

*Innovative Quality Mentoring program for
development of a Blue Competence
Framework in fin-fish production*

Output 4 - Fin-Fish work-based pilots

D4.4:

Investigate the conditions for establishing a “Blue Competence Resource Centre” in Iceland, inspired by the model for similar centres that has been successfully established in Norway. These centres have today become important contributors for sustainable growth in the fish farming sector in Norway.

Author: Sædís María Jónatansdóttir (The Westfjords Live Long Learning Centre) and Guðrún Anna Finnbogadóttir (Westfjords Regional Development Office) informed by the consortium.

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Conditions for establishing “Blue Competence Resource Centres” in Iceland

Hitra and Frøya is two municipalities located in the Trøndelag region of Norway, known for its beautiful coastal landscapes, vibrant fishing industry, and thriving aquaculture sector. It is situated on a group of islands off the coast of Mid Norway and the islands has a population of around 11,000 people.

The history of developing BCC in the region of Hitra and Frøya in Norway

Hitra and Frøya municipalities have been at the forefront of the Norwegian marine industry for many years, and are now widely recognized as a hub within the industry. This can be attributed to a combination of factors, including their business practices, favorable natural conditions, effective management, proximity to key research and development environments, and the synergies that arise from these factors. Today, the region accounts for a significant proportion of Norway's fish farming, with more than 20% of the national total, and 45% of the export value (excluding oil and gas) in Sør-Trøndelag county. The region is currently a leader in fish farming, as well as in the gathering and production of shellfish and seaweed. Additionally, the region is actively developing the marine ingredients industry, among other areas, collectively known as the marine industry.

The marine clustering consisting of companies, R&D resources, and professional provision of aquaculture VET with a centre of gravity on Hitra and Frøya, is of considerable size today, and still has great development potential. Realising the potential of the regional marine clustering in the Mid-Norway required a focus on competence, sustainability, and innovation.

In 2013, ambitions were developed by the government in Norway to develop internationally leading marine clusters, to be at the forefront of research in strategic areas within marine business development, competence development throughout the value chain, attractive educational opportunities, and competent marine capital environments. Based on, among other things, this, it was in the county municipality's strategy plan for the period 2013-2016, decided that the work on a Blue Competence Centre (BCC) should be continued as a separate organization.

Guri Kunna Upper Secondary School already had a well-developed offer within the "blue" educations. These were aimed at the education of certificate candidates in aquaculture, fishing of wild species, restaurant and food science and maritime subjects. The business community in the region was and continues to be, concerned with strengthening the educational offer, and entered into cooperation agreements with Guri Kunna School in several areas related to these "blue" educations. The school also experienced a strong interest from national and to some extent international educational institutions that either had or wanted to establish cooperation with the school. It was these cooperative relationships that were intended to develop through the BCC.

BCC should facilitate direct interaction between industry actors, R&D institutions, and educational institutions, which would also contribute to updated, relevant teaching for upper secondary education. This would benefit the business sector and R&D institutions through access to infrastructure, licences and expertise belonging to upper secondary schools and the BCC itself. Through cooperation with upper secondary schools, both business and R&D institutions would had access to resources they would not otherwise have access to, while at the same time contributing to an updated and relevant upper secondary education in aquaculture.

The relationships and projects that had already been implemented at Guri Kunna Upper Secondary School were a good starting point for trying to establish a BCC. The centre's overall goal was to facilitate and substantiate the initiatives that were already latent in the industry, in addition to generating new ones. In this way, the centre would act as a catalyst for competence enhancement and innovation in the aquaculture industry in the region.

It was desirable that BCC during a start-up phase should operate as a "junction box" for competence coupling between educational institutions, industry actors and R&D institutions within the aquaculture industry, for mutual benefit for the entire aquaculture marine cluster.

In the long term, BCC was to meet some important needs in the industry that no one else at that time managed to meet:

- The centre should become an arena for links between education at upper secondary and tertiary levels.
- The centre should help the industry make greater use of research-based knowledge, and that research can better target its R&D efforts.
- The centre would help ensure that teaching at all levels is work-based oriented, industry-relevant and maintains a high level of quality.
- The centre should help the region to attract talent nationally and internationally.

BCC at Frøya is a good example of a journey where the history of local region is of great importance for the regional business development. It demonstrates the importance of local involvement in the development of new industries. BCC is an example of a way to realize innovation- and competence-enhancing projects outside national programs, based on local initiatives and a relatively "natural" emergence of a centre in the region. In the case of BCC, it is the cooperation between the industry and the upper secondary school that formed the basis for the local initiative, which resulted in the regional design of the centre.

The idea of a BCC arose in connection with the collaboration between the "blue" upper secondary educations, and the local marine industry on Frøya. Cooperation contacts between the industry and upper secondary schools developed, and R&D institutions and institutions of higher education gradually showed interest in the form of cooperation. Separate cooperation between the R&D institutions and the local business community gradually developed as well, independently of Guri Kunna Upper Secondary School. These cooperative relationships were very fruitful for the development of the marine industry in the region and had a major impact on the number of applicants to both upper secondary school and higher education. These cooperation relationships have also aroused great interest both regionally, nationally, and internationally, and several have become interested in the "Frøya model" for cooperation. The major development of cross-sectoral cooperative relationships associated with the aquaculture industry in the region needed a separate institution to realise its full potential. The idea of a BCC located at Frøya was formulated.

BBC provides a new system for innovation and further growth of farming

An important part of BCC's work is the establishment of an innovation-friendly culture. This means working actively to create trust between the participants, lower the barriers to knowledge exchange,

and the participants' risk aversion in relation to collaboration and innovation activities. Establishing space for experimentation and a culture of openness and curiosity is necessary for BCC to achieve its goals as a facilitator. Today BBC, is an innovation and research center located in Sistranda, Frøya municipality in Norway. It focuses on providing innovation, R&D as well as supporting and providing education and training in sustainable aquaculture practices. It is organizing research and development activities related to the aquaculture industry.

The center offers a range of activities designed to help aquaculture professionals and students develop the knowledge and skills necessary to implement sustainable aquaculture practices. These activities cover topics such as fish health, nutrition, feed technology, environmental monitoring, and fish welfare. In addition, the BCC helps organizing research and development activities related to the aquaculture industry. It collaborates with industry partners, research institutions, and other organizations to develop new technologies and practices that can help improve the sustainability and efficiency of the aquaculture sector. It plays an important role in promoting sustainable aquaculture practices in Norway and beyond, and in developing the next generation of aquaculture professionals.

By creating cooperation arenas for R&D institutions, industry actors and vocational educational and training institutions, it is possible to increase the region's innovation creativity and facilitate economic development and growth. The BCC co-locates both industry actors, R&D institutions, and educational institutions, which is a unique way of organizing and operationalize close collaboration.

To achieve the necessary trust between the players, several processes in particular are designated as critical to reduce uncertainty among actors in innovative environments. These include applying collective information gatherings, collective learning processes, collective decision-making processes, and informative decision-making processes. A common feature of these processes is that they are collective, and thus contribute to creating a common understanding of the centre and its work. This helps to create a common identity for participants, reducing the cognitive distance. Thus, collective information gathering, and collective learning processes facilitate effective knowledge exchange. Indeed, collective processes for decision-making routines and informative decision-making processes will be able to provide the participants involved with predictability, and thus security and trust.

Norway is the world's largest producer of Atlantic salmon, and Trøndelag is one of the major salmon farming regions in the country. The region farms around 205 of the salmon in Norway, and it produces high-quality salmon that is exported to markets in Europe, Asia, and North America. In just a few decades, aquaculture has become a billion-dollar industry that ensures settlement and local value creation in rural areas. A high level of activity has also emerged in supply- and associated industries.

Since the beginning of the 1970s, there has been a general cross-party agreement on the strategies that formed the basis for the development of the aquaculture and fisheries industry based on environmental/resource sustainability. For Trøndelag, aquaculture has had a very good development. Based on the region's conditions, the traditional fishing industry has also developed reasonably well. Linking and cooperation between aquaculture, fisheries, research, education and derived activities has – based on an overall assessment – been reasonably successful for most of the coastal municipalities in the region.

Thus, Trøndelag, the region where Frøya municipality is located, is the most important aquaculture regions in Norway. Aquaculture has become and will still be a significant industry in the region. It produces a variety of fish and seafood products that are exported to markets around the world. Today, about 70% of export revenues in Trøndelag are based on aquaculture and fisheries. Thus, the seafood industries for the future are based on a solid business sector with origins from the coast and a forward-looking research and educational environment. The aquaculture industry in Trøndelag is an important driver of economic growth and job creation in the region, and it plays a significant role in Norway's overall seafood industry. With barely nine per cent of the country's population, Trøndelag accounts for 20-25% of the Norwegian production of farmed salmon.

Although there are still major and minor conflicts between aquaculture and fisheries in Trøndelag, the situation – compared to some other regions – is reasonably good and manageable. This is partly since cooperation and interaction between aquaculture actors, between aquaculture actors/fishermen and between different management institutions has, with few exceptions, been reasonably good and constructive.

Since the 1970s, the locality structure has changed for about 10 years, with gradual flagging off from nearby beach areas inside the fjords to the coastal areas. The ability and willingness to cooperate and cooperate in the region also strongly applies to the implementation of individual and joint measures to combat fish diseases, salmon lice, etc. that directly and indirectly affect both the aquaculture and fisheries industries.

Hardly any industry has grown faster than the aquaculture industry during the last 10 years. Fisheries and aquaculture are one of the most productive industries in Trøndelag, providing NOK 2.8 million per employee in 2020. The aquaculture industry has been a major driver of value creation in the county in recent years. Value creation in fishing, hunting and aquaculture in Trøndelag was NOK 6.7 billion in 2020, out of which NOK 6.2 billion originated from aquaculture. From 2008 to 2020, the fishing, catch and aquaculture industry in Trøndelag has experienced value creation growth that is approximately 10 times faster than the general growth in the county. Fishing and aquaculture have gone from accounting for 0.6% of value creation in Trøndelag in 2008 to 3.0% in 2020. The industry has contributed 6.3% of the economic growth in the county in the period 2008-2020.

In the brand-new Regional Development Trends 2021, the Ministry of Local Government and Modernisation (KMD) states that Norwegian value creation is increasing most rapidly in Trøndelag, by as much as 2.9 per cent annually since 2014. It's a trend that can persist.

In the national pantry Trøndelag, more of the value creation is related to aquaculture, fishing and the primary processing industry than in other counties in Norway. These industries' contribution to the gross regional product is twice as high in Trøndelag, compared to the average in Norway.

With only a few exceptions, large parts of the Trøndelag region's coastal areas are now characterized by optimism and courage, not least because of various operational/economic links directly and indirectly between fisheries and aquaculture. In particular, local/regional ownership in aquaculture/derived businesses and companies that take necessary and expanded social responsibility and the broad value creation has been of decisive importance.

In addition to the fact that the region already has world-leading technology environments, Regional Development Trends 2021 shows that businesses in Trøndelag have the highest R&D intensity in Norway. The share of enterprises with innovation activity is also above the national average.

The stage is set for Trøndelag to continue the trend of faster value creation growth. With support from Trøndelag County Council, the blue innovation communities Blåbasen in Trondheim, BCC in Frøya, Havbruksparken Midt-Norway in Flatanger and InnovArena in Rørvik have entered into a partnership to stimulate the rate of innovation in the marine sector.

In a national perspective, the aquaculture industry is important for maintaining settlements and jobs in rural areas. In a global perspective, the aquaculture industry has an important role to play in increasing the supply of food to the world's population. Most of the world's food production currently takes place on land, and the potential for increasing agricultural production with conventional modes of operation, and without extensive use of biotechnology, will, according to the UN Food and Agriculture Organization, be limited in the future. Environmental sustainability in the aquaculture industry is crucial for the industry's future, and a prerequisite for further growth in the industry. In the future, it will probably not be possible to increase production from wild fish stocks that are currently harvested a lot. Even with optimal fisheries management, most of the growth will have to take place in aquaculture.

Due to this, the BCC role has changed as the aquaculture industry has been growing. It has today become an innovation company that is growing, and which is nurturing new ideas, investing in new technology and finding sustainable solutions. For instance, around Hitra and Frøya, the BCC community is developing major investments in increased transport of salmon and vegetables by sea and with test facilities to produce renewable energy at sea.

The emergence of coastal communities with enterprising businesses and social institutions has always been a prerequisite for Norway's exploitation of the sea. Without initiative, experience, and willingness to take risks along the coast, Norway would never have had the position we have today. It is important that the country facilitates growth in ocean-based industries that builds on commercial environments, knowledge environments and capital environments located along the coast. It will both provide good conditions for growth and jobs in coastal communities and at the same time ensure that we have the world's best expertise environments to lift the aquaculture industry further. Production, processing, and sale of food contribute and will continue to contribute to significant value creation and employment.

The value creation strategy has been developed according to the methodology "smart specialisation". This means that government, business, citizens, and research work together to ensure competitive development, based on the region's unique advantages. It is about creating innovation through new combinations of existing knowledge, skills, and competencies.

To ensure that businesses and working life have relevant skills and people in the region, cooperation between educational institutions, competence providers and business and working life must be continued and strengthened. It is challenging to procure enough manpower with relevant expertise. The business sector must be mobilised to work more systematically with recruitment and to retain skilled labour. Competence-based and inclusive business and business development are crucial for

increased attractiveness in rural areas. Thus, it is important to develop decentralised competence arenas that are easily accessible to businesses and municipalities throughout Trøndelag.

A competitive aquaculture industry and an efficient public sector require further development of flexible and adapted competence offerings for the individual workplace. A greater awareness and culture of lifelong learning must be built. There is a need to ensure a balance between supply and demand for skills and labour. The challenges are greatest in rural areas. Restructuring and innovation require a comprehensive approach and a regional perspective. Many businesses are created, but too few businesses are growing. Entrepreneurship culture and further development of systems for commercialization and growth are necessary for creating success.

The BCC is intended to strengthen the entire aquaculture cluster, and not distinguish between the services offered to the organizations located in the physical centre and participants located outside the centre. The vision is to provide as far as possible as an innovation system throughout the aquaculture cluster along the Mid-Norwegian coast. Thus, as an innovation system BCC creates an arena for common understanding, and thus facilitates cooperation across the actors in the region.

It is expected that clusters and networks have been and will be considered central to Trøndelag in its efforts to stimulate restructuring, innovation, and growth in the aquaculture sector. This way of working has received increased focus in Trøndelag in recent years. Common to clusters and networks is that the participants have ambitions that can only be realized through collaboration with others. The clusters contribute to increased restructuring and innovation and are considered key players in the innovation system. It is important to have good clusters within key aquaculture business areas in the region. The Norwegian aquaculture companies and stakeholders are members of the NCE Aquatech Cluster, which is one of the world's biggest clusters operating within the aquaculture sector. The cluster's main objective is to strengthen the cluster partners' competitiveness and sustainability.

Introduction

The main objective of the Live Long Learning Centre of the Westfjords in the Blue Mentor project was to examine the need for aquaculture training in the Westfjords. Today, there is no formal aquaculture education available in the region, even though the aquaculture industry is currently perceived as an opportunity for the region going forward. Through discussions with stakeholders, the project adopted a qualitative approach and conducted a site visit to Frøya, Norway. Here we present the main findings, which are that we have begun the preparation of fisheries and aquaculture courses that meet National Occupational Standards and support vocational training in the disciplines.

The objective of this report in the BlueMentor project is formulated like this:

“Investigate the conditions for establishing a “Blue Competence Resource Centre” in Iceland, inspired by the model for similar centres that has been successfully established in Norway. These centres have today become important contributors for sustainable growth in the fish farming sector in Norway.”

Through dialogue with, for example, Iceland's largest salmon farming company, Arnarlax, there is a stated need for establishing a Blue Competence Center at one or more locations in Iceland. This as resource centers that can help the industry develop and promote new aquaculture-relevant education

programs as well as help with recruitment measures for both the educational programs and labor for the aquaculture industry itself.

Education has a major positive social impact and is one of the most important means of empowering human resources and promoting positive regional development. Training provision close to home increases participation, supports sustainable development, and enriches society. Economic impacts may include innovation, practical applications, increased competitiveness, economic growth, economic efficiency and increased employment in the region.

As part of the project, the Live Long Learning Centre worked closely with Ísafjörður Junior College (Menntaskólinn á Ísafirði (MÍ)) and local aquaculture companies, as well as consulting with relevant higher educational institutions and universities in Iceland.

When investigating the possibility of establishing Blue Competence Centres in Iceland it will be interesting to map some important factors;

1. Where are the Icelandic aquaculture industry located?
2. Where are the Icelandic aquaculture service industry located and how is it structured?
3. Where are there established knowledge institutions for collaboration located?
 - a. Research institutions.
 - b. Development and Innovation consultancies.
 - c. Universities and other higher education institutions. (EQF level 6-8)
 - d. Higher VET schools. (EQF level 5)
 - e. VET schools. (EQF level 3-4)
4. Demographics

To date, the growth of the aquaculture industry in Iceland is very much bound to the Westfjords and, to a lesser extent, to the East Iceland as the following discussion will reveal. This fact will inevitably influence the project as well as the focus of the report.

In this project, the Lifelong Learning Centre of the Westfjords worked closely with Westfjords Regional Development Office (Vestfjarðastofa) and in the later stage with Ísafjörður Junior College (Menntaskólinn á Ísafirði (MÍ)). Other stakeholders involved and interviewed were directors in local aquaculture companies, as well as directors in relevant higher educational institutions and universities in Iceland, local governments, and politicians.

The structure and main locations for aquaculture industry in Iceland

Fish farming is a young industry in Iceland which has experienced formidable growth in the last 5-8 years (Figure 1). Most of this can be explained by an increase in sea-based production of farmed salmon. Farming on Arctic char has also had a weak growth, but nowhere near the increase in salmon production. As in Norway, trout production has almost disappeared after a small peak in 2017. The same applies to cod farming.

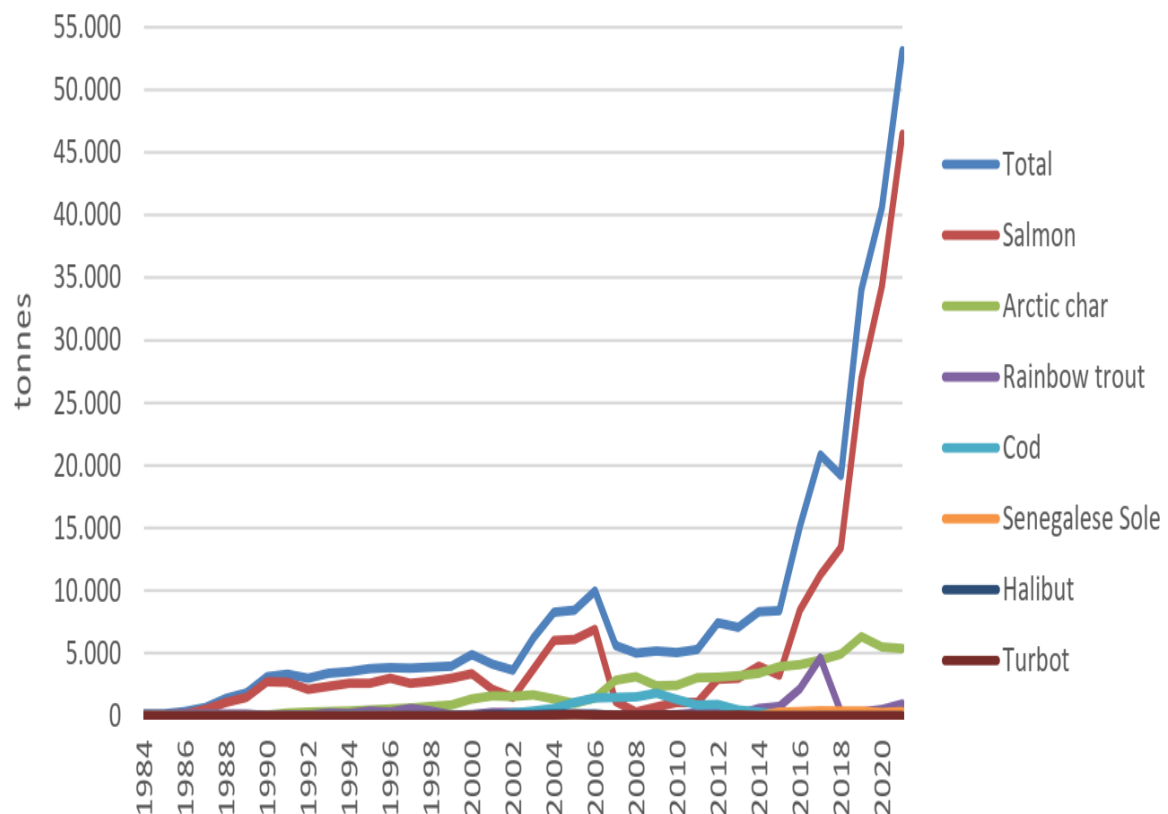


Figure 1: Aquaculture production in Iceland - Source: Statistics Iceland

With fast growing industry comes the need for more labour. In 2008, 167 people worked in the aquaculture in Iceland, compared to almost 600 employees in 2021. A challenge for the sea-based farming industry in relation to the recruitment of labour is that the sites are most often located in sparsely populated areas. This is also a challenge that is shared with Norway. In Norway, however, the industry has managed to turn around the difficult situation for recruitment and a job in this industry is now popular among young people. Many young girls are also now taking aquaculture VET education and getting a job in this industry. Apprentices in the farming industry are now actually among the best paid apprentices in Norway.

Recruitment challenges for the industry together with competence development in the industry are just a few examples of some of the most important issues a possible Blue Competence Centre can contribute to improving in the Icelandic farming industry.



Figure 2. Location of aquaculture companies and educations institutions. Source: Icelandic Directorate of Freshwater Fisheries.

Figure 2 above shows the location of the aquaculture industry in Iceland, divided in land-based (blue dots) and sea-based (orange dots) activities as well as providing information on the largest companies. The sea areas within the red lines are areas where it is not allowed to have aquaculture activity in the sea. The south coast from East Iceland to the Reykjanes Peninsula is simply not suitable for sea-based aquaculture activity. The figure also shows the location of education institutes addressed later in the report.

The Reykjanes Peninsula:

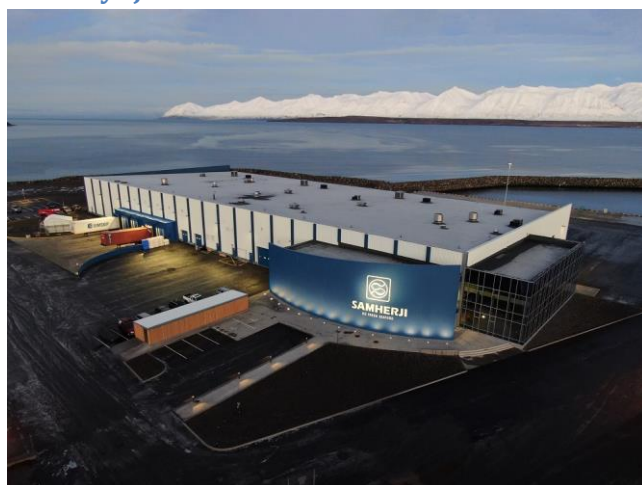


Figure 3: Source: www.samherji.is

The land-based aquaculture activity, mostly Arctic char, is mainly centered around The Reykjanes Peninsula where the biggest actor is the company, Samherji. Samherji also has several processing plants for both Arctic char and wild-caught whitefish both on the Reykjanes peninsula and on the north side of Iceland, in Dalvík (Figure 3) and Akureyri. Incidentally, they also have their head office in Akureyri, which is Iceland's second largest city.

The Westfjords and East fjords:

As figure 2 indicates the sea-based activity is mainly placed in the Westfjords and East Iceland. The sea-based activity is mostly the production of salmon. In the Westfjords you find three of five biggest aquaculture companies in Iceland, Arnarlax, Arctic Fish and Háafell as well as smaller producers. In the East Iceland you find the aquaculture companies, Laxar and Ice Fish which have now merged into Ice Fish Farm.

The Icelandic salmon industry, under the influence of Norwegian ownership, have had a very positive development in the last years. The Icelandic Westfjords and East Iceland have been characterized by emigration in recent decades, but with the positive development in the aquaculture industry, one sees that the population flow is showing signs of returning to these coastal regions. This is a development recognized from the coastal areas in Norway 15-20 years ago after the aquaculture industry also gained momentum in Norway.

Looking at the Westfjords particularly, throughout the years the economy in the area has been mostly based on the fish industry, both fishing and processing. The largest municipality, Ísafjarðarbær, has been a service center for the region although difficult transportation has put limits on that role. Tourism is a growing industry in the region, as elsewhere in Iceland. However, one can say that increased fish farming is a new pillar of the economy in the Westfjords. In 2021 about 180 people worked in fish farming in the Westfjords which is about 4.75% of the workforce in the region as figure 3 indicates.

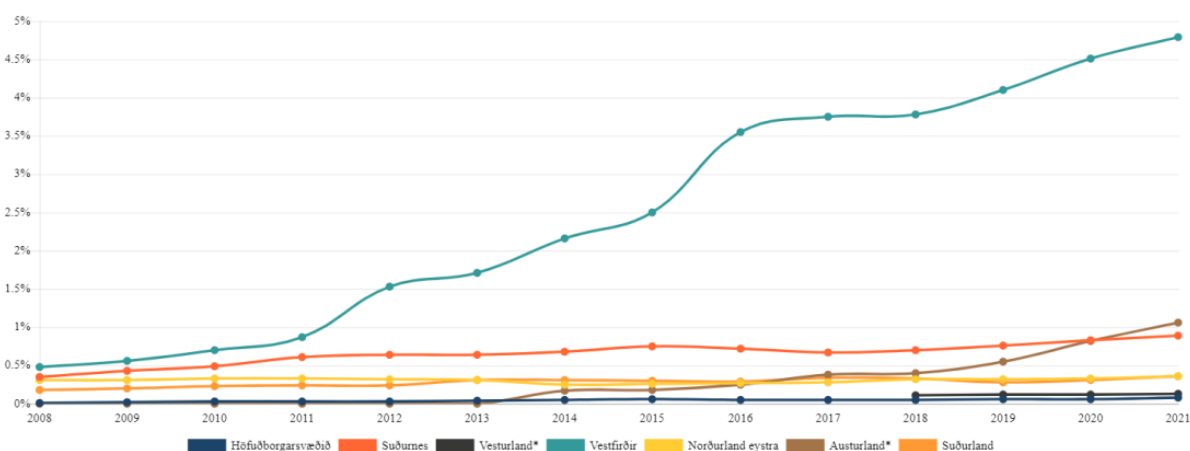


Figure 3. Share of wage-earners in fish farming out of the total number of wage-earners in each region in Iceland. Source: <https://radarinn.is/Fiskeldi/Vinumarkadur>

Service industry – Research institutes – Development and innovation consultancies

Service industry

The aquaculture industry cooperates with multiple services and supply companies. A large part of aquaculture equipment is imported but consumables are increasingly produced in Iceland. The service companies are located both in the vicinity of the industrial areas and in the capital area. In Iceland there are numerous instances of service companies that have grown and developed in the region of fish farming. Examples are companies producing supplies for the fish farming, service

regarding installing, maintaining, and inspecting of the cages, companies providing technical support, and transportation companies.

Research institutions

Research institutions in Iceland are increasingly focusing on the aquaculture industry. These institutions are mainly in the capital area but also in the regions of aquaculture companies. As an example, the key player The Marine and Freshwater Research Institution is located in Reykjavík but has branches in Ísafjörður in the Westfjords, Akureyri and Neskaupsstaður in the East Iceland among other places. Another example of a research institute which is also involved with innovation is MATIS, located in Reykjavík but with branch offices in other regions. On the local level there are Natural Science Institutes found in each region of the country, focusing on research in various fields.

Development and Innovation consultancies

Development and innovation consultancies are located in every region of Iceland. Among other things, these institutions work on specific projects with the aim of promoting the aquaculture industry in a sustainable way. An example is the Westfjords Regional Development Office which works closely with municipalities, research institutes, educational institutions, companies, and entrepreneurs in various projects. Westfjords Regional Development Office is located in The Vestra House in Ísafjörður among a number of other agencies such as the Lifelong Learning Centre, The University Centre, the local branch of The Marine and Freshwater Research Institution and other stakeholders.

Icelandic demography

Most of the population in Iceland resides in the capital Reykjavík or in the areas around it. The seabased farming industry, which has been the driver of growth in the aquaculture industry, is mainly located in the west and east of Iceland. These are areas that are sparsely populated, and this will, at least in the short term, be a challenge for further growth in the Icelandic aquaculture industry.

The last decades many areas outside the capital of Iceland have faced population decline, a monotonous economy, difficult transportation, and a low level of education. Of the two main aquaculture areas, the East Iceland has been a little bit better off than the Westfjords. According to Statistics Iceland the population in the East has been steady for some time with about 11 thousand inhabitants living there on January 1, 2022. At the same time about 7 thousand lived in the Westfjords. However, after years of depopulation the Westfjords have experienced a slight increase in the last few years, mostly in the southern part of the area where aquaculture has been growing the most.

Both the Westfjords and East Iceland have relatively high percentage of residents of foreign origin, 22,3% and 17,7% respectively. It is common for fish farming companies in Iceland to employ people of foreign origin, both permanent residents and imported labour. Therefore, the workplaces are multicultural with language barriers and cultural differences. Companies, along with societies, must aim for more inclusion, integration and multiculturalism.

According to Statistics Iceland, the level of education in the Westfjords and in East Iceland in 2021 was among the lowest in the country. About 21% of residents in the Westfjords and 23% in the East are university graduates, about 37% / 36% respectively have secondary education and 42% / 41%

had only primary education. The educational level is much lower than in the Reykjavík area where the percentage of those with primary education was 24%.

Status of aquaculture education in Iceland

Along with the increase in the aquaculture there has been a growing need for education and training in the sector, for those already working in the field as well as for potential new labour. Fish farming requires workers with a wide range of education and training, from little or no formal education to academic graduates in various fields. Despite the strong growth of the sector, the availability of education has not increased to the same extent. There are educational opportunities for employees working in the aquaculture in Iceland, some offered locally and other as a distance learning, however, the fast demand for educated and well-trained workers is far from full filled.

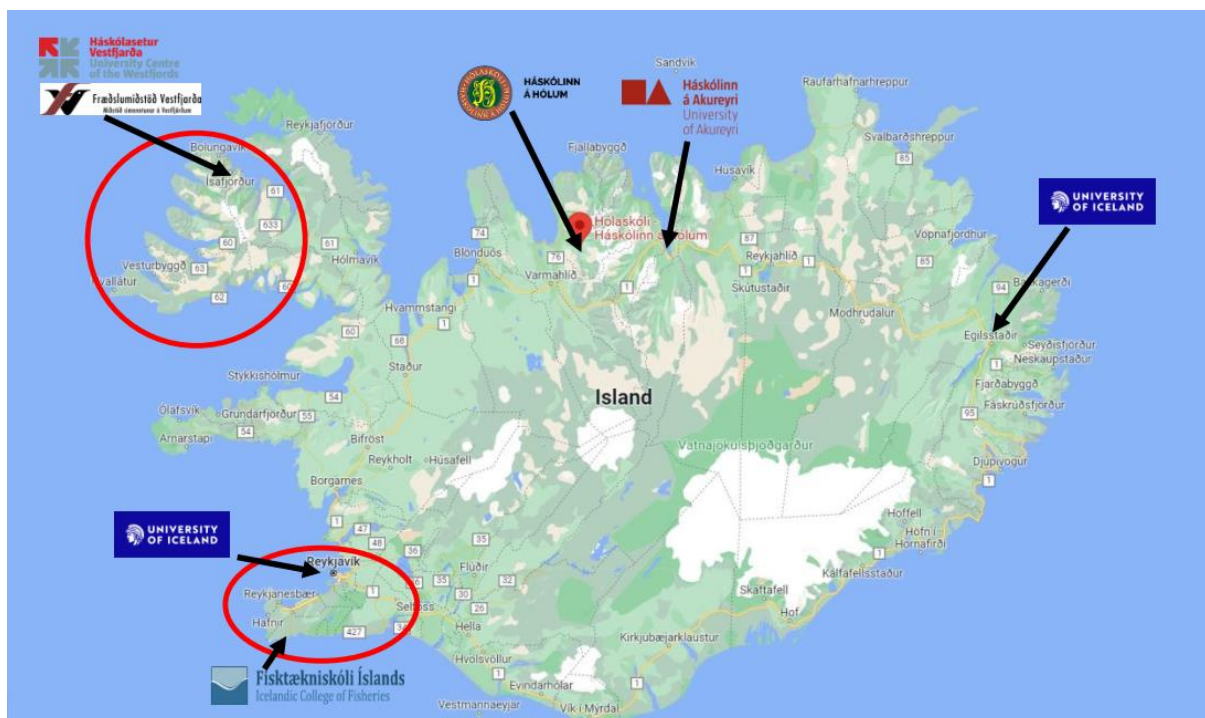


Figure 4. Higher education institutions.

The following are the main educational institutions offering education opportunities related to aquaculture. The location of these institutions is shown in figure 2 and figure 4.

Icelandic College of Fisheries (EQF3)

The Icelandic College of Fisheries, located in Grindavík, Reykjanes Peninsula, is mainly offering education and training for those already working in the aquaculture industry or at least with background in the fishing industry. The school offers a one-year program in aquaculture technology, which has been developed in partnership with the professional community and Hólar University College. However, to enrol, one must first complete a two-year program in fish technology at the Icelandic College of Fisheries. Both these programs are offered through distance learning with the vocational training taking place at the companies. In addition, the Icelandic College of Fisheries has worked with aquaculture companies providing shorter training courses for employees both through distance learning and at workplaces. These shorter courses are reserved exclusively for those who already work in the industry.

Hólar University College (EQF 6-7)

Hólar University College offers a Diploma in Fisheries Sciences, an MS in Marine and Aquatic Biology, and a Nordic Master's in Sustainable Production and Use of Organic Marine Products (MAR-BIO). The headquarters of the department are in Verið, a research, teaching, innovation, and entrepreneurship centre in Sauðárkrúkur, in the north Iceland.

University of Akureyri (EQF 6-7)

The University of Akureyri offers a B.Sc. in Fisheries Science which comprises an interdisciplinary study of fisheries science and related sciences, as well as business and management. The aim is to provide students with a sound foundation for professional employment in the fishing industry, business administration as well as for postgraduate study. There is no particular emphasis on aquaculture. In recent years the University has run the Young People's Maritime and Fisheries School, a one-week course offered to teenagers, 14-16 years old, in their hometowns. The aim of this project is to raise awareness of interesting jobs in the marine and aquaculture sectors. The project is a part of the Bridges European project, which is working on the design of new tools for the dissemination of teaching materials.

The Lifelong Learning Centre of the Westfjords (EQF 1-3)

The Lifelong Learning Centre of the Westfjords focuses on adult education in the Westfjords, particularly for those on the labour market with little formal education. The Centre offers variety of short courses, many of which are job-related, but also Icelandic courses, certified study routes, vessel training (skipper and/or engineer of vessels up to 15 metres), practical skills assessments, and academic and career counselling. Furthermore, the Centre offers an analysis of companies' educational needs and cooperates with the Education and Training Service Centre regarding qualification analyses of jobs in partnership with the private sector in specific field. In cooperation with local aquaculture, the Centre developed a beginners fisheries education curriculum (Fiskeldiskjarni), which is a basic course for aquaculture employees at a stage 2 ISQF (3EQF) qualification within the Icelandic education system framework. Another curriculum is also available for vocational trainers (Fagnám fyrir starfsþjálfara).

Junior Colleges (EQF 2-4):

Education in aquaculture at the junior college level was established in 2018 by the Junior College of Snæfellsnes and The East Iceland Academia of Engineering. The program is a two-years course (EQF3). Unfortunately, the course has not been run so far due to lack of participants. A number of junior colleges around Iceland offers vocational and technical education which can be a practical preparation for future work in the aquaculture.

The University Centre of the Westfjords (EQF 6-7)

The University Centre of the Westfjords is a small higher educational organisation. It operates two international master's programs: Coastal and Marine Management as well as Coastal Communities and Regional Development. Students graduate from the University of Akureyri but all teaching takes place at UW in Ísafjörður. The programs are international, interdisciplinary, and taught in modules. The University Centre of the Westfjords has been working on designing a B.Sc. program in fish farming education but still not started the program.

Needs Analysis and Results

Method

To analyse the status and accessibility of education in fish farming in Iceland and investigate the conditions for establishing Blue Competence Resource Centre about 30 interviews were conducted in the years 2020-2022. The interviewees were stakeholders within the fish farming industry, the educational sector as well as politicians in Iceland. The focuses of the interviews were on the current status of education for employees within the aquaculture, what kind of education and training are needed and for whom and how it should be provided and make a proposal for next steps and development in the sector.

At the initiative of the Lifelong Learning Centre of the Westfjords, meetings were held with the following entities: Ísafjörður Junior College, Icelandic College of Fisheries, Hólar University College, University Center of the Westfjord, Snæfellsnes Junior College, East Iceland Academy of Engineering and Northwest Iceland Junior College.

Within the framework of the project, the director of the Lifelong Learning Centre of the Westfjords, together with two employees from the Westfjords Regional Development Office, visited the Blue Competence Resource Centre and Guri Kunna Junior College on the island of Frøya in Norway. Institutions in the field of education and research were also visited in Norway.

Outcomes



Figure 5. Fish farming in Dýrafjörður, Westfjords.
Source: Westfjords Regional Development Office.

As previously stated, the number of employees within the aquaculture industry has been growing fast the last few years, particularly in the Westfjords. Stakeholders agree that the industry needs people with a wide range of education and skills; university graduates in various fields, people with vocational and technical background, skippers, mechanical engineers, manual labours, etc. The interviews revealed the challenges the fish farming companies are faced with in recruiting educated and/or welltrained labour, in sparsely populated areas with

weak society infrastructure and low level of education as is the case in the Westfjords. To some extent the situation today requires the aquaculture companies to hire workers with limited training and experience in the fish farming field. Furthermore, the industry in Iceland has not been able to attract young people to the same extent as in Norway. Adding to that, in many cases the fish farming companies must rely on foreign labours with various backgrounds.

The questions the companies must confront are how to attract young people to the sector, how to develop local learning opportunities for those with little formal education or experience from the industry and how to manage the challenges of multicultural environments.

Manual labours – people new in the industry and/or with primary education

The interviewees pressed the believe that, as in Norway, employees in fish farming in Iceland need a minimum of six months training to acquire the necessary skills to work in the field. Such training should take place both in the field in VET education and by formal education.

As discussed before The Icelandic College of Fisheries offers a one-year aquaculture program, however, the students must first complete a two-year fisheries program. The school is also working with some companies providing short courses on demand. Workers already in the industry can take advantage of these courses, however, they are not open for newcomers. The Icelandic College of Fisheries also cooperates with regional lifelong learning centres throughout Iceland.

The Lifelong Learning Centre of the Westfjords has a number of resources at its disposal that can be used to address the educational and training needs for people with little formal education, tools that have been developed by The Education and Training Service Centre (ETSC), an institute owned by stakeholders, unions and employers' organisations. These resources are study and career counselling, validation of prior learning (VPL), competence analysing for specific jobs, and vocational certification. These tools, which are all available for almost free due to scholarship and another financing, can all help the companies to analyse the exact need for education and training and plan further development accordingly. In this regard, language skills must also be considered in multicultural workplaces. In addition, regional lifelong learning centre around Iceland have curriculums aimed at the target group of manual labourers.

The Centre has been involved in developing studies specifically for employees in the aquaculture industry. One is a 120-hour core curriculum focusing on basic knowledge and skills needed for working in the aquaculture, including training on the site. The other is the Fish welfare course, an introduction course of salmon biology and physiology. Although both these projects were developed in collaboration with fish farming industries in the area, they have not been put into use yet, except for on experimental level. One reason being a lack of teachers, which might be addressed in the future as building up knowledge and teaching experience in the field related to the new program in the Junior College described below. The Centre will likely have better access to teachers in VET education thanks to the new initiative. Another reason is a lack of cooperation and profound recognition of the importance of education and training, something that might be expected in a new and fast-growing industry.

Young people and aquaculture education

As for attracting young people to the industry it is well known that good access to education in their local community is a great advantage. The visit to Guri Kunna in Frøya was very inspiring. Following the visit and conversations with stakeholders, both in educational institutions and in the aquaculture industry, the Ísafjörður Junior College has taken a lead in developing locally based aquaculture training for young people, in close collaboration with the Junior Colleges in Snæfellsnes, Skagafjörður in the north and Neskaupstaður in the east. The aim is to develop a program that has been given the working title "The Sea, Environment and Resources". The goal is to introduce aquaculture for people 16-19 years old, as an interesting option when it comes to choosing a future employment or further education. With the schools in different part of the country working together there is a greater chance of reaching the limits for minimum participation of students to get permission and funding to run the program.

As for now the Junior College of Ísafjörður offers about 80% of the education needed but still needs 20% specialized courses for aquaculture. There have already been discussions with Hólar University College and the Icelandic College of Fisheries about partnership in the project about, e.g., teaching specialized courses, as well as about the use of learning materials from other sources.

With support from the aquaculture industry the Junior College of Ísafjörður has been able to recruit a project manager, a veterinarian with long experience of working in the fish farming industry both in Iceland and Norway. This person's role is to lead further development and organize the program with the aim of starting teaching in the autumn 2023.

With this new program, inter-school knowledge can be used to develop powerful training that covers the oceans, aquaculture, and ocean-related resources, as well as vessel operation, engineering, and industrial training. In addition, this new approach will create opportunities for students with expertise in the local environment, which are skills highly sought after in terms of tourism, algae farming, or other things related to the coast and the ocean.

Higher education

The University Centre of the Westfjords has been planning a new B.Sc. program in aquaculture in cooperation with Hólar University College and the University of Akureyri. As for now, Hólar University only offers a diploma in aquaculture at a university level and the University of Akureyri has a B.Sc program in Fisheries Sciences but not with emphasis on aquaculture. It is hoped that by working closely together with other educational institutions and in close proximity with the main aquaculture companies in the country, an interesting option can be created for people looking for a university education. The program is expected to benefit all the involved institutions, raise the education level within the aquaculture sector and strengthen the knowledge and research community in the Westfjords. Preparation is well underway, but funding still needs to be secured.

Platform for partnership and co-operation

As indicated in the introduction, there is a sound believe that an initiative like the Blue Competence Centre in Norway could help the aquaculture industry develop and promote new aquaculture-relevant education programs as well as help with recruitment measures for both the educational programs and labour for the aquaculture industry itself. As for now, there is no such centre focusing on aquaculture in the Westfjords but there are potential initiatives that could be developed further to take on that role.

Preparations are already underway for establishing the Patreksfjörður Aquaculture Research Centre. The project is led by the Westfjords Regional Development Office, but the driving force comes from the municipalities Vesturbyggð and Tálknafjörður. The aim is to bring together various institutes to create a scientific community for research, innovation, monitoring and education in aquaculture, servicing the area and the Westfjords as a whole. Currently there is no position in that field in the southern part of the Westfjords. The Lifelong Learning Centre already has a branch in Patreksfjörður which strengthens the research centre's development. Funding is still needed to get the project of its feet.

As previously mentioned, in the Vestra House in Ísafjörður one can find various institutions that can support exciting developments in education and research structures in the field of aquaculture: the Lifelong Learning Centre, the University Centre, the Westfjords Regional Development Office, the local branches of The Marine and Freshwater Research Institution and MATIS. Initially the idea with the Vestra House was to provide a platform for service and research institutions in the area to collaborate on various projects. These well-established institutions can create a stage for further development however, partnership agreement is essential.

Conclusions:

In recent years, the fish farming industry in Iceland has grown tremendously. A further increase in growth is anticipated as a result of rising global population, growing environmental consciousness, and desire for product traceability. It is crucial for the industry to have skilled and knowledgeable labour if it is to meet these expectations. To some extent, educational institutions have not been able to follow this rapid growth, which has led to a lack of education and training for aquaculture employees. Furthermore, the number of jobs in research, innovation, and monitoring has not risen in step with the expansion of the sector.

The interviews with the stakeholders in the Westfjords confirm the critical need for aquaculture personnel's education and training. Many of the jobs call for extensive training and knowledge, and in this regard, up to six months of vocational training have been mentioned. Stakeholders in aquaculture firmly believe that education is needed at all levels and should be based on need assessments and the future vision of the industry, the government, and the education sector. Having stated the shortage of educational options it is important to point out that a number of educational institutions have created programs for workers in fish farming, both already working the industry and potential workers, that have been certified by the ministry of education. Also, the adult education sector has a number of resources that the aquaculture industry could take advantage of. Despite that, it has been challenging in some cases to carry out the programs or make use of the means at hand due to little participation. Likely reasons for this could be lack of information, ineffective marketing, or insufficient cooperation between the aquaculture and the education sectors. The industry's quick growth over a short period of time, geographic location, lack of infrastructure, prioritizing, multiculturalism, language barriers, and teacher shortage may all play a role. Furthermore, skills forecast for the industry has not been developed, and the sector and authorities lack perspective and need a future vision for aquaculture education at all levels. Above all, there are insufficient funds and a need for regulations that support the development of education and training. The importance of education and the value of learning must be prioritized by stakeholders.

A collaborative platform and common vision are among the biggest challenges when developing structure for education in aquaculture as in other strategic planning projects. It is essential to bring various parties together, pinpoint needs, and create a shared future vision. Such effort calls for stakeholder involvement, consensus, and time. A platform for aquaculture, research, and education collaboration exists in Norway, at the Blue Competence Center.

The conclusion of this project is that there is a need for a platform in Iceland based on the Norwegian model for the Blue Competence Center and the circumstances are favorable. The absence of stakeholder interaction primarily demonstrates the necessity, but the establishment of such a centre could foster greater cooperation and lay the groundwork for collaborative projects. Both in the private sector and the public sector, there are crucial conditions like needs and desires.

As previously indicated, sea-based aquaculture is concentrated in the Westfjords and East Iceland and to a smaller degree to the North, while land-based activity is expanding in the South. Westfjords is home to the biggest fish farming operations. It is only logical to place the first Blue Competence Center in the Westfjords given this fact, along with the fact that aquaculture is relatively more important for the local economy in the Westfjords than elsewhere, enthusiasm and willingness to do

so is in place and preparations have already started. The establishment of a Blue Competence Center in additional regions with extensive fish aquaculture should then be emphasized. It is crucial to build upon the institutions that are already operational in each territory and the fish farming industry. The conclusion of a cooperation agreement between the government and the stakeholders must be ensured. The regional development offices in each region must take the initiative and drive the development of Blue Competence Center in their area.

With the launch of the "The Sea, Environment and Resources" program, Ísafjörður Junior College and partner schools have already made progress in the field of fish farming education thanks to the Blue Mentor project. The program is anticipated to benefit other educational institutions in Westfjords and other regions of Iceland.

Given that the results of this research have demonstrated the need for and readiness for the development of Blue Competence Center, the next logical step would be for the Westfjords Regional Development Office to take on the task of developing a collaborative platform for aquaculture industry actors. The following steps involve assembling stakeholders and determining how to finance the creation of the Blue Competence Center. The facility should open as soon as is possible.



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