



SUMMARY

ROADMAP FOR THE AQUACULTURE INDUSTRY

SUSTAINABLE GROWTH



Our vision is that Norwegian salmon farming will become the most efficient and environmentally friendly protein production industry in the world.

Main objectives

- By 2030, salmon must be farmed using technologies that eliminate the problems of sea lice, prevent escapes and capitalize the value of particulate matter.
- By 2030, the industry will export salmon worth more than NOK 200 billion per annum and represent one of Norway's most important export industries.
- Through investments in research and innovation, suppliers to the aquaculture industry will become a significant contributor to the development of Norwegian aquaculture. Additionally, exports of products and services will increase five-fold by 2050.

This will be achieved by active development of:

- Robust Salmon and good fish welfare
- Healthy Food for a growing and increasingly health-conscious global population
- Sustainable Production that prioritises biology and environmental sustainability ahead of growth
- Strong Economy within the industry and for society

Norwegian aquaculture has experienced rather extraordinary growth since being introduced in the 1970s. In those days, the farming of salmon and trout was mainly considered a supplementary food source for the coastal population.

Since 1980, the production of Norwegian farmed salmon has increased from 4,000 tonnes to approximately 1.2 million tonnes. This means that the industry produces on average about 14 million salmon meals every day, throughout the year. Norway experienced an exceptional growth in salmon production, of around 10 per cent annually, in the 20-year period leading up to 2013. Production has since stagnated and decreased by about 5 per cent from 2015 to 2016 due to sea lice and its consequences.

Aquaculture is one of Norway's most important export industries. By 2016, seafood exceeded 12 per cent – of which salmon alone made up more than 8 per cent – of total Norwegian exports, by value. Norway accounts for more than 50 per cent of global salmon farming. Despite this, according to the FAO, the large freshwater aquaculture industry in Asia renders Norway only eighth in the world in terms of total aquaculture production.

Norwegian salmon farming is highly industrialised compared to other farming industries. Despite this, there is major potential for improvement through further industrialisation, upgrading traditional farming solutions and transferring technologies from other industries. In the future, we will also see solutions that increasingly differ from traditional production technologies.

Aquaculture suppliers, namely the providers associated with the aquaculture value chain, are among the world's most innovative and technologically-advanced companies in their field. In addition to supplying the seafood industry, they also sell products and services

to the maritime and petroleum industries. The total value contributed by these suppliers to the entire seafood industry in 2015, including associated ripple effects, was estimated at NOK 23 billion by SINTEF.

These aquaculture suppliers are currently going through a consolidation phase with acquisitions and mergers. Large established groups, both inside and outside the industry, are buying national and international technology and service companies. This consolidation is expected to continue. Leading Norwegian aquaculture suppliers have established their own organisations abroad for the purpose of selling goods and services to international markets. The Norwegian domestic market will remain important, not least for the development of new solutions. At the same time, exports of equipment and services have great potential and may exceed the value of local supply.



SALMON FARMING AS PART OF THE SOLUTION

The world's population is growing fast, getting older and richer, with more and more people living in cities. Over the last 50 years, the world's population has doubled and the world economy has increased six-fold. The middle class in emerging economies is expected to triple by 2050. The increasing purchasing power of this expanding global middle class is creating a large and growing market for Norwegian seafood. Norwegian salmon is too expensive to feed the poorest populations, but make an important contribution to world food production.

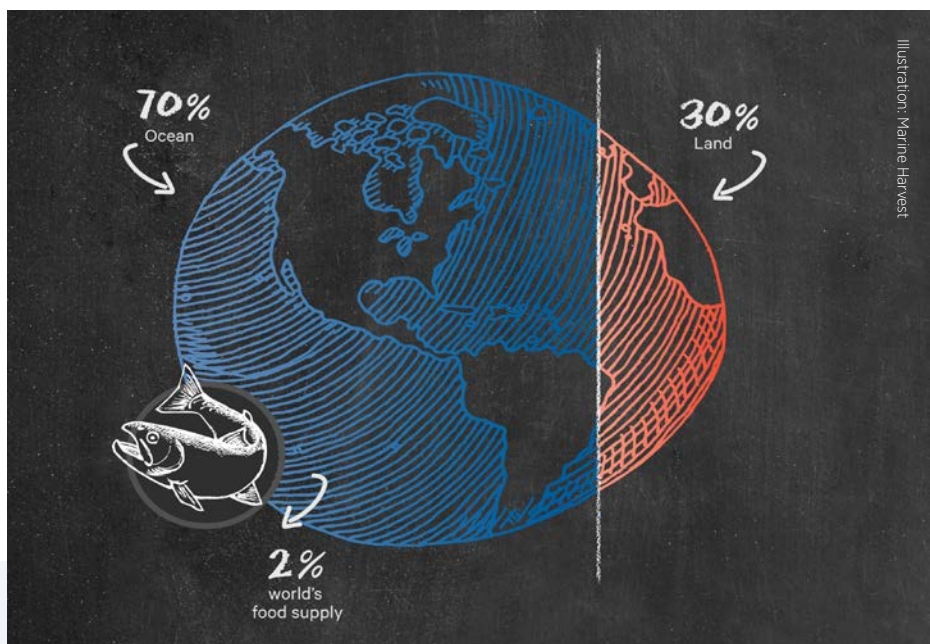
The world needs safe, healthy, good food produced in a sustainable and efficient manner. Seafood has the potential to provide this. Nearly 70 per cent of the earth's surface is covered by water, yet only about two per cent of the world's food production comes from the sea. The impact on the climate from agriculture is also significantly higher than that from aquaculture. Therefore, in order to supply an ever-increasing global population with enough food, aquaculture production must be increased.

Health authorities worldwide, including the World Health Organization (WHO), recommend

increasing seafood consumption to improve public health. Farmed salmon is a healthy and safe food. It is one of the best sources of Omega 3 in our diet. Strict regulations and ongoing monitoring ensure that farmed salmon is safe to eat. The safety and health benefits of eating fish such as farmed salmon are well-documented. According to the Scientific Committee on Food Safety (VKM), it protects against cardiovascular disease, among other things.

In many ways, access to feed raw materials represents both an opportunity and a threat to the salmon industry. A threat because of limited access to Omega 3 oils and fishmeal. An opportunity because salmon farming is one of the most efficient ways to produce protein. Additionally, many by-products are used in feed production.

Increased salmon production and greater utilisation of the opportunities provided by aquaculture will help sustain future food production. Future market opportunities for Norwegian salmon are contingent on consumers continuing to consider Norwegian salmon a healthy, sustainable and desirable product.





HEALTHY GROWTH

Further development requires a recognition of the need to increase the production of seafood as well as significant changes to the industry. New technology is crucial to reaching our vision, and the industry must accept that development cannot occur until environmental challenges, such as sea lice, are addressed and effectively managed. The future potential of Norwegian salmon production is more important than short-term results and a single-minded focus on growth.

Our extensive sea and coastal areas, ideal temperatures and well-developed infrastructure give Norway a significant advantage in terms of efficient salmon production. Norwegian aquaculture can also build on well-established traditions, solutions and expertise from the maritime industries.

The total production costs of Norwegian aquaculture need to be reduced to ensure future competitiveness. Further industrialisation is therefore needed. A proactive approach to the challenges currently facing the industry is also required, rather than using massive resources to tackle problems after the event. Collaboration between parties who contribute

to “crossover” in order to exploit solutions and expertise from other industries will be important. Technology from the petroleum and maritime industries are now being developed for use in aquaculture.

The Government’s ambition is for Norway to become the world’s leading seafood nation through a five-fold increase in salmon production and a six-fold increase in value creation between 2010 and 2050. Although growth in Norwegian salmon production has stagnated since 2012, the potential for further expansion is high.

Future growth in the aquaculture industry could take the form of increased production, greater redistribution, aggressive product development and increased market development. Additionally, there is great potential to increase sales of technologies and services to international aquaculture markets. This also includes products and services in research and fish health. Norwegian Salmon is a strong brand both nationally and internationally. Because of its environmental challenges, and the way these have been handled, the industry is still struggling with its reputation. Parts of the industry have not fully acknowledged these challenges.

DEVELOPMENT AND INNOVATION

More rapid innovation is necessary. The Government's system of development licenses is intended to stimulate ground-breaking new solutions for many of the environmental challenges facing the aquaculture industry.

The focus must be on developing solutions that prevent lice infestation, the spread of infection and fish escaping, as well as on exploiting resources that currently go to waste. This does not mean that completely enclosed facilities are the only solution; but future farms must adopt different and smarter barriers to infection and escape than at present.

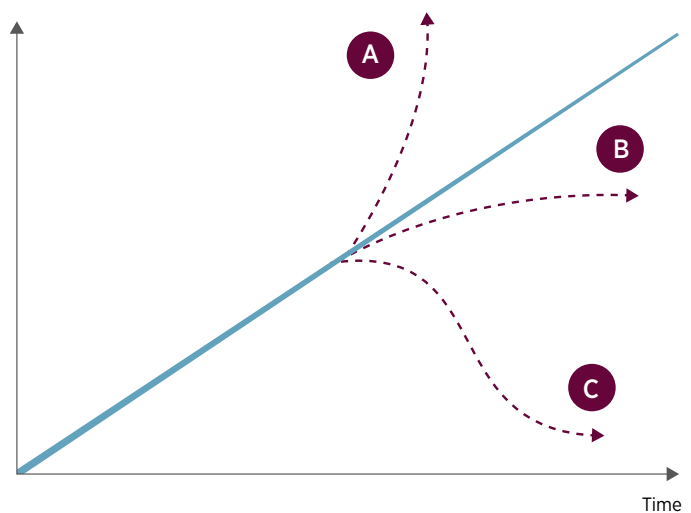
Some of the new aquaculture solutions may enable salmon production elsewhere in the world, in locations that do not enjoy the same natural conditions as in Norway with its long coastline, deep fjords and optimal water temperatures. Bearing today's high prices in mind, land-based facilities could also become profitable. The development of new solutions with less environmental impact and cheaper production costs will therefore be required to strengthen the overall competitiveness of Norwegian aquaculture. Norsk Industri harbours ambitions for Norwegian aquaculture to ensure its global competitiveness through always being at the forefront of development.

The goal is for Norwegian aquaculture to be the largest and best in salmon farming industry through sustainable growth, rapid innovation, expanding industrialisation and further development of products and markets.

AMBITIONS

The blue line illustrates production growth ambitions whereas the red dotted lines indicate potential environmental impact outcomes. Increased production volume with existing level of environmental footprint will result in an unacceptable impact on the environment (A). Stabilizing existing levels of emission (B) will not prove sustainable over time. New solutions with lower environmental footprint per kilo fish produced (C) are necessary to obtain future production growth targets.

Impact on the environment Production growth



ROADMAP OF RECOMMENDATIONS

A prerequisite for ensuring healthy growth in salmon farming is that the industry and Government work together to increase expertise, develop technologies and expand industrialisation.

In summary, the following measures are proposed:

Management and regulations

- The system of promoting and awarding development licenses must be extended until the environmental challenges identified in the roadmap are resolved.
- The production areas scheme is to be continued, but with larger areas and stricter regulations on fallowing and the use of ocean “firelines” to reduce the risk of the spread of infection.
- Fish farms that are not made escape-proof by 2024 will be required to label all salmon for tracking and easier harvesting.
- Independent regional sea lice counting teams are to be set up from 2018
- From 2022, a fee linked the number of sea lice in the farms is to be introduced.
- Additional sanctions, such as the requirement for sea lice-free facilities, is to be introduced from 2027.
- Knowledge of environmental indicators

besides sea lice, and how these can be used to regulate the aquaculture industry, must be established.

- All facilities must be ASC-certified or approved under a similar scheme by 2022.
- Existing special regulations that contribute to bureaucracy and weaken competitiveness for the industry must be abolished, while avoiding new ones.
- Fees for new production permits and the extension of existing permit must, in their entirety, be charged to the host municipalities.

Export-oriented measures

- Negotiating new trade agreements must be intensified.
- The export levy must be abolished.
- An export strategy for Norwegian aquaculture technologies must be established.

Strengthening research, development and innovation

- A national forum for research and innovation in aquaculture technologies and sustainable farming must be established.
- The aquaculture programme, Demo Havbruk, is to be established at the Research Council of Norway and focus on alleviating risk in testing and piloting new aquaculture technologies.
- Research on fish health is to be intensified.





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