nordic region would lack sufficient local capacity to process its own raw materials.
- 2) Economic and market shocks: Because the system relies heavily on overseas demand, the loss of major markets could lead to sharp price declines and require a large-scale and logistically demanding redirection of seafood to alternative destinations. Political instability or sanctions affecting key trading partners may also reduce industrial capacity. While broad market access can offer flexibility in some types of disruptions, it increases exposure in others.
- 3) Loss of key inputs and logistics: Disruptions in international supply chains for feed, or breakdowns in transportation routes and ports, would quickly reduce the actual availability of aquatic food.

4) Lack of diversification: Limited diversification in species, inputs, processing routes, or market destinations increases vulnerability. Producers and processors that rely heavily on a single species, a single input source, or a single export market face higher exposure in a crisis, whereas more diversified operations, biologically, geographically, or commercially, are more resilient.

Overall, this means that actual Nordic supply security depends on the stability of global capital flows and trade relations, underscoring the need to integrate geopolitical risks into regional preparedness planning.

This report identifies these four systemic vulnerabilities, acknowledging that some underlying characteristics may be advantageous in certain types of disruptions but can also constrain crisis-time flexibility. Biological and regulatory constraints add further limitations. Other dimensions, including fuel availability, storage capacity, and logistics, are also important for food system resilience, but fall outside the scope of the country analyses and are therefore noted only with reference to external assessments.

Biological and regulatory vulnerabilities

Biological constraints represent a fundamental vulnerability for Nordic crisis preparedness. Several key stocks across the region show reduced spawning biomass, fishing pressure above MSY, or uncertain biological reference points. This includes multiple cod stocks, Norwegian spring-spawning herring, and a range of demersal and invertebrate stocks in Icelandic and Faroese waters. Such stock conditions limit the system's crisis flexibility: in a disruption, production cannot be increased beyond sustainable levels, regardless of demand or geopolitical need.

Regulatory and governance challenges further compound these biological limitations. Several major pelagic stocks, most notably mackerel, blue whiting, and Norwegian spring-spawning herring, lack comprehensive and stable coastal state agreements (Baudron et al., 2020; Schuch et al., 2021). Prolonged disputes over quota shares have led to catches above scientific advice, reducing long-term stock resilience and creating uncertainty about future access and quota levels. This instability affects both primary producers and processors, who rely on predictable, coordinated management regimes to plan their activities and maintain market access.

Vulnerabilities also arise from shared stocks managed jointly with Russia, particularly in the Barents Sea. While the Norway–Russia fisheries cooperation has traditionally been stable and scientifically based (Hammer, 2025; Durant et al., 2021), recent geopolitical developments have increased uncertainty. Continued access to joint stocks, quota exchanges, research cooperation, and operational coordination in shared waters cannot be taken for granted under all political conditions. Given the importance of Barents Sea cod and other jointly managed

species for Nordic supply, any weakening of this bilateral management framework would have direct consequences for harvested volumes and regional availability.

Finally, the ability to build biological "buffers" is limited. Stock rebuilding and ecosystem-based management must take place in peacetime (Mildenberger et al., 2021; Scotti et al., 2022; Perryman et al., 2025); once a crisis occurs, it is too late to generate additional supply. Strengthening the status of key stocks and resolving unresolved quota sharing disputes therefore form part of the long-term foundation for Nordic food preparedness.

Other vulnerabilities

Although factors such as access to fuel, storage capacity, infrastructure robustness, and seasonal constraints are not addressed in the country chapters, they are recognised as critical components of food system resilience. Recent EU analyses reinforce this broader perspective. The *Joint Research Centre (JRC) External Study Report on Risks and Vulnerabilities in the EU Food Supply Chain* (2023) highlights several structural vulnerability factors that directly relate to these dimensions, including dependence on upstream supply chains, limited technological alternatives, weak logistical infrastructure, and constraints in natural resources such as land and water. These structural conditions can amplify the effects of disruptions in energy availability, storage, and transport systems.

Similarly, the *European Food Security Crisis Preparedness and Response Mechanism (EFSCM) Recommendations on Ways to Mitigate Risks and Vulnerabilities* (2024) explicitly emphasise the need for resilient infrastructure, diversified supply sources, reliable transport systems, and improved crisis preparedness. The EFSCM identifies climate-smart infrastructure, robust storage facilities, improved logistics networks, and better coordination mechanisms as essential measures to reduce systemic vulnerability across the food supply chain.

Together, these reports underscore that fuel availability, infrastructure performance, storage capacity, and seasonality are not peripheral concerns but rather foundational elements that shape the extent to which food systems can adapt to different types of crises.

Scenario Analysis: Assessing Nordic Self-Sufficiency and Resilience

Building on the identification of structural strengths and vulnerabilities, this section presents the Nordic region's capacity to handle trade disruptions through two hypothetical scenarios. These scenarios allow an assessment of how the systemic factors described above, such as regional production asymmetry and reliance on external inputs, affect actual food availability when normal trade flows are restricted.

Scenario 1: Only trade between the Nordic regions

Under a hypothetical scenario where all Nordic countries trade exclusively within the region, the total availability of aquatic foods would amount to approximately 176 kg per capita in 2023. The main reason is that a large part of the production cannot be exported. Also, the distribution of availability differs sharply between countries. The smaller producer nations with large marine sectors, Iceland, the Faroe Islands, and Greenland, retain exceptionally high levels of availability per capita, even after accounting for intra-Nordic exports. By contrast, the more populous countries with limited domestic production, Sweden and Finland, and to some extent Denmark, would rely heavily on imports from other Nordic countries to meet domestic supply. Denmark, despite being a modest primary producer, becomes relatively supply-rich in this closed-trade scenario due to substantial inflows from the other Nordic countries and its role as a processing and re-export hub within the Nordic region. However, some of the lost imports may be offset by increased intra-Nordic trade in this scenario, as major producer countries find new markets within the region. Even in a closed Nordic trading system, import-reliant countries could choose to limit or stop imports from the larger producer nations. The figures therefore show potential availability rather than guaranteed trade flows.

Table 8.3: Per capita available for consumption, scenario 1.

Country	Primary production	Imports Nordic	Export Nordic	Available for consumption	kg/capita/year
Norway	3,136,890	63,960	367,383	2,833,467	511
Iceland	762,370	55,171	45,259	772,282	2,013
Faroe Islands	463,785	43,077	95,662	411,200	7,550
Denmark	186,615	591,000	174,000	603,615	101
Sweden	44,580	122,893	32,903	134,570	13
Finland	44,205	73,321	3,160	114,366	20
Greenland	261,734	3,652	190,372	75,014	1,323
Total	4,898,469	962,485	900,695	4 960,259	176

Scenario 2: Trade with allied European countries

This scenario is not quantified and is presented only as a qualitative illustration. It considers a crisis in which the Nordic countries retain access to trade with close European partners, primarily EU and EEA member states, as well as the United Kingdom, while global trade beyond Europe is disrupted. Under such conditions, Nordic seafood systems would benefit from continued access to established European processing hubs (such as Poland and the Netherlands), major consumer markets, and key logistics corridors. Likewise, imports of strategic raw materials and finished feed from intra-European suppliers would remain possible, helping to stabilise aquaculture production. Compared to a fully closed Nordic system, this scenario would alleviate some of the pressure on domestic processing capacity and reduce the need to redirect large export volumes into the Nordic market. However, the system would still face constraints due to the loss of overseas markets such as China, reduced availability of non-European feed ingredients, and potential bottlenecks in European ports and transport routes. This scenario represents a more plausible crisis setting than complete isolation, while still capturing the Nordic region's exposure to disruptions beyond Europe.

The scenario analyses indicate that the Nordic region could, in principle, sustain high levels of internal availability if external trade were restricted. The region's ability to supply aquatic foods during a crisis will hinge on its capacity to mitigate global dependencies and maintain access to key inputs, fishing grounds, processing capacity, and markets.

Overall, the Nordic aquatic food system has considerable potential to contribute to regional food preparedness. Realising this potential, however, requires addressing the underlying biological, regulatory, and geopolitical vulnerabilities well before a crisis emerges.

This scenario represents a more plausible crisis setting than complete isolation, while still capturing the Nordic region's exposure to disruptions beyond Europe. In an extreme crisis situation, some pelagic raw materials that are currently used for feed production could be diverted to human consumption, offering supplementary food options beyond the levels modelled in the scenarios.

Policy recommendations

Building on the structural vulnerabilities identified above, the following recommendations outline key policy measures to strengthen preparedness and resilience in the Nordic aquatic food system:

1) Systematically assess and prepare supply chains disruptions

Nordic seafood value chains are closely integrated with global markets for inputs, processing, and logistics. Coordinated, scenario-based assessments should be used to examine how disruptions to feed supply, processing capacity, transport routes, or market access would affect product flows. This would help identify critical bottlenecks and clarify the minimum levels of regional processing flexibility and routing capacity needed to maintain supply when external routes are constrained. Strengthening such internal options can reduce exposure to disruptions and support both crisis preparedness and consumer access.

2) Diversify feed sources

Nordic aquaculture remains highly dependent on imported feed ingredients, exposing the sector to global supply disruptions and limiting preparedness. Increasing the share of regional or domestically sourced feed materials would reduce risk and improve the robustness of primary production across the Nordic region.

3) Strengthen management co-operation on shared stocks and management of all stocks

Fisheries management is a core element of Nordic preparedness. While the management of many stocks is science-based and well-functioning, several important stocks now face biological pressure due to high fishing mortality, low spawning biomass, or unresolved management frameworks. For shared stocks, unresolved coastal-state agreements and quota disputes further reduce predictability and long-term resilience. Such constraints should be mitigated in peacetime.

Aquatic Food Consumption in the Nordic Region

Aquatic foods are essential for supporting healthy and sustainable diets, yet consumption across the Nordic region remains below the Nordic Nutrition Recommendations (NNR). Although the NNR are broadly supported by Nordic authorities, actual consumption often does not meet the recommendations, especially among younger age groups. At the same time, choices around aquatic foods are shaped by a complex interaction of cultural, individual, and product-related factors, which makes lasting dietary change challenging to achieve.

This report addresses these challenges and explores opportunities to increase aquatic food consumption in the Nordic region. It begins by reviewing the NNR and national guidelines, alongside current intake patterns and which species are consumed across Nordic countries. Next, it introduces the Aquatic Food Choice Framework, which identifies three key dimensions shaping aquatic food choices: cultural and contextual, individual, and food-related factors. Building on this framework, the report examines the most influential factors and their impact on consumer behaviour with particular emphasis on Nordic consumers.

The report also reviews EU initiatives aimed at promoting healthier and more sustainable food choices. It provides examples of how Nordic authorities are working to increase the consumption of aquatic foods in line with the NNR. It proposes a set of recommendations to help close the gap between current intake and NNR targets, drawing on insights from the Nordic Council's report "Policy Tools for Sustainable and Healthy Eating." These recommendations include strategies for diversifying diets by incorporating less commonly consumed species and promoting sustainable choices.

Nordic nutrition recommendations for the intake of aquatic foods

The Nordic Nutrition Recommendations (NNR) set the target and provide the scientific foundation for dietary guidelines across the Nordic and Baltic countries. The NNR generally recommends eating 300–450 grams of fish per week, measured as cooked or ready-to-eat weight. Of this amount, at least 200 grams should come from fatty fish such as salmon, mackerel, or herring. While there are minor deviations, these recommendations are broadly consistent with national guidelines throughout the Nordic region.

- **Norway:** The national guidelines recommend eating 300–450 grams of fish per week, with at least 200 grams coming from fatty varieties such as salmon or mackerel (Norwegian Directorate of Health, n.d.).
- **Sweden:** Adults are advised to eat fish 2–3 times per week and include a variety of species (Swedish National Food Agency, 2025).
- **Finland:** The recommendation is to eat fish at least twice a week, using different species for variety (Finnish Food Authority, 2019).
- **Denmark:** Guidelines suggest a weekly intake of 350 grams of fish, of which 200 grams should be oily fish (Danish Veterinary and Food Administration, 2024).
- **Iceland:** The recommended amount is 300–450 grams of fish per week, including both fatty and lean fish (Icelandic Directorate of Health, 2025).
- **Greenland:** Consumers are encouraged to eat local fish products frequently, ideally several times per week (Paarisa, n.d.).
- **Faroe Islands:** The advice is to follow the Nordic nutrition recommendations, adapted to local cultural traditions (Fólkaheilsuráðið, n.d.).

Intake of aquatic foods in the Nordics

In the Nordic region, aquatic food consumption is dominated by a relatively small number of species. Although reports and studies indicate that 6–10 species are a regular part of the diet in each country, some of these are eaten only in very small quantities (less than 0.5 kg per person per year, ready-to-eat weight). The four species most commonly consumed in each country are:

- **Norway:** Salmon, cod, shrimp, and saithe (Norwegian Directorate of Health, 2023).
- **Sweden:** Salmon, herring, shrimp, and cod (Axelsson & Hornborg, 2025).
- **Finland:** Farmed salmon, farmed rainbow trout, tuna, and shrimp (Natural Resources Institute Finland, 2025).
- **Denmark:** Cod, herring, mackerel, and salmon (Eurofish, n.d.).
- **Iceland:** Haddock, cod, tuna, and salmon (Sveinsdóttir et al., 2011).
- **Greenland:** No official statistics or studies available.
- **Faroe Islands:** No official statistics or studies available.

Salmon is the most consistently reported species, present in all Nordic countries with available data, underscoring its central role in the Nordic diets. Cod is also widely consumed, appearing in Norway, Sweden, Denmark, and Iceland. Shrimp is noted in Norway, Sweden, and Finland. While there are differences in the most consumed species across countries, many of the listed species are shared throughout the Nordic region, though their relative importance varies.

A framework for Aquatic Food Choice

Food choice is a complex process shaped by multiple interrelated factors. To capture this complexity, several theoretical frameworks have been developed (Chen & Antonelli, 2020; Eertmans et al., 2001; Furst et al., 1996; Grunert et al., 1996; Meiselman, 1996; Shepherd, 1999; Steenkamp, 1997). Most of these frameworks identify three broad categories of influences: the food itself, the individual, and the cultural or contextual environment in which food is consumed.

Building on this foundation, the Aquatic Food Choice Framework takes a comprehensive approach by grouping the most important determinants into three categories, reflecting the complexity of aquatic food consumption and dietary change.

- Cultural and contextual factors include traditions, social norms, and food socialisation processes that shape the environment in which choices are made.
- Individual factors involve socio-demographic characteristics, psychological drivers, and individual tendencies that influence decision-making.
- Food-related features, both internal (e.g., sensory properties, quality) and external (e.g., price, labelling, packaging).

The following chapters explore these dimensions in detail and examine how they affect aquatic food choices in the Nordic region. Understanding these interconnected elements is crucial for explaining consumer behaviour and identifying opportunities to increase seafood consumption. Together, they form the basis for designing effective interventions and policy measures that support higher intake of aquatic foods in line with the Nordic Nutrition Recommendations.

Figure A : Aquatic food choice framework

Aquatic food framework		
Cultural and contextual factors	Individual factors	Food-related factors
• Sociocultural factors • Food socialisation • Social norms	• Socio-demographics • Attitudes and beliefs • Subjective norms • Trust • Affective factors • Habits • Food literacy • Identities and individual tendencies/orientation • Personal identity • Dietary orientation • Environmental orientation • Health orientations • Innovativeness	• Food-internal factors • Sensory properties • Quality • Food-external factors • Branding and marketing • Health and sustainability • Product price • Packaging

Determinants of Aquatic Food Consumption

Our individual food preferences are unique, but they are based on cultural rules, practices and traditions we have around food (Sobal & Bisogni, 2009). In Nordic countries, eating fish has strong cultural roots varying regionally based on location and access to fish, with islands and coastal areas relying on the sea, whereas the inner parts of the countries have relied on lakes and rivers as the source of fish. Despite the differences in traditional sources of fish, the preservation methods of drying, fermenting, smoking and pickling are shared practices in the Nordic countries. The traditional use of seafood is still part of the seasonal festivities at Easter, Midsummer and Christmas meals for many consumers.

The culture creates the frame for using food, but also the context in which it is bought or eaten shapes how a product is perceived and accepted. Context covers a wide range of factors related to where, when, and with whom food is bought or eaten, as well as whether the eating occasion is an everyday routine or a special occasion. To understand why a fish product is chosen and eaten, we need to combine the product characteristics and consumers' motivations and capabilities with the context of use.

Sociocultural factors

Typically, fish is eaten as part of a meal, most commonly either lunch or dinner (Holm et al., 2019). Fish is suitable for several types of meal solutions, eaten as a fried, baked, or cooked component in a meal, or used in a casserole or soup. There are several Nordic traditional dishes where fish is the core component, and these dishes are often served as part of special occasions or seasons, such as pickled herring and raw-salted salmon at Midsummer or Christmas in Finland or fish stew at Christmas in Iceland. When the goal is to promote fish consumption, considering the roles fish play in food culture is important, as they may pave the way for greater use or serve as barriers to it. Traditional use patterns may not be functional in today's household provisioning activities, but they may provide heuristic analogues that make fish more attractive to consumers.

Food traditions are part of how consumers express their identity in terms of culture, ethics, and social belonging. For traditional food products, nostalgia related to what was eaten in childhood increased involvement in traditional products, and perceived uniqueness increased intentions to use traditional products (Olsen et al., 2021). For example, closeness to fishing traditions and locally caught species

connected to where consumers live can create nostalgia, often expressed through the use of specific seafood and processing methods (Tobias & Dieterle, 2023). There is also an effect of generations and how they express identities through seafood consumption, such as Gen Z (people typically born between mid-to-late 1990s and the early 2010s), being more focused on sustainability (Gibson et al. 2023)

Food socialisation

Food preferences and habits are learned throughout our lifetime as part of the food socialisation process (Birch et al., 2007). An important part of learning happens during childhood when children are exposed to different food-related experiences in different social environments, including home with parents and siblings, as well as daycare, schools and other environments with peer influences. Part of food socialisation is learning to eat fish as well as learning to use and prepare fish for different eating occasions. In a Norwegian study, children (4-6 years old) who participated in an intervention, eating fish at least twice a week in the kindergarten, had a more positive disposition towards fish (Alm et al., 2015). Parents and older siblings provide a model that may either promote or discourage fish eating. Parents' model and influence increased fish consumption in an Icelandic study (Thorsdottir et al., 2012).

Fish and seafood often have the challenge of being disliked by some members of the family, which may act as a barrier against eating fish at family meals (Bredahl & Grunert, 1995; Olsen, 2004). Although buying food for the household is mainly the responsibility of adults, children and adolescents influence decisions either directly or by expectations parents have about their preferences (Olsen & Ruiz, 2008; Alm et al., 2015; Hesselberg et al., 2024; Pedersen et al. 2012). Negotiating food choices among household members with different needs plays an important role in creating harmony and contentment in households.

Social norms

The social norm for desired fish consumption is set by the nutrition recommendations, and these norms are based on current knowledge on relationships between food and health, and to an extent also sustainability. As previously mentioned, Nordic countries share the basis for nutrition recommendations through the NNR. However, each Nordic country has its own food-based dietary guidelines that vary in minor details depending on each country's dietary patterns and food traditions.

Cialdini et al. (1990) have divided the norms into injunctive and descriptive norms. The injunctive norms relate to what we should do, and descriptive norms to what we expect to be typical behaviour in a situation. The injunctive social norms are expressed in food-based dietary guidelines recommending eating fish 2-3 times per week, but the social sanctions for deviating from the norm are not strong. The

descriptive norm of fish eating is lower than the injunctive norm, as people eat fish less often than recommended; therefore, there is no strong pressure to follow the recommendation, as it is not what people usually do.

Social norms are conveyed to children during the socialisation process through family eating routines and decision-making. Social norms may play a central role in adopting aquatic food to one's diet because they act as drivers for choosing fish despite the fact that children may dislike the taste or have neophobia towards eating fish (Olsen, 2004; Altintzoglou et al., 2015). Social norms of fish eating imposed by parents and by giving a model of enjoying the food may act as cues of rewarding consequences from eating fish (Higgs, 2015). Consuming the food will increase familiarity, and positive consequences of eating are likely to support the development of food preference.

Individual factors

Individual factors refer to personal characteristics and psychological determinants that shape aquatic food choices. These include socio-demographics such as age, gender, and income, as well as attitudes and beliefs, subjective norms, trust, affective factors, habits, food literacy and individual tendencies. Unlike cultural or contextual influences, individual factors act at the personal level. Understanding these factors is important when developing interventions that can target different consumer segments and encourage shifts toward healthier, more sustainable diets.

Socio-demographics

Demographic features such as age, gender, education, and ethnic identity significantly influence aquatic food consumption in Nordic countries. Age is a particularly important factor. Norwegian adults under 34 consume considerably less aquatic food than older groups, with the highest intake reported among those aged 65 and above (Norwegian Seafood Council, 2018). Similar age-related patterns have been found in Sweden (Becker et al., 2007) and among Danish children and adolescents aged 10–17 (Højer & Frøst, 2022).

At the same time, younger consumers often have a high level of environmental concern and a strong preference for sustainably sourced seafood (Gibson et al., 2023). Gender differences are also evident as women tend to place greater emphasis on health considerations when choosing seafood compared with men (Harwatt et al., 2024). Education is another socio-demographic factor that influences consumption. People with higher levels of education are generally more knowledgeable about aquatic foods and more likely to adopt sustainable food choices. Ethnic background also matters, as cultural traditions and familiarity with seafood strongly influence preferences and eating habits (Olsen et al., 2017). Taken

together, these socio-demographic factors play an important role in shaping aquatic food choices across the Nordic region.

Cost is another critical consideration. Aquatic foods are often more expensive than other sources of animal protein, and price is frequently identified as a barrier to higher consumption (see chapter on product price). Price sensitivity differs between population groups, with income, education level, and household composition all influencing how consumers balance cost against health, sustainability, and other product attributes (Franco-Arellano et al., 2019; Jensen et al., 2018). Fish and seafood have experienced the steepest price increases among all food categories in recent years in the Nordic countries (see chapter on product price). Consumers with higher education and high income are more likely to use fish according to recommendations when measured as 2-4 times per week (Salmela et al., 2022). The higher price may partly explain why the higher socio-economic status is linked to higher fish consumption. Although less expensive fish options are available, they may not be well-known or widely accepted among consumers.

Attitudes and beliefs

Attitudes are among the most extensively studied constructs in the social and behavioural sciences and are considered one of the most influential determinants of food choice (Fishbein and Ajzen, 2010; Chen and Antonelli, 2020), including aquatic food choice (Olsen, 2004). An attitude can be defined as a summary evaluation of an object or behaviour, which can be positively (favourable) or negatively valued (unfavourable) (Ajzen, 1991). Several studies have confirmed a strong positive effect between attitude towards eating fish and consumption frequency of fish, as well as seafood in Nordic countries (Olsen, 2003; Olsen, 2007; Tuu et al., 2008; Tunca et al., 2024). Attitudes follow directly from beliefs about the attitude object, which are typically formed by associating the object with various characteristics, qualities, and attributes (Fishbein & Ajzen, 2010). Over time, individuals develop beliefs about aquatic foods through personal experiences, direct observation, or indirectly via information from friends, teachers, media, and other external sources. However, only salient beliefs, those that come readily to mind, serve as the primary determinants of attitude (Fishbein & Ajzen, 1975). For aquatic food products, examples of these beliefs include health-related, taste and quality, price, environmental, and cultural aspects. These represent only some of the beliefs shown to influence consumer attitudes, and these and other important factors are discussed throughout this document.

Subjective norms

In addition to previously described social norms, individual consumers have subjective norms related to how they think they are expected to behave. In the

Reasoned Action Approach (RAA; Fishbein & Ajzen, 2010), the interest is in subjective norms related to what we think those people important to us think we should do and our willingness to comply with their expectations. Personal norms relate to our own standards and expectations of our own behaviour. If we deviate from the wishes of our important people, their disapproval can be a strong motivator towards either maintaining or changing the behaviour. Subjective norms have been shown to explain intentions to choose sustainable seafood options (Olsen et al., 2008; Tunca et al., 2024).

The distinction between social and subjective norms is complex in empirical studies, as norms in general are based on a shared understanding of what is expected and appropriate in a given context. The subjective norm relates more to the perception of social pressure from people close to us, whereas social norms can be described as generic guidelines for expected or desired behaviour in society. Eating fish regularly is often regarded as a social norm, but whether we follow it depends on perceived pressure from our immediate environment. Subjective norms develop as part of the food socialisation process, similar to preferences and attitudes, but they can also change over time.

Trust

Consumer trust is crucial for effective communication about the product's potential benefits. Many quality attributes in fish are conveyed to consumers with labelling information, such as sustainability, time and place of catching the fish, date marks on shelf-life and nutrition composition. However, these pieces of information are helpful only if consumers can trust their accuracy. According to the EIT Food Trust Report 2021, consumers in Denmark and Finland have relatively high trust in the integrity of food (61% and 64% vs. 47% in the whole sample of 18 countries), as well as fewer consumers reporting distrust (14% and 10% vs. 23% in the whole sample). Similarly, the trust in all actors in the food sector (farmers, manufacturers, retailers, and authorities) was rated higher than the whole sample. The high trust in integrity and different actors suggests that consumers in the Nordic countries trust the information they receive in food products, and therefore, product labelling can be used as a trusted channel to deliver information about the products.

Research across several EU countries (Belgium, Denmark, the Netherlands, Poland, and Spain) has examined how consumers use and trust different sources of information about fish (Pieniak et al., 2007). The findings show clear differences in both usage and trust. Personal sources such as family, friends, and fishmongers are the most frequently consulted and have the most significant influence.

Recommendations from health professionals and authorities are among the most trusted sources and are strongly linked to higher fish consumption. By contrast, mass media channels like television, radio, and newspapers tend to be less trusted,

although they help distinguish consumer segments. Product labels also play an important role, providing practical details such as expiry dates, price, species, and assurances of safety and health benefits. A recent Swedish study supports these findings, confirming that personal sources remain highly trusted and widely used, and highlighting the potential role of fishmongers and seafood counter staff in guiding consumers and offering reliable information (Costa et al., 2024). These findings show the importance of using the appropriate information sources to communicate about increased aquatic food consumption.

Affective factors

Food choices are strongly linked to emotional and affective responses to food. Taste and liking for food comes out as the strongest reason behind food choices (Steptoe et al, 1995). Taste of food and pleasure are experience-based attributes in foods and require no information or knowledge. Emotions are short-term bodily reactions that can be divided according to their valence to positive and negative emotions as well as according to their arousal level (Russel, 1980). Taste and pleasure derived from positive sensory experience are known as the strongest motivations behind food choices, whereas dislikes and the high arousal negative emotions of disgust and fear can act as barriers in food choices (Costa et al., 2024). Children in the kindergarten talked about their fish preferences in terms of making them happy (love it) or disgusted (hate it), demonstrating the emotions we associate with foods and eating from an early age (Alm et al., 2015). Capture fish and aquaculture induced more positive than negative emotions (Böhm et al., 2025). Older respondents express more positive emotions, whereas women express them less compared to men. Emotions were also linked to values so that those with biospheric values and sustainability concerns expressed stronger negative emotions towards captured fish, but those with hedonic value orientation expressed less strong negative emotions. Dislike for fish products is a challenge for adopting higher fish consumption, but it is easier to tackle with behaviour change mechanisms, such as improving capabilities and motivation, than the disgust reaction. Disgust reaction can also carry a moral dimension related to diet orientation, with low disgust scores among omnivores and pescatarians, whereas the vegans and vegetarians score high on fish disgust (Ioannidou et al., 2023).

Habits

There is a growing awareness among scientists that food choice behaviour is not necessarily based on cognitive processes only, but at least some food consumption behaviour is habitual (Khare & Inman, 2006; Jeżewska-Zychowicz et al., 2024; Coricelli, C. 2023). It is an activity we repeat several times every day, and we often do not invest much thought and effort in everyday food choices because of limited information processing capacity (Cohen & Babey, 2012; Zhu et al. 2024). The

literature of habitual food consumption in Nordic countries is scarce. Most of the "habit" literature is about food consumption patterns, which is not in the scope of this chapter. However, we believe that the nature of habits is universal, and the theoretical findings presented in this chapter also apply to the Nordic countries.

Habit is treated as a psychological factor in this report; that is, it is not just an often-repeated behaviour, as it is often used in relation to consumption patterns. Habits are evoked by cues in the environment (Brug et al., 2006; Khare & Inman, 2006; Ji & Wood, 2007), and they develop through repeatedly performing behaviour in stable contexts (Wood et al., 2002). When this repetition occurs, associations are built up between the cues in the environment and the person's response. If the context is stable and the behaviour is perceived as satisfactory, the associations acquire a degree of automaticity (Verplanken, 2006): behaviour is performed without awareness, is difficult to control, and is mentally efficient (i.e., one may do other things in parallel) (Verplanken & Orbell, 2003). Ji and Wood (2007) found in a study that consumers repeated habitual behaviours of snacking even if they intended otherwise, thus underlining the efficiency of habits: they free capacity in people's minds to think about something else. Research on habits and food choice has mostly focused on product categories. This research has shown that habit is a powerful predictor of consumption of a wide range of food categories (e.g., Verplanken, 2006; Brug et al., 2006; Saba et al., 2000), including aquatic foods (Verbeke & Vackier, 2005; Birch & Lawley, 2014; Honkanen et al., 2005).

Food literacy

Food literacy encompasses the knowledge, skills, and behaviours essential for influencing dietary choices. It is defined as a multidimensional construct consisting of several interrelated competencies required to plan, select, manage, prepare, cook, consume, and dispose of food in ways that meet nutritional needs and determine intake (Vidgen & Gallegos, 2014). Food literacy develops over time, meaning that it generally increases with age. It helps individuals to understand and navigate an increasingly complex food system (Edwards et al., 2025).

Some dimensions of food literacy have been studied among Nordic consumers, in particular cooking skills and knowledge. One in three Norwegian young adults (ages 18–35) reports that limited cooking skills and knowledge influence their food choices (Heide et al., 2023). The study also shows that there is significant variation in confidence levels when preparing meals with different types of ingredients. Young adults feel most confident making familiar dishes such as pizza, tacos, and pasta, while they are least confident when cooking fish fillets, cod fillets, or vegetarian meals. Confidence in preparing pork, beef, and chicken dishes falls between these extremes. The findings further show that young adults can prepare the greatest number of dinner dishes using vegetables and chicken (an average of seven), followed by beef and pork (around six dishes). They can prepare fewer dishes with

salmon and other fish fillets (around five), and the fewest with cod fillets (around four). The findings also show a clear connection between cooking skills and the amount of aquatic food being consumed. The young adults with the highest reported cooking skills eat about 40% more fish than those with less skills. Other studies suggest similar influences at the family level, where parents' cooking skills have been positively associated with children's seafood intake. Greater confidence in preparing fish seems to encourage higher fish consumption among youths (Burns et al., 2024). Finally, cooking skills have been shown to influence food choices in Norwegian men (Wien et al 2021). This suggests that enhancing food literacy and, in particular, culinary skills could be a strategic approach to increasing seafood consumption. This suggests that improving practical cooking skills, particularly for aquatic foods, could be an effective strategy to increase fish intake.

Individual tendencies and orientations

Food-related individual tendencies and orientations refer to how consumers perceive themselves and how this perception shapes their food choices. Individual tendencies, such as food neophobia and innovativeness, are regarded as relatively stable consumer features, whereas orientations are more malleable and shift over time. Below are gathered those factors that are regarded as most relevant in aquatic food choices.

Dietary orientation

The majority of Nordic consumers identify themselves as omnivores when asked in different consumer studies, with flexitarians and pescatarians getting a smaller but varying share in the description of diet. The share of vegetarians and vegans is typically low, staying below five percent. There is no standard way of asking about diet orientation, and the numbers between studies are therefore not directly comparable. In Danish annual surveys, the number of people who tried or reported reduced meat consumption varied between 39 and 47 percent in 2020–2023, depending on the year (Lejsgaard et al., 2024). If the aim is to promote fish consumption, those consumers who identify as pescatarians or flexitarians are a potential target group, as they are looking for alternatives to meat consumption.

Environmental orientation

Environmental orientation reflects consumers' concern for sustainability and ecological impact. Those with strong environmental values tend to choose foods with a low environmental footprint, often guided by eco-labels. In seafood, this is commonly expressed through preferences for fish or products certified by sustainability schemes such as the Marine Stewardship Council (See chapter on health and sustainability labelling for more examples). In the Nordic region, sustainability is embedded in the NNR, and in 2025, the Nordic Council emphasised the importance of sustainable aquatic food systems and responsible stewardship of marine ecosystems.

Health orientation

Health orientation is when consumers prioritise nutrition and disease prevention when they choose their food. Consumers with a high health orientation often include seafood in their choices, as it is frequently selected due to its health-promoting properties and recommendations, such as positive health outcomes from omega-3 fatty acids and overall dietary benefits (Budhathoki et al., 2022). This type of behaviour is not influenced by whether seafood is farmed or wild (Altintzoglou et al. 2011). Health-oriented consumers represent a substantial segment, approximately 30%, of Nordic seafood consumers, as identified in a study in Norway, Iceland and Denmark (Altintzoglou et al., 2012).

Convenience orientation

Convenience orientation is the degree to which consumers prioritise ease and speed while planning, preparing, cooking and disposing of food. Ready-to-eat products and easy recipes are examples of concepts that are attractive to such consumers. According to a recent review, the perceived convenience of seafood products significantly influences purchase decisions, as busy lifestyles lead consumers to choose seafood that requires minimal effort and time (Govzman et al., 2021). Many Nordic consumers prefer convenient seafood options. The convenience factor often overrides other considerations, leading to potentially less sustainable seafood choices; hence, improving convenience without compromising sustainability is an important challenge for the seafood industry (Christenson et al., 2017). Convenience in terms of including ingredients and recipes that assist food preparation is also relevant for the Nordic markets (Altintzoglou et al. 2012). However, when consumers have high confidence in their cooking skills, they do not prefer convenient products (Wien et al 2021). Convenience-oriented consumers account for a large portion, approximately 40% of seafood consumers in Norway, Iceland, and Denmark (Altintzoglou et al., 2012).

Ethical orientations

Ethical concerns are becoming increasingly important in seafood consumption across the Nordic region. Ethically conscious consumers want transparency in sourcing and production methods, and they support responsible fishing and aquaculture practices (Theben et al., 2020; Altintzoglou et al., 2010). Labels that effectively communicate their commitment to animal welfare and sustainable harvesting are more likely to engage these consumers (Franco-Arellano et al., 2019). Fish welfare is also increasingly important for consumers in Norway (Govaerts and Altintzoglou, 2024).

Certifications can help reassure consumers about the ethical standards of seafood products. When paired with detailed sourcing information, these certifications enhance trust and influence purchasing behaviour (Wellard-Cole et al., 2020). In the

Nordic context, where ethical consumption is closely tied to cultural identity, aligning marketing strategies with these values is essential (Franco-Arellano et al., 2019).

Food neophobia

Food neophobia can be described as a personality trait characterised by *“the reluctance to eat and/or avoidance of novel foods”* (Pliner and Hobden, 1992). This trait significantly influences consumers' food choices and is characterised by a cautious approach toward foods with unfamiliar sensory attributes. Food neophobia has been positively related to other factors like familiarity, convenience, and price, while negatively correlated with health, natural content, weight control, environmental concerns, animal welfare, social justice, and ethical food choices (Jaeger et al., 2021). The majority of studies identify food neophobia as a significant barrier to the consumption of certain foods, including insects (e.g., Hartmann et al., 2015) and cultured meat (Wilks et al., 2019).

For aquatic foods, food neophobia has been associated with various types of aquatic foods, including algae (Birch et al., 2019; Moons et al., 2018; Costa et al., 2025). Costa et al. (2025) recently examined how food neophobia influences sensory expectations for five types of seafood (salmon, herring, oysters, octopus and seaweed), among Swedish consumers. The findings revealed that expected liking was highest for salmon, followed by herring, seaweed, and, lastly, octopus and oysters. Food neophobia showed a negative association with expected liking for all species except salmon, likely due to its familiarity and regular consumption in Sweden.

In a Norwegian study, food-neophobic toddlers were found to consume less fish. Although not directly investigated, the authors suggested several possible explanations, including instinctive avoidance of unfamiliar fish varieties, heightened sensitivity to strong odours, and aversion to soft or easily crumbling textures (Helland et al., 2017).

Innovativeness

Innovativeness is, in a sense, the opposite of neophobia, and it is defined as when consumers are willing to adopt new products and are open to novelty, as well as try unfamiliar foods. Examples of current innovative food choices include functional foods, lab-grown meat, fermented food, and plant-based protein sources. In terms of seafood, underutilised and unfamiliar species could be chosen more often by consumers with a higher innovativeness (Garibay-Yayen & Willer, 2025). A study found that about one-third of Norwegian consumers exhibit high innovativeness (Heide and Altintzoglou, 2015). These individuals also show the strongest preference for convenience, meaning they are willing to try new food products as long as they are easy to use and prepare. This focus on convenience likely stems from the fact that this segment has the highest number of children, leaving less time for meal preparation.

The adoption of new products can be described using the innovation adoption model, where crucial consumers are innovators who seek novelty and early adopters who follow closely if the indications of product quality are promising (Rogers, 2003). The early majority follow the early adopters, and once the early majority adopt a product, the late majority will follow. The innovators and early adopters can differ in different domains, and there is a special measure to segment consumers according to their innovation adoption interest in the food domain (Huotilainen et al., 2006).

Food-related features

Food-related features influencing aquatic food consumption in Nordic countries can be divided into two factors: food-internal and food-external factors. A food-internal factor can be defined as the features inherent to the food itself, such as sensory properties (e.g., flavour, taste, smell, texture) or product quality. Food-external factors refer to factors that are associated with a food product, but not a part of the physical product itself. These factors include both visual characteristics and informational elements related to the product. Visual characteristics include aspects such as labels, brand logos and packaging design. Informational elements comprise marketing, labelling and product price. Although these factors do not alter the properties of the food itself, they play a significant role in shaping consumer perceptions and decision-making processes. This chapter explores some of these factors and how they individually or in interaction influence consumer behaviour in relation to aquatic foods.

Food-internal factors

Sensory properties

Food is closely associated with sensory characteristics such as taste, smell, and texture (Aikman et al., 2006; Grunert, 2002). Sensory appeal, the physical and chemical properties perceived before and during consumption, significantly influences food choices (Jaeger et al., 2021). Among these, taste preferences are the most crucial factors (Ophuis and Van Trijp, 1995; Steptoe et al., 1995). Sensory appeal and taste preferences are also highly important for aquatic food consumption (Olsen, 2003; Verbeke and Vackier, 2005; Govzman et al., 2021). This is very evident among Nordic consumers, as highlighted by numerous studies (Bredahl and Grunert, 1995; Pihlajamäki et al., 2019; Sveinsdóttir et al., 2009; Olsen, 2003; Sveinsdóttir et al., 2009).

Several studies have identified taste, smell, and the presence of bones in fish as barriers to aquatic food consumption (Govzman et al., 2021). This has also been found among Nordic consumers (Bredahl and Grunert, 1995; Heide et al., 2023;

Olsen, 2001; Pieniak et al., 2009). In a study of Norwegian households, the negative impact of smell and bones accounted for 13% of the variance in motivation to consume seafood (Olsen, 2001).

Quality

Perceived quality is recognised as a critical determinant of consumer attitudes and food choice (Oude Ophuis and Van Trijp, 1995). Perceived quality can be defined as *"the consumer's evaluation of a product's overall excellence or superiority"* (Zeithaml, 1988). In aquatic consumption behaviour, perceived quality is a key factor in shaping positive attitudes toward seafood choices (Olsen, 2002; Thong & Olsen, 2012; Verbeke & Vackier, 2005)."

Aquatic food quality is shaped by both product-related and individual factors. Commonly cited product-related dimensions include safety (Sheng and Wang, 2021), nutritional content (Khalili Tilami and Sampels, 2018), freshness (Altintzoglou and Heide, 2016), and physical attributes of the fish product (Bernardo et al., 2020). Although quality is closely linked to the characteristics of the raw material, food choice is also shaped by individual factors, including consumer attitudes and trust in the final product (Grunert, 2002), as discussed in earlier chapters. Accordingly, both the inherent quality of the raw material and how it is perceived by consumers represent key determinants of choice in the market for aquatic products. Importantly, quality evaluations vary across consumers and cultures, also within Nordic countries (Verbeke et al., 2007; Østli et al., 2013).

Food-external factors

Branding and marketing

Brand is acknowledged as a highly important factor in consumer decision-making (Sasmita & Mohd Suki, 2015). The literature further highlights brand as one of the most influential food-external factors (Hoffmann et al., 2020). In the context of aquatic foods, brands are associated with a higher price (Bronnmann & Asche, 2016) and greater product longevity, the number of consecutive weeks a product remains available in retail settings (Asche et al., 2021). To date, however, the impact of branding on consumer choices for aquatic foods has not been studied in the Nordic countries.

Marketing strategies play an important role in influencing consumer behaviour within the seafood sector. Clear and trustworthy communication, especially about health benefits and ethical sourcing, helps build consumer trust and loyalty (Giménez et al., 2017). In an environment characterised by abundant and often conflicting information, consistent branding becomes essential for differentiating products.

Clear and open communication about aquaculture in Europe can help improve the image of farmed seafood and strengthen trust in seafood products overall (Altintzoglou et al., 2010). A potentially impactful communication strategy is storytelling. One approach can be explaining to the consumers where aquatic food comes from, for example, through references to local fishing traditions or sustainable production methods. This approach appears to have a particular impact in the Nordic region, where authenticity is highly valued (İlçer & Karadağ, 2023). These stories can create an emotional connection with consumers, which in turn supports more informed and positive purchasing choices (Giró-Candanedo et al., 2022).

Digital marketing is also gaining importance, especially among younger consumers who increasingly rely on online platforms for food-related information. Targeted use of social media and influencers can improve awareness of seafood's health benefits and ethical considerations, helping brands remain relevant in a rapidly changing market (Jensen et al., 2018).

Health and sustainability labelling

Nutrition labels play an important role in shaping consumer choices, particularly for aquatic food. Research shows that health and nutrient claims on packaging can strongly influence how people perceive the nutritional value of these products (Hieke et al., 2016). In the Nordic countries, awareness of the health benefits of seafood, such as its high omega-3 content, has grown steadily. Labelling schemes such as the Nordic Keyhole make it easier for consumers to identify healthier food choices and have been linked to higher consumption of fish and seafood (Hieke et al., 2016). At the same time, health claims may sometimes lead to a so-called "health halo" effect, where products are perceived as healthier than they actually are based on limited cues (Wellard-Cole et al., 2020). This shows the importance of clear and accurate labelling, which is particularly important because of the increasing interest in trends such as clean eating. Labels that offer transparent nutritional information and comply with recognised standards are generally viewed more positively by consumers (Donato & D'Aniello, 2021).

Interest in sustainability labelling is also rising, but its impact remains modest due to inconsistent formats, difficulties in understanding, and confusion caused by multiple schemes, a challenge that applies to aquatic food as well (Richter & Klöckner, 2017). While such labels can influence attitudes and willingness to pay, trust, simplicity, and complementary measures are essential to drive real behavioural change (Cook et al., 2023). Nordic consumers currently encounter a wide range of sustainability certifications, including the Marine Stewardship Council (MSC), Aquaculture Stewardship Council (ASC), Friends of the Sea (FOS), and the Swedish label Krav. The abundance of these schemes reinforces previous findings that the sheer number of labels available constrains effectiveness.

Product price

Price is a key factor in food choices, particularly for low-income consumers (Steenhuis et al., 2011). Affordability and food prices are also key factors influencing the selection of healthy foods. This also applies to aquatic foods, where price is a major consideration in purchasing decisions and is often perceived as a barrier to increased consumption (Govzman et al., 2021). These patterns can be found among Nordic consumers as well (Olsen et al., 2017; Heide et al., 2023).

Price is a key driver of aquatic food consumption in the Nordic region. Evidence from several sources shows a clear inverse relationship: as prices for aquatic foods rise, consumption declines (Norwegian Seafood Council, 2018; 2025; Axelsson & Hornborg, 2025). An important development in terms of price for aquatic food can be found by comparing the development in the Consumer Price Index (CPI) of different food product groups across the Nordic countries. By using data from national statistical agencies in Norway, Sweden, Finland, and Denmark (Statistics Norway, Statistics Sweden, Statistics Finland, and Statistics Denmark), CPI changes for major food groups between 2015 and 2023 can be analysed. Iceland was excluded due to a lack of comparable product-level data. Using CPI is important because it reflects changes in consumer prices over time, providing a reliable measure of inflation and its impact on household purchasing power.

Table A: Percentage increase of CPI for different food groups in Nordic Countries (2015–2023)

Product group	Norway	Sweden	Finland	Denmark	Overall
Bread and cereals	35.5%	11.7%	26.1%	33.5%	26.7%
Meat	36.3%	7.9%	27.7%	25.2%	24.3%
Fish and seafood	63.4%	13.8%	52.7%	31.6%	40.4%
Milk, cheese and eggs	28.9%	13.0%	23.8%	40.7%	26.6%
Fruit and berries	35.9%	3.1%	17.9%	19.8%	19.2%
Vegetables	39.1%	8.6%	23.1%	28.0%	24.7%

The results show that fish and seafood experienced the most substantial price growth among all food categories between 2015 and 2023, with an overall average increase of 40.4 % across the four Nordic countries. This increase is much higher compared to other food groups such as meat (+24.3%), vegetables (+24.7%), bread and cereals (+26.7%), milk, cheese and eggs (+26%), and fruit and berries (+19.2%). Norway and Finland stand out with exceptionally high increases for fish and seafood, at 63.4% and 52.7% respectively, far above their other food categories and the Nordic average. In Sweden, overall food price inflation was lower, yet fish and seafood remained the most affected category, increasing by 13.8%, which is

modest compared to neighbouring countries. Denmark showed a moderate rise of 31.6% for fish and seafood, while milk, cheese and eggs saw an even higher increase of 40.7%.

Higher prices for aquatic foods in the Nordic countries can have an impact on how much people eat. As prices rise, many consumers, especially those who are sensitive to price, may eat less seafood, making it harder to follow the NNR. Instead, people may choose cheaper options like frozen or processed fish, or replace seafood with other protein sources such as meat or plant-based products.

Packaging

Packaging plays a crucial role in capturing consumer attention, shaping perceptions of product quality and value, and ultimately influencing food choices (Karimi et al., 2013; Silayoi & Speece, 2007). Food products utilise a diverse array of packaging attributes, combining visual elements such as colours, designs, shapes, and functionalities, as well as technical features, symbols, and informational elements such as messages and nutritional information, to appeal to consumers (Nancarrow et al., 1998). The visual design of packaging plays an important role in attracting consumers to food products. For instance, packaging that incorporates green tones or eco-friendly symbols can enhance perceptions of health and sustainability (Theben et al., 2020).

The packaging attributes of aquatic food products have received relatively little attention in the literature (Carlucci et al., 2015). Research from the Nordic countries indicates that packaging attributes moderately influence consumer decisions about aquatic foods (Heide & Olsen, 2017; Olsen et al., 2017). Other aspects, like perceived quality, are more important in influencing consumer preferences. When comparing packaging design attributes to informational attributes, a Norwegian study indicates that informational elements, such as freshness claims, taste descriptions, and convenience information, are more influential than visual features like packaging shape and colour (Heide and Olsen, 2017). A limitation of these studies is that other influential packaging elements, such as brand name and brand logos, were not a part of the studies. A product development study in Norway, Iceland and Denmark also indicated that consumer segments respond differently to various product concepts in the same packaging. The shape of fish fillets and additional ingredients, together with lifestyle, were more influential than the product packaging (Altintzoglou et al. 2012).

Policy Measures and Interventions (to Promote Aquatic Food Consumption)

Increasing the use of aquatic food among consumers in the Nordic countries requires finding ways that enable changes, taking into account the complexity of factors influencing aquatic food choices. Changes may require finding ways to break the existing habits to give space for new routines, and build consumers' motivation and capability to make the changes, together with providing opportunities to select fish and seafood options. Adopting the COM-B approach (Michie et al., 2011) from the Nordic Council policy report (Jungsberg et al., 2024) entails that consumers' active behaviour change requires not only adequate motivation but also an opportunity and capability to make changes in the diet.

Motivation to increase aquatic food consumption can be supported by the social norms of nutrition recommendations and information about seafood being good for health, and, if chosen correctly, also sustainable to promote positive attitudes towards aquatic food. Those with high environmental and health orientations may be the ones most responsive to health-and sustainability-related information, because it aligns with their values and identity. There is also a need to pay attention to those consumers who may be more driven by convenience orientations and those with an interest or fear of novelty driving motivations. The motivational factors that are appealing differ in importance among consumers based on individual factors.

Capability to make changes refers to both physical and psychological capability. In increasing fish consumption, the lack of skills in handling and cooking the fish can be a barrier that needs overcoming. Health and sustainability claims or other product information require the capability to interpret the messages correctly. The lack of experience with cooking fish may also be a psychological barrier, creating uncertainty about buying and serving fish, as it carries a risk of failure in providing tasty food to the family.

Providing the opportunity to choose aquatic food can be physical and related to the availability of good-quality and local fish in the stores, or having the necessary financial resources to buy fish. There is also the social aspect of opportunity, as many meals are eaten together with other household members, which requires shared acceptance of decisions. Whereas motivation and capability mainly depend on individual consumers, opportunity depends on external factors. What is produced, what are the distribution channels, and what is the cost of fish?

When considering policy options to promote aquatic food consumption, it is important to also consider the possible behavioural mechanisms through which the behaviour changes can happen. Instead of trying to increase consumer motivation, one option is to bypass the reflective motivation and make changes in the choice architecture or impose regulations.

Nordic authorities' efforts to promote aquatic food consumption

This chapter provides examples of how governmental authorities in Nordic countries participate in campaigns and initiatives aimed at promoting the consumption of aquatic foods.

Nordic nutrition recommendations

As described earlier in the report, the Nordic Nutrition Recommendations (NNR) provide the scientific foundation for dietary guidelines in the Nordic countries. The most recent edition, NNR 2023, is the most comprehensive to date and is the first to explicitly combine health and environmental perspectives. It includes updated nutrient reference values as well as a broader assessment of different food groups. Information about NNR 2023 is shared through several channels, including the Nordic co-operation website (www.norden.org) and websites of national authorities. The NNR is the basis for the national guidelines, which are promoted through various national channels. NNR 2023 is promoted through various channels, including the official Nordic Cooperation website and national authorities across the Nordic region, serving as the standard foundation for country-specific dietary guidelines and public health policies.

Fiskesprell – Norwegian national nutrition program

Fiskesprell is part of preventive public health efforts and aims to reduce social disparities in dietary habits. Public health in Norway is generally good, but there are significant differences in life expectancy and years lived in good health. Therefore, it is essential to ensure equal opportunities for all children and young people.

The goal of all activities in Fiskesprell is to facilitate increased seafood consumption among children and young people. This will be achieved by motivating and inspiring adults responsible for their diets, as well as the children and youth themselves, to prepare seafood dishes that they enjoy (source: fiskesprell.no).

The school curriculum for Food and Health emphasises that food and meals are vital for both physical and mental health. Nutrition is also addressed in other subjects, such as Physical Education, Social Studies, and Science, creating opportunities for interdisciplinary teaching. Knowledge about food and meals that promote healthy eating habits can help reduce health inequalities in the population. Fiskesprell encourages children and young people to eat healthier by learning more about seafood. The program works closely with schools, helping teachers to include

seafood in Food and Health classes through free teaching materials and support with ingredients. Fiskesprell also offers courses for teachers in different subjects, helping them build confidence and knowledge about food and nutrition. In kindergartens and after-school programs, Fiskesprell helps implement national dietary guidelines through staff training. Additionally, it offers annual courses to universities, colleges, and vocational schools to ensure future educators understand the importance of healthy food offerings and gain practical experience in preparing seafood dishes.

Finland's school meals

School meals in Finland are considered an integral part of education, upbringing, and promoting pupils' well-being, as well as a key public health measure. The Finnish National Board of Education and the National Public Health Institute recommend that municipalities, education providers, and schools adhere to guidelines provided by the State Nutrition Advisory Board when planning and organising school meals.

Finland's school meal guidelines encourage schools to provide healthy, well-balanced meals that follow national dietary advice and cover about one-third of a pupil's daily energy needs. Schools are advised to serve fish at least once a week, and preferably twice, using low-fat cooking methods and a variety of fish species. Fish is presented as an important part of a healthy diet, alongside vegetables, whole grains, and low-fat dairy products. These guidelines aim to make sure children get the nutrients they need while helping them develop healthy eating habits that can last a lifetime, including regular seafood consumption (Finnish National Nutrition Council, 2017).

Sweden's school meals

School meals in Sweden are an important part of both learning, health and social equality. They give children nutritious food that supports growth, concentration, and school performance, while also promoting fairness by providing free meals to all pupils, regardless of their background.

Swedish school meal guidelines encourage schools to serve fish and shellfish regularly as part of a healthy and environmentally responsible diet. Fish should be offered at least once a week, with fatty fish included every other time to ensure children get enough important nutrients such as omega-3 fatty acids and vitamin D, which many children do not get enough of. Common examples of fatty fish include salmon, herring, and mackerel. However, some types of herring and certain wild-caught fish from the Baltic Sea and large lakes are not recommended due to environmental pollutants (Swedish Food Agency, 2023).

Finnish recommendation for workplace catering

In Finland, there is also a targeted nutrition recommendation for worktime eating, which is targeted to those who make decisions about organising worktime meals and restaurants and canteens that provide the services. The newest guidelines will be published in February 2026. These guidelines will give more detailed information about how the nutrition guidelines can be implemented in different work conditions, including shift work.

Paarisa (Socialstyrelsen) in Greenland

In Greenland, the authorities have run different campaigns and produced materials to promote fish consumption in Greenland. The Eat Fish campaign (Paarisa – Spis fisk) is a health promotion campaign with a focus on nutrition, targeting especially children and families. The materials include recipes, videos, and teaching materials, including a cookbook.

In 2016, another campaign, 'Meeqqat aalisarlit', targeted children and encouraged them to eat more fish with a gaming component of competing in sharing the best fish recipes.

Åland

The local government in Åland is running a campaign "Heja fisk" as part of the food-based dietary guidelines. In addition, the public local health organisation ran in 2025 a campaign (Måltid för Måltid (Folkhälsan på Åland) on locally caught fish as an important component of a climate-friendly diet.

Selection of initiatives by other organisations

In addition to direct initiatives from authorities, the Nordic and national food-based dietary guidelines are used as a basis for aquatic food promotion actions carried out by different organisations and interest groups. Below are a few examples of these activities.

The Norwegian Seafood Council is a marketing and communications organization that collaborates with the Norwegian seafood industry to increase the value of Norwegian seafood in both established and emerging markets worldwide. This includes activities to increase the consumption of Norwegian seafood in the Nordic countries. "Godfisk" (good fish) is the Norwegian Seafood Council's brand, aimed at consumers in Norway. "Godfisk" aims to give Norwegian consumers inspiration and knowledge about seafood, and to make it easier to choose fish and shellfish more often. "Godfisk" seeks to foster positive attitudes and encourage most families to increase the number of seafood dinners from typically one to at least two meals per week. The goal is to promote enjoyment of food and knowledge about seafood, seafood dishes, and seafood seasons by showing how easy it is to prepare good, healthy seafood meals (The Norwegian Seafood Council, n.d.).

In Finland, the "Pro Kala" (Pro Fish) registered association has the aim to increase fish consumption among Finnish consumers by providing materials to increase knowledge of fish and its nutritional qualities, as well as ways to use fish in a versatile manner (Pro Kala, n.d.). Thus, the aim is to improve both consumer motivation and capabilities. "Pro Kala" is a non-profit association with organisational members from the fish sector, from fishermen and fish processors to fishmongers, covering the whole value chain. The association's promotional campaigns included, in 2025, a fish soup day promoting different recipes for fish soup and the month of May as the fish month, with a challenge to eat fish at least twice a week (Pro Kala, n.d.).

In Denmark, several commercial and institutional actors have launched a campaign to promote eating fish at least twice per week (2gangeomugen, n.d.). The campaign is based on official nutrition recommendations, but the activities among the campaign partners are diverse, from producing promotional materials to marketing their own fish products and services.

In Iceland, the fish industry association "Seafood from Iceland" runs several campaigns promoting local fish, targeting mainly tourists and other consumers in export markets. The campaign uses humour and videos to endorse its message (Seafood from Iceland, n.d.)

"Smart Swedish Seafood" focuses on turning underused Swedish freshwater and Baltic fish, currently treated as bycatch or underused species, into nutritious and appealing food products. By bringing together people from the fishing industry, food producers, and researchers, it seeks to support sustainable fisheries, make better use of local resources, and boost food self-sufficiency (Smart Swedish Seafood, n.d.).

EU initiatives for healthy and sustainable food consumption

The European Green Deal is the foundation for EU initiatives promoting healthy and sustainable food consumption. Its overarching objective is to make Europe the first climate-neutral continent by 2050. To support these goals, the Green Deal sets out a plan for sustainable and inclusive growth that aims to stimulate the economy, improve public health and quality of life, and protect the environment. A key part of this effort is the Farm to Fork (F2F) strategy (European Commission, 2020). This strategy focuses on making Europe's food system fairer, healthier, and more environmentally friendly. By creating a food environment that makes healthy and sustainable choices easier, the strategy can benefit people's health, improve everyday well-being, and help reduce healthcare costs for society. Aquatic foods and blue bioeconomy are integral to the F2F strategy by promoting sustainable food systems, increasing food security, and providing sustainable alternatives to

land-based agriculture. Some of the key initiatives for sustainable food consumption and facilitating the shift towards healthy, sustainable diets that link to aquatic food consumption are:

Proposal for a harmonised mandatory front-of-pack nutrition labelling to enable consumers to make health-conscious food choices

As part of the F2F Strategy, the European Commission has announced plans to revise EU regulations concerning consumer information on food products (EU, 2020). The primary objective of this revision is to enhance food labelling to support healthier and more sustainable consumer choices and reduce food waste. Key proposals include:

- The introduction of harmonised mandatory front-of-pack nutrition labelling, along with nutrient profiling criteria to regulate health and nutrition claims on food products
- The extension of mandatory origin or provenance information for selected product categories
- A revision of date marking rules, specifically concerning the use of "use by" and "best before" dates.

These measures aim to improve transparency and empower consumers to make informed decisions aligned with public health and sustainability goals.

Proposal for a sustainable food labelling framework to empower consumers to make sustainable food choices

The proposed legislative framework for sustainable food systems (FSFS) is one of the main initiatives of the Farm to Fork Strategy (EU, 2021). Its purpose is to guide how information about the sustainability of food products is shared with consumers. Together with other labelling initiatives like the ones on front-of-pack nutrition labelling (see above), animal welfare labelling and 'green claims', it will help ensure that consumers receive clear information about the nutritional value of food, as well as its climate, environmental, and social impacts.

Determine the best modalities for setting minimum mandatory criteria for sustainable food procurement to promote healthy and sustainable diets, including organic products, in schools and public institutions

To make sustainable food easier to find and more affordable, and to support healthier and more sustainable meals in public catering, the European Commission plans to introduce minimum requirements for sustainable food purchasing (European Commission, 2020). These requirements will help cities, regions and public authorities to choose more sustainable food for schools, hospitals and public institutions, and it will also boost sustainable farming systems, such as organic

farming. At the same time, they would support sustainable farming practices, including organic production. The Commission also plans to lead by example by strengthening sustainability standards in the food services used in its own canteens.

Review of the EU school scheme legal framework with a view to refocusing the scheme on healthy and sustainable food

The Commission will review the EU school scheme to enhance its contribution to sustainable food consumption and, in particular, to strengthen educational messages on the importance of healthy nutrition, sustainable food production and reducing food waste.

Policy instruments for changing eating habits

This chapter uses the report “Policy Tools for Sustainable and Healthy Eating” (Jungsberg et al., 2024) as a starting point and explores how the insights can be used to increase consumption of aquatic foods. The aim is to suggest some practical policy measures that can help shift diets toward aquatic foods from sustainable sources. Additionally, the chapter explores opportunities to diversify consumption patterns by incorporating less commonly utilised species.

The chapter is structured as follows: it begins with a summary of the key findings of the “Policy Tools for Sustainable and Healthy Eating” report (Jungsberg et al., 2024), focusing on the framework for dietary change. It then moves on to present policy recommendations designed to increase the intake of sustainably sourced aquatic foods. Finally, it discusses potential opportunities and barriers to expanding the range of species consumed.

General overview of policy instruments

Policy instruments can broadly be classified into those that incentivise specific consumer behaviours and those that directly regulate individual actions (Banerjee et al., 2021). While most behavioural change initiatives are policy-driven, evidence from the literature indicates that certain approaches are more effective than others. The report “Policy Tools for Sustainable and Healthy Eating” (Jungsberg et al., 2024) reviewed evidence from previous studies on policy measures designed to support more environmentally sustainable diets (e.g. Ammann et al., 2023; Rööß et al., 2021) as well as healthier eating habits (e.g. Livsmedelsverket, 2022). Four main types of policy tools were identified: market-based instruments, regulatory measures, nudging approaches, and information-based initiatives (Ammann et al., 2023). These measures are different in terms of how directly they affect consumer behaviour, with market-based and regulatory measures generally seen as more intrusive, while nudging and information-based approaches are considered less so (Banerjee et al., 2021). A description of each category follows:

Market-based instruments modify food prices through taxes and subsidies, thereby influencing consumer behaviour by altering relative price structures. Taxes on less healthy or environmentally harmful products, combined with subsidies for more nutritious and sustainable alternatives, are meant to encourage better food choices by making them more attractive and affordable (Critchley & Unwin, 2010; Culliford & Bradbury, 2020; De Schutter et al., 2020).

Regulatory measures, such as bans or restrictions on certain products, are the most direct form of intervention because they limit what consumers can choose from. These tools are usually introduced to address specific health or environmental risks and help maintain a controlled and safer marketplace. Although they can be effective in changing consumption patterns, they often spark debate about personal freedom and the appropriate role of government (Hatløy et al., 2021).

Nudging approaches aim to guide people toward healthier or more sustainable choices without taking options away. This can involve changes such as where products are placed, how large portions are, or how food is presented. Examples include making healthier foods easier to choose in cafeterias or increasing the availability of plant-based options in public meals (Bucher et al., 2016; Coucke et al., 2019; de Vaan et al., 2019; Friis et al., 2017; Gynell et al., 2022).

Information-based measures focus on helping people make informed decisions by improving knowledge and awareness. These include food labels, education in schools, public information campaigns, and dietary guidelines (Ammann et al., 2023; Rööß et al., 2021). Their effectiveness depends largely on consumer interest and perceived relevance, which explains their widespread adoption and high public acceptance (Banerjee et al., 2021; Macura et al., 2022).

Recommendations and Future Directions

Efforts to increase the consumption of sustainable aquatic foods in the Nordic region must be grounded in insights into the factors influencing aquatic food choices and supported by effective policy instruments. Determinants of choice have been explored in the aquatic food choice framework and the preceding review of important factors, providing a foundation for targeted interventions. As highlighted in the Nordic Council report "Policy Tools for Sustainable and Healthy Eating" (Jungsberg et al., 2024), addressing the three essential components of behaviour change, capability, opportunity, and motivation, is critical for designing impactful strategies. Consumers need not only the motivation to adopt healthier and more sustainable diets but also the skills, resources, and an enabling environment to make these choices feasible. Moreover, achieving meaningful behaviour change requires a combination of policy instruments that target different determinants of aquatic food choice. Building on the recommendations from "Policy Tools for Sustainable and Healthy Eating," the following sections outline actionable recommendations, based on the determinants of aquatic food choice, to promote sustainable aquatic food consumption through market-based, regulatory, nudging, and information-based approaches.

Market-based recommendations

Aquatic foods have seen the sharpest price increase of all food categories in the Nordic region, over 40% since 2015, making cost a major barrier for consumers to meet dietary recommendations. Because price is one of the strongest drivers in the aquatic food choice framework, lowering costs is essential to give consumers a real chance to choose fish and seafood. The report "Policy Tools for Sustainable and Healthy Eating" (Jungsberg et al., 2024) shows that lowering prices can lead to a clear increase in sales of specific food groups. For example, when Denmark removed the 20% VAT on fruit and vegetables, sales rose by 25% (Mikkelsen et al., 2021). Similar effects have been seen in Norway, where supermarket campaigns that reduced fish prices led to higher seafood consumption (NRK, 2023). Research also suggests that consumers respond more positively to subsidies than to taxes, with the removal of VAT being one of the most widely accepted measures (Lindahl, 2023). Based on these findings, reducing VAT on fish and seafood, in particular sustainably sourced products, would make them more affordable and encourage increased consumption. Additional measures, such as targeted subsidies to offset recent price increases, could further influence consumption and support increased choice of aquatic foods.

From a COM-B perspective, lowering prices expands opportunity, the external conditions that enable behaviour change. When fish becomes affordable, motivated consumers with the necessary skills can act on their intentions, making VAT cuts and subsidies powerful tools for increasing aquatic food intake.

Information-based policy recommendations

Individual factors in the aquatic food choice framework are the ones that can best be changed by information-based tools, which can enhance individual consumer knowledge, raise awareness and encourage consumers to modify their behaviour (Jungsberg et al., 2024). Individual factors are also the ones that can be used to select specific target groups for policy action.

Although consumption of aquatic foods is lower than recommended in most Nordic countries, especially among the young age groups, people eat fish and seafood less than recommended. Information efforts can be used to make young people more aware and knowledgeable about the benefits of eating aquatic food and thereby reinforce the message of food-based dietary guidelines on recommended use. Information campaigns based on nutrition recommendations mainly target changing attitudes as motivational factors, but they may also need additional activities, such as educational materials on skills or behavioural challenges linked to them, to strengthen the intended message. Furthermore, materials and messages used in campaigns need to be pre-tested among the target group in order to guarantee that the messages are understood as intended.

Young consumers can be seen as a primary target group for information-based policy instruments. Providing funding for running integrated campaigns combining awareness and educational materials with skill-building (e.g., cooking workshops, online tutorials) would support the use of aquatic foods among young adults by trying to change both their attitudes (motivation) and their capabilities to prepare fish and seafood. Although young adults can be regarded as the primary target group, the approach can be tailored to other target audiences as well.

Information-based tools include different labelling systems, and some of these are under regulatory control, such as health claims or nutrition labelling, whereas others are based on various labelling systems governed by both private and public actors. Consumers increasingly expect their choices to align with ecological sustainability, but the lack of straightforward guidance on how to make environmentally sound choices at the point of purchase can create confusion and reluctance among buyers (Petereit et al., 2022). Hence, fostering clearer communication about the consequences of seafood consumption, especially its environmental footprint and animal welfare, can enhance consumer engagement. (Govaerts and Altintzoglou, 2024).

Aquatic products are perceived to be good for health in consumers' minds, and encouraging to make this message clearer in food packaging would remind consumers about this in the shopping context. Developing and supporting harmonised labelling systems would benefit consumers' decision-making. The majority of fish products can carry a keyhole label in Sweden, Denmark and Norway, and the same applies to the Finnish Heart symbol to an extent. The keyhole and heart symbols give consumers an opportunity to identify the better options among the products in the supermarket. These labels are likely to appeal more to health-oriented consumers. Similarly, for environmentally conscious consumers, the low carbon footprint and sustainability certifications on the package can give added value (MSC, ASC).

In addition to an information-based approach, regulatory policy instruments could also be used to harmonise and simplify the sustainability and health labelling in products to support the ease of finding the relevant information when consumers are making purchases. This would improve consumers' opportunity to perceive the information in an accessible mode.

An increasing number of consumers are identifying themselves as flexitarians or consumers who try to reduce meat consumption. In addition to plant-based foods, fish and especially fish from local or underused species could be promoted as an alternative to meat among consumers who wish to reduce meat. Information about the possible less-used aquatic food alternatives and support on how these raw materials can be best utilised would both provide an opportunity and increase the capability of using new fish products.

Information campaigns could leverage cultural traditions by promoting aquatic food in connection with Nordic cultural events (e.g., seasonal festivities) and bringing up traditional dishes to strengthen cultural relevance. These campaigns could be linked to developing new product alternatives that rely on traditional fish ingredients but modify them to modern dishes (Logren et al., 2025). Combining tradition and modern dishes increases familiarity with food and thereby supports the acceptance of new traditional options by removing capability barriers.

The advantage of information-based tools is the relative ease of applying them and the ability to tailor the messages and campaigns to specific target groups, governing the heterogeneity of consumers' various food-related orientations and interests. Information-based policy instruments have high social acceptance as they appeal to consumers' freedom to make choices, but they are not very effective in inducing behaviour change (Jungsberg et al., 2024). Information-based instruments mainly support motivation in the COM-B model, but when combined with educational aspects, they can also improve consumers' capability and provide an opportunity to make desired choices.

Regulatory-based policy recommendations

Contextual factors and social norms are an important part of the aquatic food choice model. Regulation-based policy instruments can change the choice context and thereby promote the use of fish and seafood. In the Nordic Council Policy report (Jungsberg et al., 2024), regulatory instruments are divided into those that relate to consumer choice, marketing, public procurement and the new types of instruments. From these, public procurement is the most feasible option in the short term.

Aquatic foods can be promoted by strengthening the public procurement policies to ensure that schools, hospitals, and workplace restaurants serve a fish option at least twice per week, following the Nordic Nutrition Recommendations.

Implementing such a regulatory measure requires support actions to guarantee that the catering personnel have the required skills and competence to follow the recommendations, as well as sufficient financial resources to back up the policy. Putting emphasis on fish and seafood in the education and training of foodservice professionals as a supportive information-based approach would support capability building in both the public and private foodservice sectors.

As regulatory measures are often seen as intrusive and restricting consumers' own choice, social acceptance of them may be low (Ammann et al., 2023). This may require implementing supportive information-based policy action to build support for the procurement policies. From a consumer perspective, the restriction of choice can be a negative aspect, but at the same time, it bypasses the possible hurdles of needing skills to prepare the fish and provides a frequent opportunity to eat aquatic food.

As young people have lower fish consumption and report limited cooking skills (Heide et al., 2023), mandatory education and training in handling and preparing fish and other aquatic foods in school curricula (e.g. as part of Home Economics) would improve young consumers' capability to use fish in cooking.

The previous Nordic council report "Policy Tools for Sustainable and Healthy Eating" (Jungsberg et al., 2024) brings forward new types of regulatory instruments targeting the producers and retailers' side of the food value chain. For aquatic food, these kinds of regulations might demand retailers to keep a certain degree of aquatic food products available in the store or make it mandatory to have promotional material for desired options, such as eating fish twice per week, visible in the store, thus supporting consumers' opportunity and capability to make better choices. Although there is little evidence of how to implement these kinds of actions or what their effectiveness would be, regulatory instruments that target the choice environment and upper part of the value chain should be considered as possible options to influence consumer behaviour, as they may improve consumers' opportunity and motivation to buy aquatic food products.

In relation to the COM-B model, regulatory policy tools do not try to change consumers' motivational factors directly; instead, they try to change the market and use environment in a way that improves consumers' capability and opportunity to make better choices.

Nudging-based policy recommendations

Habits and social norms play an important role in the aquatic food choice framework. One way to influence these factors is by using default options, a nudging approach discussed in "Policy Tools for Sustainable and Healthy Eating" (Jungsberg et al., 2024). Default options are pre-set choices that automatically apply unless a person actively decides to change them. In everyday situations, this means that the default is followed if no conscious action is taken by the consumer. Such defaults are widely used in nudging because people often go along with the option already in place, rather than making an effort to choose something else (Lemken et al., 2023).

For aquatic food, this can be achieved by making fish the standard protein choice in public meals, such as school lunches, workplace canteens, and hospital catering, one or several days a week. This strategy can significantly increase consumption without restricting freedom of choice. When fish is presented as the standard option in shared eating settings, it helps shape social norms, encourages positive attitudes, and lowers practical barriers. Default options also make decisions easier by reducing the effort needed to choose, which supports the development of new habits. By making fish the standard choice, institutions can help people make healthier and more sustainable decisions with little extra effort. Introducing this policy in public meals is also in line with literature showing that nudges may be more effective in controlled environments, such as school cafeterias or workplace dining areas (Thapa and Lyford, 2014).

From a COM-B perspective, making fish the default option helps shape the food environment so that healthier choices are easier and more appealing. When people see others making the same choice, it feels more natural to follow along, especially when the option is convenient. This can be combined with clear information about sustainability, which can support a faster shift toward healthier and more environmentally responsible diets in Nordic public institutions.

Recommendations for expanding the range of species consumed

In Nordic countries, aquatic food consumption is concentrated on a few well-known species such as salmon and cod, even though the Nordic fishery and aquaculture industry supplies a huge selection of species. Many of these lesser-used species are much more affordable than the established ones, offering an opportunity for price-conscious consumers and those with lower incomes to meet dietary recommendations without increasing costs. The aquatic food choice framework

identifies key barriers to adopting these species. Limited food literacy, including cooking skills and knowledge, often makes consumers hesitant to purchase and prepare unfamiliar fish. Food neophobia, or reluctance to try novel foods, further reduces acceptance of less familiar species. On the other hand, innovativeness serves as an important enabler; consumers who are open to novelty are more likely to adopt new species.

Several actions can be taken to increase the consumption of less-used species:

1. Increase food literacy
 - a. Develop educational campaigns and interactive cooking workshops focused on preparing less familiar species.
 - b. Provide step-by-step recipes, interactive, and recipes on packaging for easy access to guidance on how to cook less-used species.
 - c. Integrate aquatic food literacy on aspects ranging from acquisition, how to prepare and store, and how to cook seafood lesser-used species into school curricula and other consumer education programs.
2. Reduce Food Neophobia
 - a. Organise tasting events in schools, workplace canteens, and public spaces to increase familiarity and positive sensory experiences. Support companies and initiatives that focus on bringing less-used species to the market.
 - b. Mandate variety in institutional catering (schools, workplace canteens) by including less-used species in menus.
 - c. Collaborate with chefs and influencers to normalise these species through social media and cooking shows.
 - d. Use storytelling and cultural narratives to connect lesser-known species to Nordic traditions and sustainability.
3. Nudging options
 - a. Introduce default options in institutional catering (schools, hospitals, workplace canteens) where less established species are the standard protein choice one or more days per week.
 - b. Pair defaults with clear sustainability and health labelling to reinforce trust and positive attitudes.

In terms of COM-B, this approach targets all behavioural change mechanisms. It builds Capability by improving food literacy through education, tasting events, and practical help, such as recipes. It creates opportunities by making unfamiliar species more accessible and socially accepted through tasting events, menu variety in institutional catering, default options in public meals, and collaborations with chefs

or influencers. Finally, it strengthens motivation by reducing neophobia through positive experiences and cultural storytelling, leveraging innovativeness with campaigns highlighting novelty and sustainability, offering convenient products such as meal kits, and using clear health and sustainability labelling to build trust. Together, these actions address skills, environment, and attitudes to drive lasting adoption of less-used aquatic species.

It is also important to leverage previous or existing campaigns and initiatives on increasing the consumption of less-used species, such as:

Smart Swedish Seafood - Underutilised Fish Species (Sweden)

This initiative promotes freshwater and Baltic Sea species such as bream and burbot. It has developed consumer products like minced bream and frozen fish cakes, turning bycatch into valuable food items and increasing the utilisation of these species in Swedish kitchens. Active since 2020 (Axfoundation, n.d.)

Hooked on Herring – Marketing Danish Herring (Denmark)

The "Herring 52" campaign promoted the health and sustainability benefits of herring across Denmark and neighbouring countries, achieving 13 million impressions and 2.9 million video views. Campaign launched in 2022 (Danish Pelagic Producers' Organisation, n.d.)

Smartfisk – Local Lake Fish Education (Finland)

Introduces Finnish Lake fish (roach, bream, perch) into schools across Finland and Åland. Students aged 12–18 learn to fillet and cook these species, fostering appreciation for local, sustainable aquatic foods. Recipe development and dissemination. EU-funded project, active since 2021 (Martha Foundation, n.d.)

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The Nordic Council of Ministers

The Nordic Council of Ministers is the official body for inter-governmental co-operation between Åland, Denmark, Finland, the Faroe Islands, Greenland, Iceland, Norway and Sweden.

In 2019, the Nordic prime ministers presented a vision of the Nordic Region as the most sustainable and integrated region in the world by 2030. The work of the Nordic Council of Ministers is designed to pursue that goal by making the Nordic Region green, competitive and socially sustainable.

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