

The Norwegian Aquaculture Analysis 2019

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The Norwegian aquaculture analysis: an overview

Dear distinguished reader,

We are honored to present the fourth issue of the Norwegian aquaculture analysis presenting the 2019 edition of the EY Aquaculture Segment Analysis. The analysis has become an appreciated standard tool and trend guidance within the industry. Furthermore, we share insights on trends within technical solutions and technology, together with global perspectives on trends and forces that are driving demand and market trends. We also give you our forecast of key performance indicators for the industry, together with the verdict of last year's forecast.

Given our position as a leading tax advisor for the leading companies within all segments of the value chain, we have included a section in this year's edition on key tax considerations.

Every year, the report dedicates an analytic section to a topic of special interest and relevance for the industry. In the 2019 edition, we focus on the continued challenge of balancing growth and sustainability within the Norwegian aquaculture industry. Land-based aquaculture represents a relevant, sustainable alternative to traditional aquaculture. The focus in the report is on the viability of land-based production. We not only bring updated financial and quantitative facts and figures for the key driving segments of the value chain, but also convey the most recent experiences from breaking technologies together with our views on structural shifts and development. The unique and extensive EY Seafood Company Database (EY-SCD) with a comprehensive volume of key financial figures for more than 900 companies within the value chain – ranging from technical solutions to production and export of salmon and trout – substantiates both the quantitative and qualitative analyses presented.

EY teams, as a multidisciplinary provider of professional services to the industry, possesses in-depth insights into the characteristics of each segment of the value chain. The segments are seamlessly tailored with EY core professional services within Advisory, Transaction Advisory Services, Tax and Legal Services and Assurance. Specialist seafood sector teams are located in numerous seafood clusters and marketplaces around the world.

When analyzing the developments in the aquaculture industry, global megatrends are of great importance. Underlying forces of disruption include technology, globalization and demographics.

EY research has further identified the following key megatrends that will affect the global food industry and salmon, in particular:

- ▶ Growing world population
- ▶ Growing middle class, together with urbanization
- ▶ Health conscious consumers
- ▶ Resourceful planet focusing in sustainability and exploited resources

These trends will greatly impact the global potential and development of this industry. The effects of disruption within the future working world are broader in scope and occur on a longer timeframe than megatrends. Hence, they fundamentally reshape the entire political and economic landscape, including global consumption of seafood.

Regardless of the greater and more fundamental drivers of trends, we are however now facing a geopolitical situation in which globalization – the most apparent driver of global trade and prosperity growth – is seriously challenged by populism. Among other, the rise of populism is likely being a scapegoat for digitalization and automation, causing job disruption to an increasing degree, also in emerging markets.

For the seafood industry, global trade and export to distant markets has been a matter of cause. Not only do we see protectionist discriminatory interventions such as toll barriers and break up of trade agreements and unions, there is also an all-time high number of armed conflicts together with a populism index on levels in line with late 1930s. Seen from a global perspective, this may impose increasing obstacles for global export and hence lead to structural implications for the location of production – making land-based aquaculture close to consumers a more viable option. The carbon footprint of transportation naturally adds to this.

Basing oneself on a larger global framework with implications greater than those created locally is vital when analyzing trends. We observe increasing consciousness and awareness within the value chain and end consumers about sustainability and

preventive health. This awareness affects the whole value chain and not just farming. The latter has been experiencing volume constraints due to biological challenges, regulations and a need for technical development. Continued industry growth is highly dependent on solving the existing challenges on present volumes as well as growing its perspective on the global consumption potential.

As for a range of other industries, we see a noticeable shift in the attitude and investment that support sustainable value creation. Salmon and trout constitute a marginal volume of the global seafood production with margins having attracted investment in R&D, resulting in knowledge and insights. Hence, the potential to transfer the value of know-how and applied technology to other species and agriculture sectors globally is notable.

The export value of sea farming has more than doubled since 2006. In 2019, Norwegian companies' export of salmon and trout is experiencing a continued value growth, both in terms of turnover and shareholder value.

From 2017 to 2018, there were modest changes in the industry in terms of revenue development. The industry as a whole only grew with approximately 2%.

The sea farming, feed and transportation at sea subsegments retain their positions as the strongest contributors to value creation. Within these segments, the industry has managed to develop large industrialized business units. However, there are forces reducing the margins and the strategic strength of the traditional feed producers, calling for business repositioning and core product development.

The sea farmers experienced an increase to both revenue and EBITDA through increased volume. At the same time, stable prices and a small increase to cost per kg resulted in a slight margin reduction.

The super profit of the well-boat industry continues, with all-time high EBITDA margins once again. This subsegment has experienced consolidation in the later years, creating larger businesses with a competitive edge. Furthermore, the fish health

subsegment shows a relatively stable growing profitability over time.

The technical solutions segment has experienced high M&A activity with more than 30 transactions recorded since 2016. Despite the ongoing consolidation in the segment, it remains fragmented with a high number of smaller niche players.

The use of experiences and technology from challenging sectors such as subsea, offshore, shipping and pharmaceutical sectors will play an important role in the development of robust offshore production installations. However land-based production is attracting investments from venture capitalist and investors to an increasing degree.

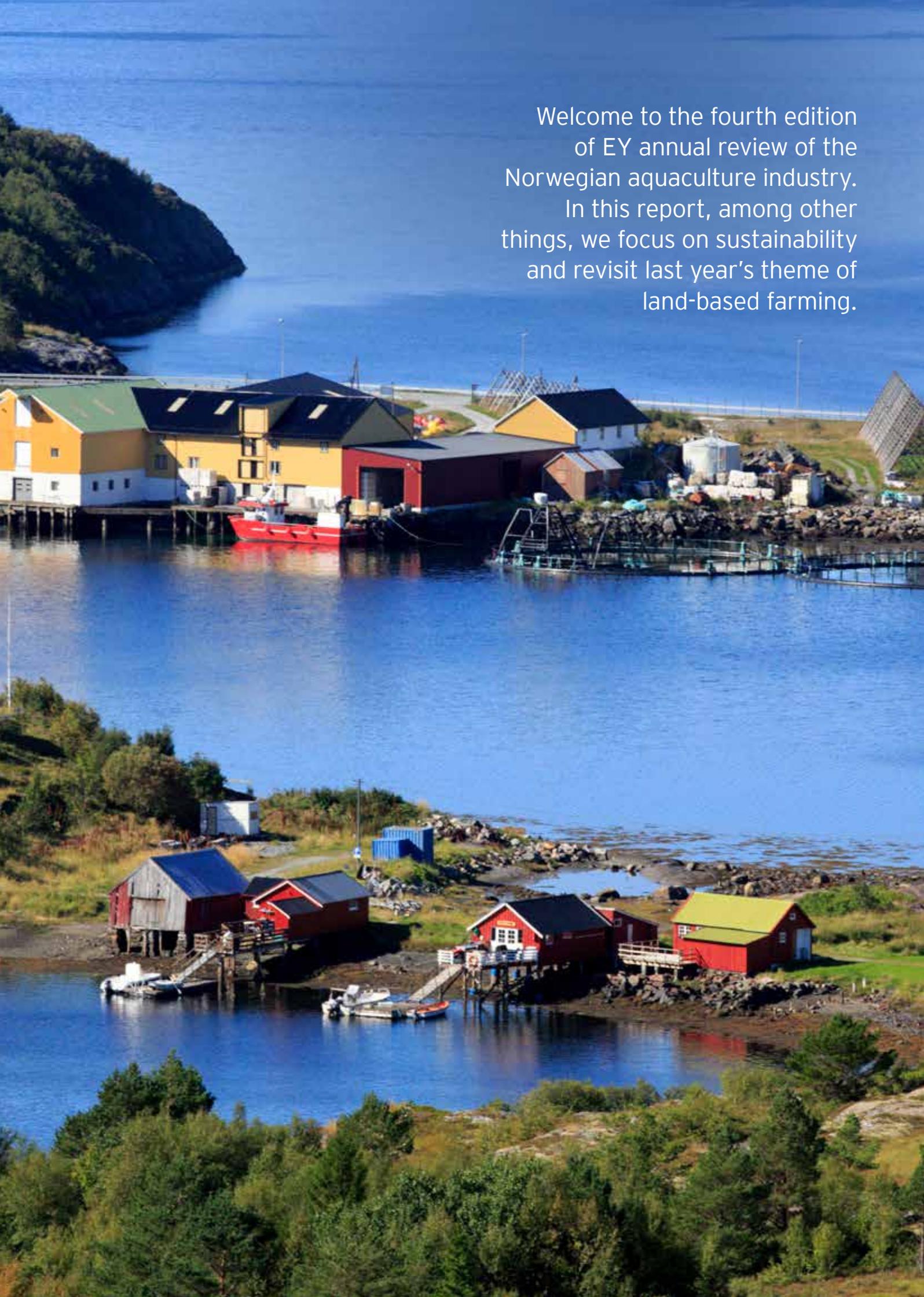
Given the positive development of the salmon aquaculture industry in the recent years, we have seen an increased interest for this industry among investors and financial institutions and players entering the aquaculture value chain. Industry representatives recognize this positive attitude by the way of barometers. However, by nature, such measures are biased and tend to underestimate the efforts needed to manage the challenges and realize the opportunities in an industry exposed to biological risks, consumer disruption and strong competition from a range of products and substitutes. Reputational risks related to sustainable and sound production and fish health may here represent the greatest market risk for the industry.

I hope you find our annual analysis both interesting and enlightening. If you have any comments or questions with regard to the analysis, please don't hesitate to contact us to discuss the aspects of this exciting industry.



Eirik Moe
Sector Leader, Aquaculture and Seafood
Ernst & Young AS

Welcome to the fourth edition
of EY annual review of the
Norwegian aquaculture industry.
In this report, among other
things, we focus on sustainability
and revisit last year's theme of
land-based farming.



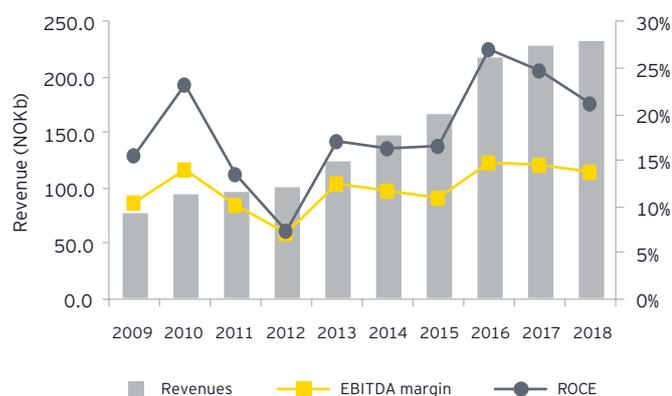
Introduction

The Norwegian aquaculture industry has become one of the larger industries in Norway. Continued high salmon prices and an increase in volume of fish sold have driven revenue to new heights in 2018.

The industry as a whole and the different segments of the value chain attract a lot of attention. With this report, EY teams sets out to give you the big picture and a better understanding of the financial performance of the aquaculture industry.

In this edition, we put extra focus on the growth and sustainability of the industry. We revisit last year's topic of land-based farming, taking a look at the development since last year. Also, as with earlier editions, we analyze the development of different segments of the value chain. With a database including more than 900 Norwegian companies, we can provide insights based on large amounts of data.

Norwegian aquaculture industry, aggregated revenues 2009-18



Calculations

EBIT = earnings before interest and taxes

EBITDA = earnings before interest, taxes, depreciation and amortization

Capital employed = total assets - (financial long-term and short-term investments + cash) - (trade creditors + tax payable + public duties payable)

Return on capital employed (ROCE) = $\frac{\text{EBIT}}{\text{capital employed}}$

CAGR = compound annual growth rate

Inclusion criteria

A company is defined as a Norwegian aquaculture company if both of the following criteria are met:

- ▶ At least 50% of its turnover is generated in the aquaculture industry.
- ▶ It is a Norwegian-registered legal entity.

Value chain segments

- ▶ Technical solutions
- ▶ Biotechnology
- ▶ Production
- ▶ Distribution
- ▶ Processing

Each of these categories are further broken down into subsegments to capture the huge diversity within the industry.

Company size definition

- ▶ Large company: revenue above NOK1b
- ▶ Medium-size company: revenue between NOK100m and NOK1b
- ▶ Small company: revenue below NOK100m

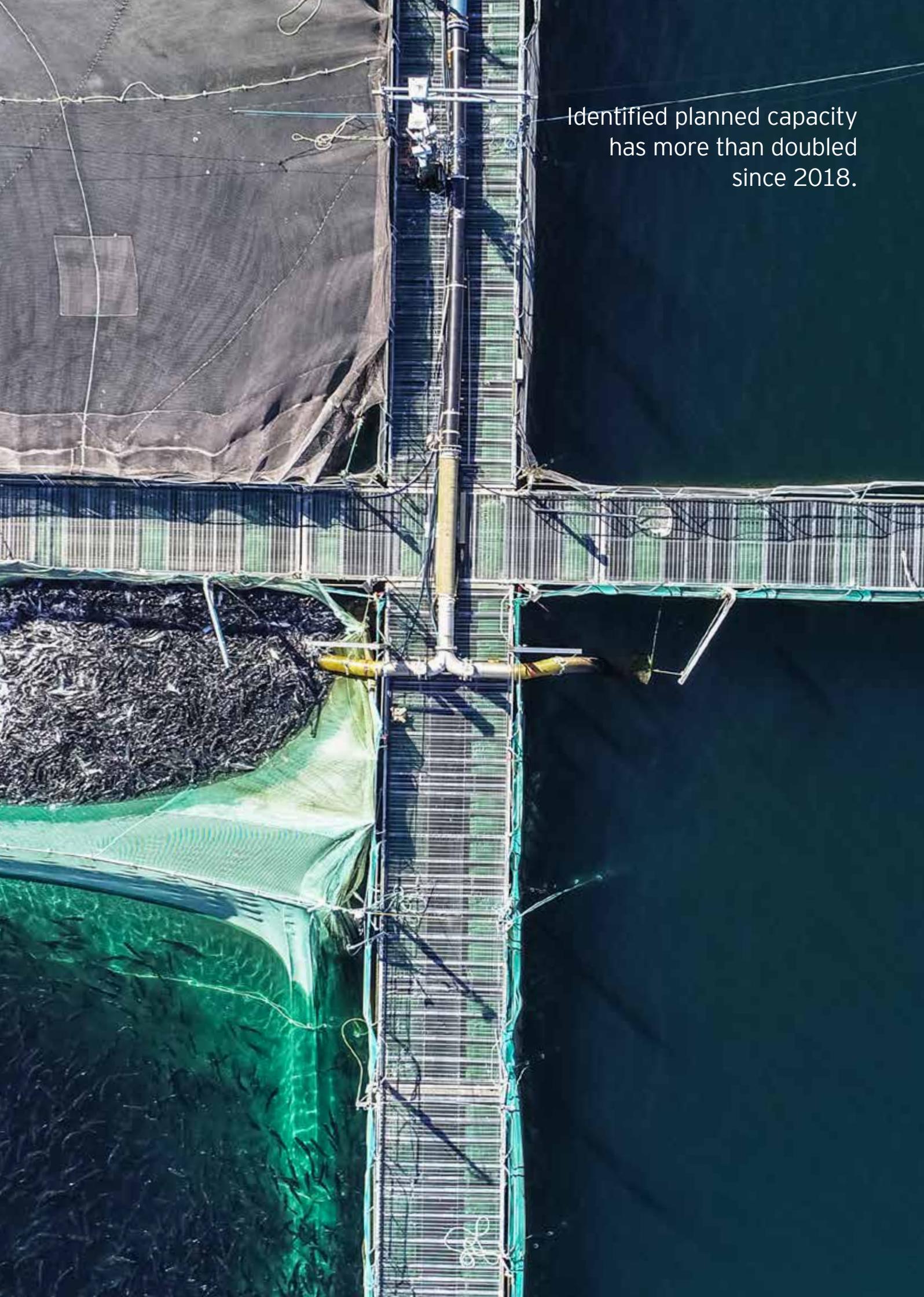
Methodology

In order to analyze financial activity across the value chain, we have gathered information from standalone financial statements of individual legal companies. Accounting information is publicly available from the Brønnøysund Register Centre. The number of companies included in the analysis will vary slightly depending on the availability of financial information. For companies operating with divergent financial periods, adjustments have been made to present the data on a calendar-year basis.

Many of the identified companies offer products and services in more than one segment of the value chain. However, in this analysis, each company is linked to only one segment of the value chain based on its main activity. This simplification could result in subsegments being over- or understated compared with the actual total. For larger industrial conglomerates with multiple subsidiaries, each entity is allocated to its respective best-fit segment.

The methodology does not capture or eliminate intercompany transactions or revenues in holding companies registered abroad.

Please note that the analysis is limited to the domestic aquaculture industry. Thus, foreign units owned by Norwegian companies are not reflected in the analysis. This may give a somewhat misrepresentative picture, particularly for the companies noted on the Oslo Stock Exchange, as many of them have a substantial part of their business outside Norway.



Identified planned capacity
has more than doubled
since 2018.

Current state of land-based farming

What is the status of bringing the production of salmon onshore?

Planned land-based capacity around the world has accelerated since last year's aquaculture analysis

In last year's version of the Norwegian aquaculture analysis, we turned our focus to land-based farming. Since then, there has been an ever-increasing interest in the market for land-based grow-out facilities for Atlantic salmon.

Since last year, several players have increased their planned land-based production volume and even more companies have expressed their intention of starting land-based production of Atlantic salmon around the world. As a consequence, the identified planned volume generated from land-based production has skyrocketed and the expected volume in the "2022+" category in the right table has more than doubled. It is also worth noticing that out of the 622,700 tons growth in the 2022+ category, only 64,300 tons are in the Norway and Denmark region, indicating that the newly planned volume growth is by large at sites located closer to the consumer markets. For instance, since last years report, Atlantic Sapphire has increased their expected annual harvest volume from 90,000 tons to 220,000 tons within 2030. Further, Pure Salmon has announced that they are planning a global production volume of 260,000 tons, whereby 100,000 tons will be located in China. This means that two producers alone represent nearly 50% of the total planned production volume of land-based salmon from 2022+.

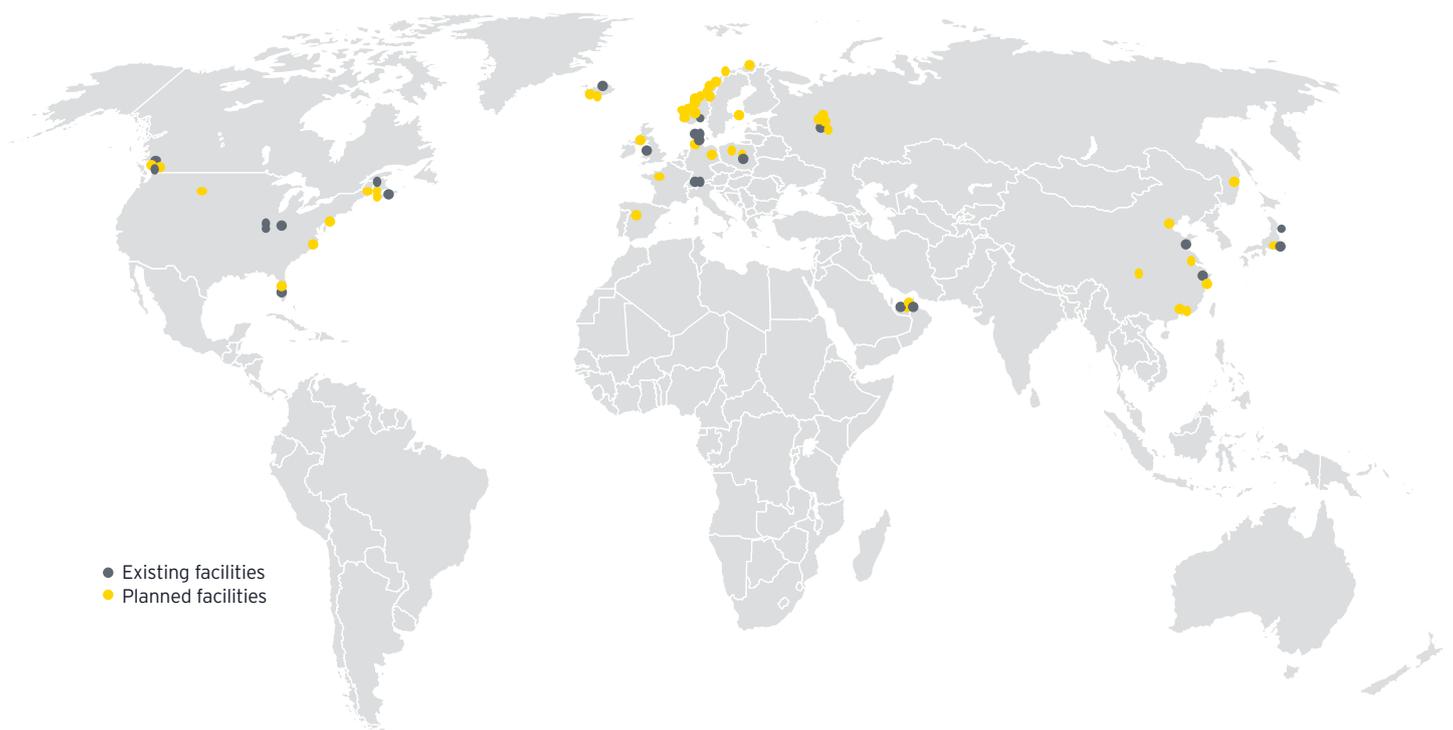
While the number of planned land-based projects has grown tremendously since last year, very little volume has yet to be produced. Also, several of the identified projects are quite ambiguous and have yet to receive the necessary funding, the required permission to operate, etc. Thus, it is highly unlikely that all these projects will get realized, and the planned capacity reflected in the right table must be viewed as a rough estimate of the maximum expected volume from the identified projects.

If all goes according to plan, some of the land-based grow-out projects will harvest the first generation of land-based salmon next year.

Identified planned capacity per year*

1,000 tons	2019	2020	2021	2022+
Norway-Denmark	50.7	76.6	117.4	208.0
US-Canada	33.5	46.5	46.5	357.6
Other	23.5	28.9	38.9	407.6
Total	107.8	152.1	202.9	973.2
Total from our 2018 analysis	101.7	143.1	173.9	350.5

* Not an exhaustive list, only identified projects included. The table illustrates the companies' announced expected production capacity/volume. Note that the "2022+" segment reflects the total annual volume by the identified entities in the period after 2022 and onward and as such does not reflect the volume in 2022.



How to finance the identified plans for land-based salmon farms

While receiving external financing is still a challenge ...

Investments in land-based salmon production facilities are very capital-intensive and are thus highly dependent on both equity and external financing.

Banks have historically been reluctant to provide financing for land-based grow-out facilities. In 2015, DNB, the largest aquaculture loan issuer, expressed that they were unwilling to provide any sort of financing to land-based salmon production. In 2018, they opened up for financing of land-based production facilities as long as they were overseas or in countries other than Norway. In April 2019, Anne Hvistendal, the head of Foods and Seafood in DNB, was cited in salmonbusiness.com¹ that they may open up to financing land-based production in Norway and that they had become more nuanced in their thinking in relation to land-based farming. Still, Atlantic Sapphire is so far the only land-based initiative to have received financing from DNB, despite numerous applications.

Even though the tide seems to have turned somewhat, receiving external financing is still a challenge. According to a quote in salmonbusiness.com² from Vegard Helland, Executive Vice President of Sparebank 1 SMN: "In order for us to contribute with financing, the developer must set a considerable amount of equity and not least, must demonstrate extremely good expertise." We believe that proven technology and industrial knowledge and competence will continue to be key lending criteria going forward.

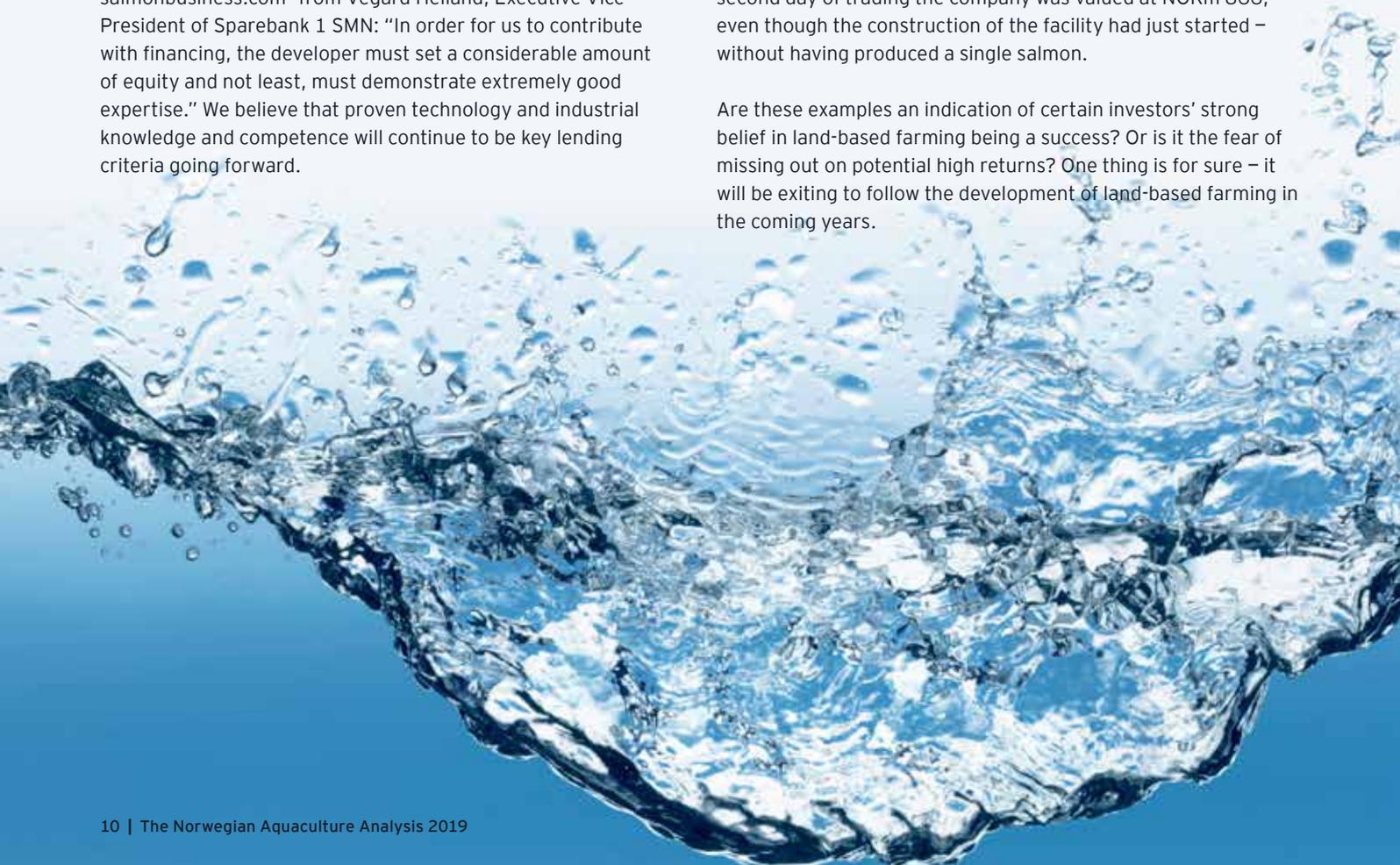
... some investors are more than willing to take the risk

While receiving external financing from credit institutions still seems to be challenging, some projects have managed to raise equity financing and there is currently a tremendous interest in land-based farming.

This is all the more evident when looking at the market cap for some of the listed land-based producers. Atlantic Sapphire's land-based production facility in Miami is currently under construction, with the first phase of the project expected to be 90% complete, with biomass growth up to 1,000 tons by the end of 2019. Despite not having finished the construction of the facility or having produced or sold any salmon, the company was valued at NOK 7.6b as of September 2019 and is the 9th most valuable stock listed salmon company according to IntraFish³ (August 2019).

Another example is Andfjord Salmon, which is planning a shore-based farming concept entirely based on flow-through technology. The company started the construction of the facility in June 2019 and was listed on the OTC till late August 2019. The second day of trading the company was valued at NOKm 866, even though the construction of the facility had just started – without having produced a single salmon.

Are these examples an indication of certain investors' strong belief in land-based farming being a success? Or is it the fear of missing out on potential high returns? One thing is for sure – it will be exciting to follow the development of land-based farming in the coming years.



System solutions and technology

Recirculating aquaculture systems vs. flow through systems

Choosing which technology to use in land-based farming provides restrictions on where to locate the facilities. Facilities using Recirculating Aquaculture Systems (RAS) technology can be placed anywhere compared to traditional Flow Through Systems (FTS) which have to be near the coastline. Facilities using RAS can, therefore, be near end-market, logistics hubs and with easier access to labor. RAS technology opens for opportunities with regards to reduced water consumption and savings associated with lower energy use for heated water during winter and spring seasons. However, RAS has much higher technological complexity compared to FTS and requires more capital expenditures and land area.

In Norway, several of the producers are planning for FTS for land-based farming. Still, the share of RAS is higher. Producers in Norway seem to exploit the advantage of being near the coastline. By moving the production to land, they reduce the costs related to license fee, avoiding problems with salmon lice, algae bloom and escapes. In addition, as per today, FTS solutions are used in many of the smolt and post-smolt facilities which have given experience with this solution.

As previously mentioned, there has been a significant increase in land-based grow-out projects in areas outside Norway. Thus, in general and on a global scale, there seems to be a clear shift towards RAS in favor of FTS as the planned choice of production technology for land-based farming.

There is a clear shift toward recirculating aquaculture systems compared to flow through systems.

RAS

- Minimal water consumption – assumed recycling of water is 95%-99.9%; for illustrative purposes, moving the Norwegian salmon and trout production will require approximately 0.520b cubic water
- Full escape and lice control
- Demands high degree of technological competency
- Requires larger investments compared to FTS
- Requires substantial land areas. The area need is estimated to be six to nine m² per kg fish produced
- Allows production close to end-market
- Challenges with hydrogen sulfide

FTS

- High water consumption – for illustrative purposes, moving the Norwegian salmon and trout production will require approximately 33.7b cubic water
- Full escape- and lice control. Often uses seawater from depths with no lice
- Limited advanced technology. Do not have the extensive recycling technology. Little operational disruption
- Low investments costs compared to RAS
- The area required is estimated to be 2.5-6 m² per kg fish produced
- Need to be placed near the coastline
- Challenges related to hydrogen sulfide will be less than in RAS due to continuous replacement of water

1 "We have become more nuanced in our thinking in relation to what we said about land-based farming," SalmonBusiness, salmonbusiness.com/we-have-become-more-nuanced-in-our-thinking-in-relation-to-what-we-said-about-land-based-farming/, 10 April 2019.

2 "Banks skeptical about financing land-based fish farms: Must have a better overview of the overall risks," SalmonBusiness, salmonbusiness.com/banks-skeptical-about-financing-land-based-fish-farms-must-have-a-better-overview-of-the-overall-risks/, 15 January 2019.

3 "Here's a ranking of the world's most valuable salmon farmers," IntraFish, www.intrafish.com/finance/1838820/heres-a-ranking-of-the-worlds-most-valuable-salmon-farmers, 20 August 2019.

Is land-based salmon farming more sustainable than traditional open net pen farming?

Is land-based farming more environment-friendly than traditional net-pen production?

In August 2018, the Danish Environment Minister, Lea Wermelin, announced that the Danish Government will put a halt to the development of fish farming at sea in a bid to protect the environment. Further, she announced that the Danish Government generally will aim to breed fish on land in the future. Denmark mainly farms rainbow trout. Is land-based farming more environmental-friendly than open net-pen production and is land-based production the way to go in making production of salmon even more sustainable?

While the Danish environment minister focused on local pollution and environmental factors, salmon production has also a global environmental impact, especially through the production and consumption of feed, but also in relation to energy use, transportation to retailers, the construction of production facilities, etc. A common and increasingly popular way to measure the global environmental impact is to assess the carbon footprint. So, how is the carbon footprint of land-based farming compared to traditional net-pen production?

Land-based farming vs. open net-pen production in Norway

In September 2018, Sintef, NTNU and SNF released an analysis of land-based farming vs. net-pen production in Norway.¹ The report was a result of a research project funded by the Norwegian Seafood Research Fund (FHF) and the main objective was to analyze possible consequences related to shifting the total production of Atlantic salmon from traditional sea-based production to land-based production using RAS technology.

In relation to the carbon footprint, the report concludes that land-based production of salmon in Norway will have a carbon footprint which is approximately 28% higher than net pen production. It is worth mentioning that the outcome is highly dependent on several assumptions, especially the feed conversion ratio on land vs net-pen production, the electricity mix and the fact that full out-grown production is yet in its early stage and little empirical data exists. However, the result gives an indication that, from a global perspective, land-based farming is less favorable for the environment compared to the traditional open net-pen production.

Land-based farming close to end market

The above-mentioned paper focuses on the effect of land-based production of salmon in Norway. However, one important argument for land-based salmon production is placing the production closer to the end market, reducing the transportation cost and carbon emissions.

Environmental assessments of open net-pen salmon production and distribution have identified transportation of salmon to the retailer as one of the most dominating negative climate aspect of salmon aquaculture production. In a paper from Liu et. al² from 2016, the difference in carbon footprint of serving the US market with salmon was analyzed, comparing land-based closed containment RAS production (LBCC-RAS) in the US with open net-pen production in Norway.

Estimated carbon footprint²

CO ₂ eq. per kg	1a)	1b)	2a)	2b)
Feed production	2.69	2.69	3.21	3.21
Construction of facility and equipment	0.39	0.39	0.02	0.02
Grow out and smolt (fuel and electricity)	3.48	0.21	0.16	0.16
Oxygen and lime	0.44	0.44	0.00	0.00
At producer gate (live weight)	7.01	3.73	3.39	3.39
Transport, road	0.03	0.03	0.06	0.06
Transport, air, or water	0.00	0.00	11.40	0.09
Packaging and ice	0.37	0.37	0.37	0.11
Refrigeration during transport	0.00	0.00	0.00	0.10
At retailer gate (HOG)	7.41	4.14	15.22	3.75

- 1a) Salmon from a LBCC-RAS system in the US running on a typical electricity mix of coal, gas, nuclear, wind and hydropower;
- 1b) Salmon from a LBCC-RAS system in the US running on electricity generated predominantly from hydropower;
- 2a) Salmon from a Norwegian open net-pen system transported by airfreight to Seattle in the US;
- 2b) Salmon from Norwegian open net-pen system transported frozen by ship to Seattle in the US.

The paper calculates the carbon footprint of four different scenarios, using the life cycle assessment methodology. Please refer to the above table for more details.

¹ "Analyse av lukka oppdrett av laks – landbasert og i sjø: produksjon, økonomi og risiko," FHF, <https://www.fhf.no/prosjekter/prosjektbasen/901442/>, accessed 26 September 2019.

Due to the significant carbon footprint of airfreight, the LBCC-RAS system close to the market is by far a more climate friendly alternative for serving the US market with fresh salmon, compared to production and transportation of fresh salmon from Norway. This is the case even when running on electric power that mainly originates from fossil fuel. However, according to the analysis, the single most climate-friendly alternative is to ship frozen salmon from Norway with a modern container ship. With new modern freezing technologies, the quality of frozen products may not necessarily be inferior to fresh, possibly increasing the potential for this alternative going forward.

Summing it all up

There are numerous papers and analyses comparing the carbon footprint of land-based salmon production with open net-pen production. The results vary considerably due to differences in assumptions, methodology, experimental data and site-specific properties. However, the selection of literature points to the same main conclusions;²

- i) Feed production is a dominating factor for carbon footprint in salmon production;
- ii) For LBCC-RAS, the use of energy (energy mix) for water treatment can be equally as important as feed production;
- iii) The way of transporting the goods to the market has a significant impact on the carbon foot print.

In summary, from a global environmental perspective, land-based salmon production in Norway does not seem to be the way to go. On the other hand, placing the production of salmon closer to the end market will reduce the climate impact of supplying the market with fresh salmon, as airfreight has such a significant carbon footprint.



² Yajie Liu, Trond W. Rosten, Kristian Henriksen, Erik Skontorp Hognes, Steve Summerfelt, Brian Vinci, "Comparative economic performance and carbon footprint of two farming models for producing Atlantic salmon (*Salmo salar*): Land-based closed containment system in freshwater and open net pen in seawater," *Aquacultural Engineering*, <https://doi.org/10.1016/j.aquaeng.2016.01.001>, March 2016.



The sustainable future of traditional fish farming

Will sustainability in Norwegian aquaculture enable the sea farmers to maximize their growth potential?

Introduction

Never before has sustainability received so much attention. Aquaculture will have a crucial role in feeding the growing global population going forward. But, in order to feed an increasing population, the environmental impact and animal welfare has to be emphasized. As growth is dependent on environmental factors, sustainability will be the main enabler for increase in production volumes. Hence, sustainability is, or should be, a key focus area for all Norwegian aquaculture companies today.

Many potential solutions for increased aquaculture sustainably have been launched by industry players. But what is the potential impact? We will deep-dive into a few of the sustainable initiatives

that are being implemented in the aquaculture industry today in an attempt to understand this a little further.

In this section, we will touch upon sustainability approaches such as the shift toward more sustainable feed, producing larger smolt, moving the sea farming offshore or into closed containment systems and the increased use of technological solutions for entering the knowledge-based era.

To what extent will these sustainable initiatives enable the current aquaculture companies to maximize their growth potential?

Sustainable feed

The industry is continuously working on developing new sources of fish feed, improving both the omega-3 content and the sustainability profile of the salmon production. In addition, improving the feed conversion ratio is key.

Larger post-smolt

To decrease mortality and reduce time in sea, sea farmers are now looking into producing larger post-smolt of up to 500-1,000 grams, some even larger.

Offshore farming and closed facilities

The need for new areas for sea farming has led the industry to test offshore farming as well as closed or semi-closed systems in sheltered coastal areas, enabling them to prevent escapes and sea lice as physical barriers will prevent interaction with the external environment.

The knowledge-based era – technological solutions

The industry needs to evolve from experience-based to knowledge-based production. This shift is essential for the industry to realize benefits and insight gained over the last decades of operations and will secure long-term value creation by optimizing production and reducing risk and environmental impact.



Can sustainable feed reduce sea farming's environmental impact?

Introduction

Efficient feed utilization is crucial to ensure the sustainability of the growing aquaculture industry. As already mentioned on page 12, feed production is a dominating contributor to the carbon footprint in salmon production, making out approximately 95% of the carbon footprint in traditional salmon farming.

Due to shortage of marine resources (such as fish oil and fishmeal), the industry has shifted toward vegetable materials (e.g., soy and wheat). Currently, conventional marine materials constitute between 25%-30% of the average Norwegian fish feed, improving the fish in- fish out ratio for the feed producers. On the other hand, long chain omega-3 fatty acid content in farmed salmon has declined, as a result of the shift from marine to vegetable materials. Another impact of the aforementioned shift is an increase in the carbon footprint from feed production, as the vegetable ingredients that replace the marine ingredients in general have a higher carbon footprint (especially soy).¹

Improving the feed conversion ratio is the key ...

Feed conversion ratio (FCR) is the dominating parameter for improving the environmental impact of traditional salmon farming. By reducing the FCR with 10%, this will result in a 9.5% reduction in the carbon footprint.¹

Today, several companies are using underwater cameras and sensors to reduce the feed waste. In addition to improving the FCR and thus the carbon footprint, this also reduces the discharge of nutrients impacting wild fish and other organisms. Finding new and improved ways for optimizing the FCR is high on the agenda for salmon producers, as well as their suppliers.

... but the feed content is equally as important

The feed industry is continuously working on developing new sources of fish feed, focusing on improving both the omega-3 content and the sustainability profile of the salmon production. Some examples of initiatives taken:

- ▶ Increased focus on utilizing by-products from other fisheries or aquaculture sectors in the feed production.
- ▶ Several feed producers are now offering krill and algae-based omega-3 ingredients in their feed.
- ▶ Several companies are working on utilizing insect-derived proteins in fish feed.
- ▶ Approximately 90% of the imported soy protein concentrate (SPC), one of the main vegetable ingredients used in the Norwegian feed production, is sourced from Brazil.² Although all SPC imported for Norwegian fish feed production is certified by an international sustainability scheme,³ the question is whether the use of Brazilian SPC is viable considering the recent forest fires and the deforestation of the Amazon rain forest. While still a vital ingredient, the use of SPC in Norwegian fish feed production has decreased significantly from 2015 (388,692 tons) to 2017 (282,448 tons).² Also, following the recent events with the increase in wildfires in the Amazon, Mowi has announced that they are considering to stop buying Brazilian soy for its fish farms unless the Brazil curbs Amazon deforestation.⁴ Salmon Group, a network of Norwegian family owned sea farmers has removed the use of Brazilian soy in its feed as a consequence of the fires in Amazon. According to the Group, they plan to replace Brazilian soy with "alternative and more sustainable sources of protein."⁵

1 "LCA of Norwegian salmon production 2012," SINTEF, www.sintef.brage.unit.no/sintef-xmliui/handle/11250/2458163, 21 October 2014.

2 "Soya i norsk fôr – Forbruk og arealbeslag," Fremtiden, www.framtiden.no/aktuelle-rapporter/852-soya-i-norsk-for-forbruk-og-arealbeslag/file.html, 20 November 2018.

3 "Soy in salmon feed," Salmon Facts, www.salmonfacts.com/what-eats-salmon/soy-in-salmon-feed/, 26 May 2016.

4 "Fish farmer Mowi could halt Brazil soy imports over Amazon fires," Reuters, www.reuters.com/article/us-brazil-environment-mowi/fish-farmer-mowi-could-halt-brazil-soy-imports-over-amazon-fires-idUSKCN1VI2HT, 28 August 2019.

5 "Norwegian salmon farmers' group cuts Brazil soy from feed," Undercurrent News, www.undercurrentnews.com/2019/09/24/norwegian-salmon-farmers-group-cuts-brazil-soy-from-feed/, 24 September 2019.

In addition to the above mentioned initiatives, feed producers are continuously improving the feed formulations by having a higher energy content in order to reduce the FCR and, consequently, minimize the nutrients discharge.

As new sources of fish feed are being introduced to the market, success is dependent on prices being viable for sea farmers while simultaneously avoiding negative environmental and social impacts from production processes.

Conclusion

In the table below, we have summarized the areas which we believe will be key in improving the feed-related environmental impacts.

Key focus areas for improved sustainability

Feed conversion ratio (FCR)	<ul style="list-style-type: none"> ▸ The dominating parameter for improving the environmental impact ▸ Improve FCR through, e.g., technological solutions, knowledge-based farming (big data and digitalization) and new and improved feed formulation with higher energy content
Feed content	<ul style="list-style-type: none"> ▸ Maintain or reduce fish in – fish out ratio to prevent overfishing and to have the lowest possible impact on wild ocean resources ▸ Utilize alternative protein sources such as algae, insect meal, trimmings from other fisheries, etc. improving both omega-3 content but also lowering the carbon foot print ▸ Replace vegetable protein sources such as SPC with alternative protein sources or by shifting to more sustainable vegetable protein sources



Post-smolt – will larger post-smolt increase productivity?

Why produce larger post-smolt?

Traditionally, smolt is transferred to open net-pens when they have reached a weight of approximately 100 grams, followed by 18-20 months in sea before the fish is harvested. Smolt at this size is small and vulnerable when transferred to net-pens. To decrease mortality and reduce time in sea, sea farmers are now looking into producing larger post-smolt of up to 500 grams, some even up to 1,000 grams. Some companies even look into alternatives for producing post-smolt up to two kg.

By allowing the smolt to grow in a post-smolt facility for three to five months, the fish will be larger when transferred to sea, hence spending less time in open net-pens before it reaches harvest size.

Larger post-smolt has several benefits ...

Producing post-smolt allows sea farmers to exercise more control on a larger part of the production process. When post-smolt is kept in closed-containment systems (CCS) or semi-closed containment systems (S-CCS), it allows more control over the interaction between the fish and the external environment. Being able to reduce the time the fish is exposed to uncontrollable risk factors in open net-pens allows the sea farmers to obtain control over a larger part of the production process.

Larger smolt is more robust when transferred to sea which in turn increases the quality and improves the survival rate. The survival rate for post-smolt can be as high as 99% when the salmon has reached a weight of 2.5 kg, compared to an average survival rate in traditional sea farming of 84%.⁴

Biological challenges such as sea lice and diseases will be reduced as the time exposed to these risks decreases. Consequently, the fish welfare increases and costs related to sea lice and disease control are expected to be reduced.³

Moreover, as fish spend less time in open waters, the local environmental footprint will be reduced since more of the production process takes part in closed or semi-closed facilities. This enables the collection and potentially recycling of the sludge.²

Producing larger smolt frees up time in sea and enables sea farmers to have more flexibility on sites. Consequently, the maximum allowed biomass (MAB) can be better utilized. Increasing smolt from 100 grams to 400 grams will allow the production period in sea to be reduced from 19 months of grow-out and two months of fallowing to 12 months of grow-out and two months of fallowing. By introducing larger post-smolt, the number of production cycles increases from four to six over a seven-year period, hence increasing the production capacity by 50%.¹

... but is it that easy?

Even though there are several benefits from introducing post-smolt to sea farming, there is limited experience in the field of post-smolt in Norway, making the outcome more uncertain. For example, experience related to transferring seawater into the systems still needs further research.

Larger post-smolt will increase production cost for smolt producers, which will result in higher purchase prices for companies buying smolt externally. Hence, cost saving is not necessarily the outcome as the production cost and purchase price of smolt might increase more compared to the cost saved by larger post-smolt.¹ The ratio between cost savings related to biological issues and increased production costs are not yet known, as there are only a few production cycles with post-smolt that have ended.

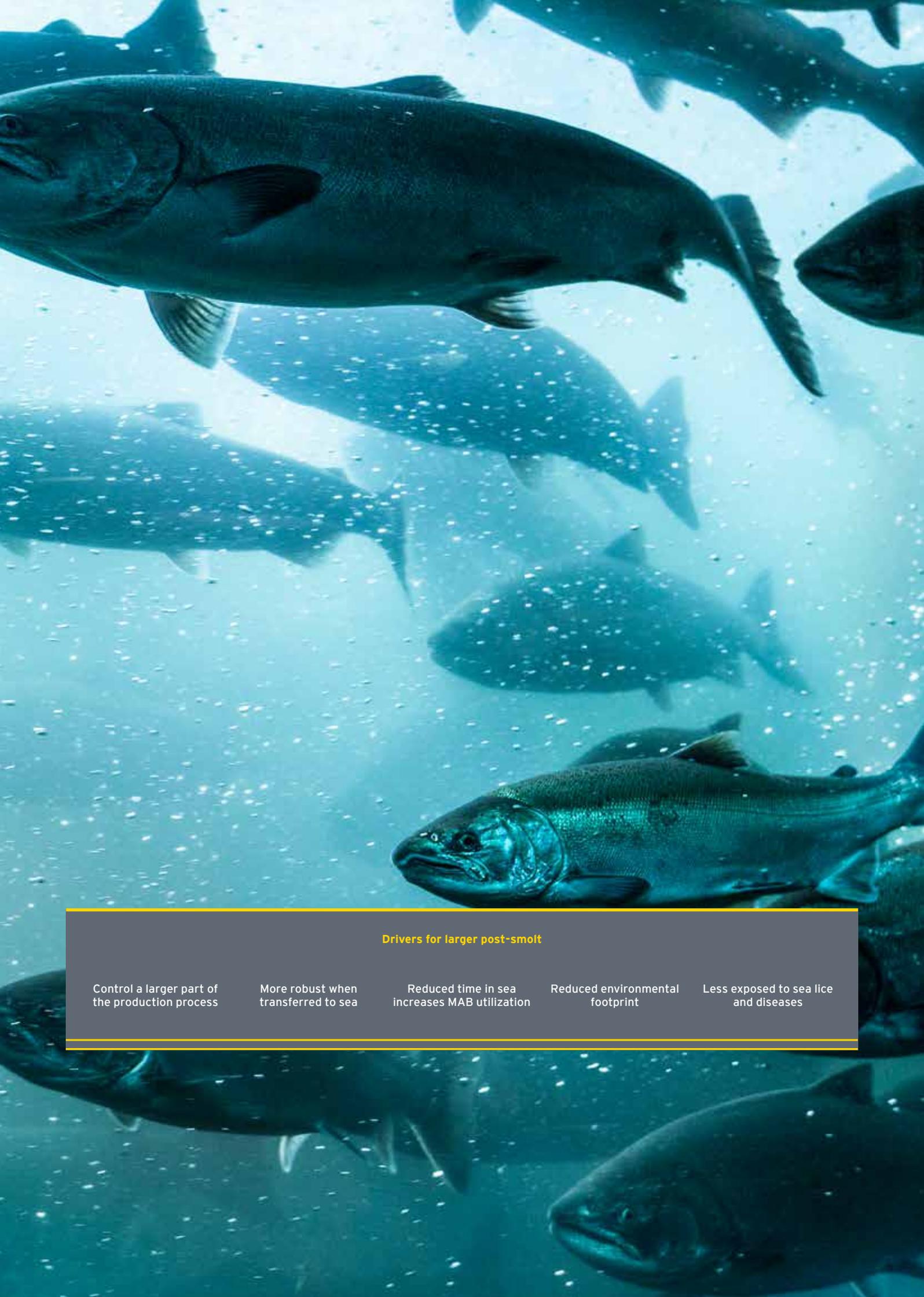
Despite limited knowledge from post-smolt production, many Norwegian sea farmers are focusing on post-smolt strategies today. Several companies have already started to test post-smolt production, whereas others are in the process of implementing it in their production cycle. Greig Seafood has even implemented post-smolt as one of the main pillars in their strategy. Despite the high-level of post-smolt implementation, tangible evidence of the effect are still not available as several salmon farmed from post-smolt are not yet harvested.

1 "Land based farming of salmon: economic analysis," NTNU, www.ntnu.no/documents/1265701259/1281473463/WPS+1+2017.pdf/6ee4cd65-e3b0-44a6-aa42-d017cb42d020, accessed 18 September 2019.

2 "Ulike typer oppdrettsanlegg," Nofima, www.nofima.no/verdt-a-vite/ulike-typer-oppdrettsanlegg, 19 March 2019.

3 "Environmental and biological requirements of post-smolt Atlantic salmon (*Salmo salar* L.) in closed-containment aquaculture systems," BORA – UiB, bora.uib.no/handle/1956/16127, 22 June 2016.

4 "Reduced losses with post-smolt," Nofima, nofima.no/en/forskning/naringsnytte/reduced-losses-with-post-smolt/, accessed 20 September 2019.



Drivers for larger post-smolt

Control a larger part of the production process

More robust when transferred to sea

Reduced time in sea increases MAB utilization

Reduced environmental footprint

Less exposed to sea lice and diseases

Offshore sea farming and closed facilities – will there be a future without traditional open net pens?

The need for new solutions in sea farming

Sea farmers continually strive to produce fish more efficiently and sustainably. But as salmon production has increased over the years, so has the environmental footprint. One of the largest challenges facing the aquaculture industry in Norway is sea lice and escapes, negatively affecting both profits and the marine habitat. Additionally, sea farming's discharge of nutrients impacts the Norwegian coastline. For example, increasing production for algae which in turn reduces the oxygen levels on the seabed, or negatively impacts the environment for wild fish and other organisms.¹

To enable the industry to find new, sustainable solutions for sea farming, the Norwegian Government has allowed sea farmers to apply for development licenses. The rate of innovation in the aquaculture sector in Norway is high and several sea farmers are now looking into exploring offshore sea farming and production in closed facilities to solve some of the issues facing the industry today.

Offshore farming – the new traditional sea farming?

Sea farming facilities placed in exposed locations in the open ocean, rather than today's solution with open net pens close to the shore, are referred to as offshore sea farming.

Several of the offshore farming facilities are submersible or semi-submersible. By lowering the facilities and keeping the fish further below sea level, the occurrence of sea lice is expected to diminish. This could reduce the challenges and costs that sea lice imposes on traditional production today. Reducing the risk of sea lice is one of the main drivers for offshore sea farming.²

The need for new areas for sea farming has led the industry to turn to offshore farming. Offshore farming reduces space constraints as areas are not as limited as by the coast. Several companies have received development licenses for offshore farming.⁴

Due to the lack of strong currents, traditional open net pens have to lay fallow between production cycles as feed residue and faeces often gather on the seabed.³ To increase production,

the industry is seeking to reduce the fallowing time. Offshore farming offers stronger currents and deeper water, leading to more frequent water exchange, thus removing feed residue and faeces.⁶ This reduces the sea farming's environmental footprint on the seabed.

Moreover, moving sea farming offshore will create a greater distance to the shore, thus minimizing the effect sea farming has on the coastal wildlife.

Transitioning from traditional sea farming to offshore sea farming could potentially face several issues. As facilities will be located in rough, unpredictable environments, it will require new equipment made for handling these extreme conditions.⁷ The rough environment also has a risk of imposing stress on the fish and thus potentially lead to higher mortality.

As per today, Salmar has successfully completed the first production cycle for their offshore farm Ocean Farm.¹ They had an incident of escape during fall 2018. However, this was due to human error and not issues with the farm itself. Nordlaks' Havfarm will be delivered during the spring 2020. These two projects evidently show the development in offshore farming, but it will still take time before we see some concrete results in this area.

Closed facilities – a new era?

Closed-containment systems (CCS) and semi-closed containment systems (S-CCS) tackle some of the challenges with offshore farming. By placing closed or semi-closed systems in sheltered coastal areas, companies will be able to prevent escapes and sea lice as physical barriers will prevent interaction with the external environment.⁶ The first results of Aquatraz, a submerged net pen, already shows promising results. Aquatraz had levels of sea lice significantly lower than what has been seen in open net pens placed nearby during their first production cycle.⁸

As the facilities are closed, the feed will not be picked up by currents. Hence, feed will not be transferred out of the pens and the feed conversion ratio will decrease.

1 "Fiskeoppdrett," Miljødirektoratet, miljøstatus.miljodirektoratet.no/tema/hav-og-kyst/fiskeoppdrett/, accessed 19 September 2019.

2 "Land based farming of salmon: economic analysis," NTNU, www.ntnu.no/documents/1265701259/1281473463/WPS+1+2017.pdf/6ee4cd65-e3b0-44a6-aa42-d017cb42d020, accessed 18 September 2019.

3 "Bunnforholdene under SalMars havmerd dokumenteres av Ecotone," Ecotone, ecotone.com/bunnforholdene-under-salmars-havmerd-dokumenteres-av-ecotone/, accessed 18 September 2019.

4 "Oversikt over søknader om utviklingstillatelse," Directorate of Fisheries, www.fiskeridir.no/Akvakultur/Tildeling-og-tillatelse/Saertillatelse/Utviklingstillatelse/Soekere-antall-og-biomasse, accessed 19 September 2019.

Closed facilities will process the water moving in and out of the facility.⁵ Water will be pumped up from 20-30 meters below the surface, where sea lice is not able to live. Moreover, closed facilities enables collection of sludge further reducing sea farming's environmental footprint.

By making use of closed facilities, companies are able to get problems related to emissions, escapes, sea lice and diseases under control. However, these facilities also face the risk of transmittable diseases, mass deaths and high costs.

Could there be a future where open net-pens are forbidden?

The Norwegian Government has expressed a desire to have a significant growth in aquaculture, going forward. Given the legal

and environmental restraints present in the aquaculture industry today, sea farmers have to look for new, innovative ways to increase volumes.

In our view, the future will most likely be diversified – changing from one way of producing salmon as seen today, to an industry approaching sea farming with several solutions. We believe that traditional sea farming in open net pens is not likely to be replaced by other solutions, but rather be supplemented by these new farming methods.

In the end, it's all about achieving the best possible fish health while also having the most sustainable operations.

Development licenses granted as of September 2019

Company	Development licenses granted	No. of licenses	Maximum allowed biomass	Current status
Nordlaks Oppdrett AS	Havfarm 1 (ocean-based farming)	13	10,140	Currently under construction. Estimated start of operation – summer 2020
Nordlaks Oppdrett AS	Havfarm 2 (ocean-based farming)	8	6,240	Building contract and further progress in the project – TBD
Ocean farming AS (SalMar)	Ocean Farm (offshore solution)	8	6,240	The Ocean Farm has been finalized and is in use by SalMar.
Mariculture AS (SalMar)	Smart Fishfarm (offshore solution)	8	6,240	"Big brother" to the Ocean Farm. Still under planning and development
NRS ASA/Aker ASA	Artic Offshore Farming (offshore solution)	8	5,990	The cage is under construction at Fosen Yards and NRS. The plan is to depoly the solution in 2020.
Mowi Norway AS	The Egg (closed solution)	6	3,120	Mowi is contemplating dropping the egg due to costs being too high.
Mowi Norway AS	Marine Donut (closed solution)	2	1,100	Licenses granted in April. The concept is currently under development
Midt-Norsk Havbruk	Aquatraz (semi-closed solution)	4	3,120	Several Aquatraz cages have been deployed and are in use today
Other	Projects with MAB <= 3,120	19	14,820	Various offshore, closed and semi-closed solutions
Total licenses granted		76	57,010	

Source: Directorate of Fisheries*

* "Oversikt over søknader om utviklingstillatelse," Fiskeridirektoratet, www.fiskeridir.no/Akvakultur/Tildeling-og-tillatelse/Saertillatelse/Utviklingstillatelse/Soekere-antall-og-biomasse, accessed 14 October 2019.

5 "Han tror oppdrett til havs bare blir en av mange måter å produsere laks på," Fiskeribladet, fiskeribladet.no/teknisk/nyheter/?artikkel=68665, accessed 18 September 2019.

6 "Annual report 2018 – CtrlAQUA – Centre for Closed-Containment Aquaculture," CtrlAQUA, accessed 19 September 2019.

7 "Investing in Innovation: Bold Ideas in Salmon Aquaculture," Norway Royal Salmon presentation by Chares Høstlund, accessed 24 September 2019.

8 "I de tradisjonelle oppdrettsmerkene rett ved siden av var det mye lus, mens i Aquatraz har det ikke vært behov for avlusing," Ilaks, ilaks.no/i-de-tradisjonelle-oppdrettsmerkene-rett-ved-siden-av-var-det-mye-lus-mens-i-aquatraz-har-det-ikke-vaert-behov-for-avlusing/, accessed 9 October 2019.

Entering the knowledge-based era

The aquaculture industry has been and still is, relying heavily on traditional experienced-based approaches for salmon farming. However, the stagnating volume growth and sustainability issues in major salmon farming countries clearly indicate that the industry must introduce changes to the present production regime.

From insight gained from interviewing players within the entire aquaculture value chain, EY global aquaculture team has conducted an analysis of how the industry can increase value creation and solve its challenges. The conclusion from the analysis is clear and supports our hypothesis – the industry needs to evolve from experienced-based to knowledge-based production. This shift is essential for the industry to realize benefits and insight gained over the last decades of operations and will secure long-term value creation by optimizing production and reducing risk and environmental impact.

We have defined knowledge-based fish farming as, “A shift that requires the application of insight from data analysis and the recommendation of leading practice technological solutions, thus helping the discovery of new relationships between parameters, better decision-making and continuous optimization to name a few.”

Taking a data-driven, multidisciplinary approach it is possible to gain insights that can contribute in addressing key challenges limiting sustainable growth.

Some of these include:

- ▶ Develop improved methods and solutions to optimize licenses
- ▶ Improve growth rates and feed conversion ratios
- ▶ Identify and increase use of sustainable feed ingredients
- ▶ Increase fish welfare and reduce fish mortality related to sea lice infestation, infectious diseases and algae blooms

- ▶ Reduce the financial and environmental burden of lice treatment techniques
- ▶ Achieve more efficient and less costly control, monitoring and, documentation of biological processes
- ▶ Improve utilization and support in value creation of by-products from fish processing
- ▶ Increase the value of end products by increased traceability and sustainability
- ▶ Increase the use of feedback loops across the value chain to measure performance based on historical data in order to drive innovation and continuous improvement
- ▶ Reduce the environmental footprint
- ▶ Warming waters due to climate changes is potentially a long-term challenge resulting in among other faster sea lice reproduction, lower water oxygen content and more extreme weather
- ▶ Explore synergies with new industries such as kelp and sea weed farming
- ▶ Increase electrification and decarbonization of the industry

Most industry players do not have the breadth or granularity of data, as well as data capabilities needed to solve the many challenges. Therefore, data sharing and collaboration across the entire value chain is a prerequisite for gaining insight. In addition, there is also a need for improved cross-functional cooperation within the companies themselves – e.g., segments such as marine biology, fish health, pharmacology, genealogy, oceanography and economy. Nevertheless, before any value can be gained from collaborative data analysis, the industry must increase data standards and improve measurement and data integration. Additionally, issues such as insider risk and lack of trusted mechanisms also represent barriers to data sharing.

Some industry players and vendors of technical solutions are developing and implementing pre-developed algorithms, artificial

intelligence and machine learning on data sets. However, few examples have been observed where these companies combine this with implementing feedback loops, which is a key to provide insight and directions for companies to thrive and grow. Nevertheless, companies with already implemented feedback loops rarely share the insight gained from these with other industry players in order to draw insight across datasets and incidents. A few industry players have started to build centers of excellence as a first step toward developing world-class analytics capabilities. EY teams sees great potential of transferring knowledge from other industries to the aquaculture industry in order to achieve this goal.

To transform data into valuable knowledge, companies need to capture and aggregate the right data and knowledge from numerous sources and use it effectively to solve challenges and optimize processes. This includes adding competencies within data analytics, machine learning and artificial intelligence to their projects, implementing new business models and ways of partnering with experts and researchers. Another key element for companies to extract value from data is to invest and upgrade their infrastructure and data structure using open systems and updated technological solutions.

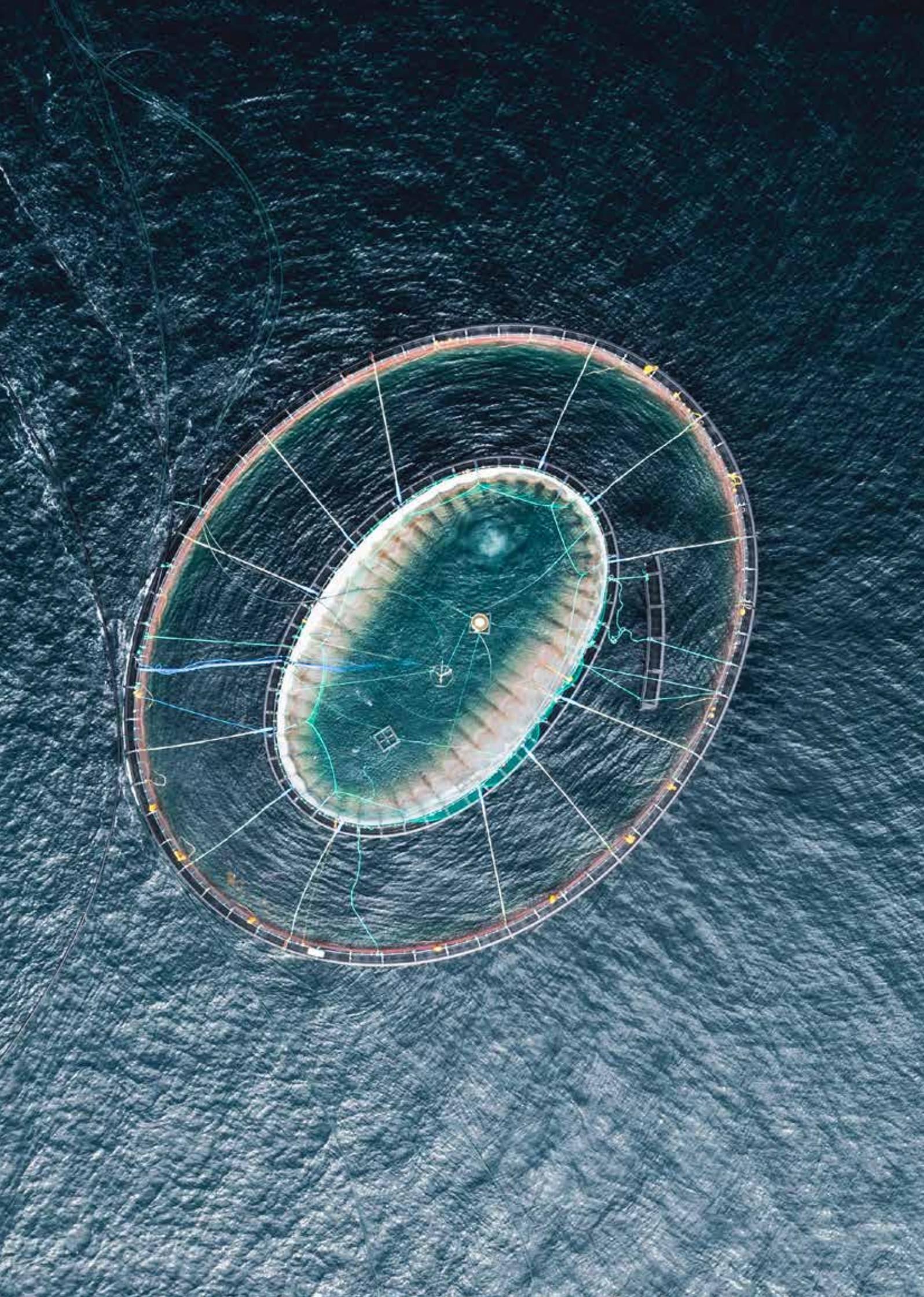
The industry is itself aware of several challenging areas where increased knowledge would have a significant impact on current initiatives and best practices.

Ongoing initiatives observed by the aquaculture team and mentioned by interviewed players include:

- ▶ Remote-controlled operations – e.g., inspection, maintenance and repair
- ▶ Improved control and monitoring of biological processes – e.g., sensor and sonar systems, cameras and blood analysis
- ▶ New methods for sea lice counting, control and treatment

- ▶ Integrated operations – e.g., fully automated feeding systems and increased automation of fish processing
- ▶ New sustainable fish feed ingredients, including single-cell protein from industrial waste products
- ▶ Biotechnological research and development to enhance growth and feed factors
- ▶ Developing and testing of RAS, land-based, offshore and closed fish farming solutions

The industry is well on its way into the knowledge-based era as the innovation rate and initiatives for solving the many challenges are high and many. Knowledge-based fish farming is on the rise and a key determinant for future success. Although many industry players embrace this change including the use of machine learning and AI for system automation, there is still a natural reluctance to cede control to these systems. Nevertheless, the fact that these overarching industry changes are being embraced through significant development work is a favorable sign for the entire industry.



Short-term forecast

First the verdict on last year's forecast ...

Methodology

Revenue has been estimated for 2019 and 2020 based on a quantitative forecasting model. Several approaches have been incorporated into the model, varying between the different subsegments.

Among the approaches used are:

- ▶ An analysis of historical correlation between key variables (such as salmon price and volume) and revenue
- ▶ Guidance from public companies
- ▶ Analyst reports for certain subsegments
- ▶ Discussions with industry experts

Introduction

We have presented our forecast in two previous editions of the Norwegian Aquaculture Analysis. The goal is to forecast the development of the companies included in our database.

We note that in terms of revenue contribution, the subsegments of sea farming and trading are, by far, the largest. Their revenue is, to a large extent, the product of volume and price. With this in mind, our primary focus in our forecast section will be on the main factors impacting these two subsegments.

There is currency exposure in both revenue and cost for the farming companies. Most sales are in euros and a large part of the fish feed costs are in currencies other than NOK. In theory, the forecasted NOK price of salmon should, therefore, take currency effects into account. Although input factors for feed are purchased primarily in US dollars, the raw materials originate from a broad range of currencies and are as such more diversified than the trading currencies may imply.

How did we do?

Salmon price

We finalized the 2018 forecast in the start of the fourth quarter of 2018. As such, we had data for salmon price for most of the year and only had to forecast one quarter in 2018. Our forecasted 2018 salmon price was close to the actual average for 2018 when comparing to Fish Pool.

While the average salmon price is a key input factor in our forecast, the degree to which the sea farming and trading subsegments actually achieve the spot price is also of importance. For instance, an average spot market salmon price of NOK60 does not mean that the average salmon price of the sea farming subsegment constitutes 100% of this. This will be impacted by the long-term contract coverage and related contract prices. Historically, we have observed that the combined sea farming subsegment in our database has achieved between 80% and 90% of the average annual spot price.

In our 2018 forecast, we estimated the achieved spot price for the sea farming subsegment to be 90%, which ended up being slightly below the 91% of the actuals. For the sea farming subsegment, we estimated the EBITDA margin to be 33.9%, close with the actual at 33.4%. We had estimated an increase in cost per kg of NOK1, when factoring in the actual volume and costs and the cost per kg increased with NOK1.2 from 2017 to 2018.

Fish volume

According to the Directorate of Fisheries, the sales volume of slaughtered fish¹ increased with 3.6% (salmon and trout (WFE)). In our forecast, we had estimated the growth to be a little lower at 3.0%. We based our estimates on our professional judgment combined with observed growth and guidance data from some of the publicly traded sea farming companies, as well as estimates from various analyst reports.

The verdict

Top-line growth from 2017 to 2018 ended up increasing with 1.8%, which is slightly higher than our estimate of 1.0%. In our 2018 forecast, we had estimated the EBITDA margin of the Norwegian aquaculture industry to remain stable. However, we observed a decrease of approximately one ppt. We had estimated a reduction for the sea farming subsegment and our forecast was close to the actual observed reduction for the sea farming companies. However, we had not forecasted a drop in margins for the other subsegments which turned out to have somewhat lower margins in 2018 compared to 2017.

1 "Salg 1994-2018." Directorate of Fisheries, <https://www.fiskeridir.no/Akvakultur/Tall-og-analyse/Akvakulturstatistikk-tidsserier/Laks-regnbueoerret-og-oerret/Matfiskproduksjon>, accessed 29 September 2019

... followed by our thoughts on 2019 and 2020

Massive stock movements in 2018 followed by a slowdown in 2019?

2018 was a great year for aquaculture companies, both in terms of financial results and development on the capital markets. The OSLO Seafood Index (OBSFX) is an index containing the largest aquaculture companies listed on the Oslo Stock Exchange. In 2018, this index increased with 50%. To put this into perspective, the Oslo Stock Exchange Benchmark Index (OSEBX) had a negative 1.8% return in the same period. The aquaculture sector continues to experience growing interest from large investors and there has been M&A activity from both industrial and private equity players in several parts of the value chain in the later years.

As this paragraph is written in October 2019, the seafood index is up 9.5% year-to-date, compared to 9.9% for OSEBX. While a 9.5% return in nine months is a great return, it is below the average Norwegian market performance and far from the 2018 returns.

Volume and price

2019 has been a troubled year for a number of sea farmers located in the northern parts of Norway. A massive algal bloom in Northern Norway ended up killing approximately 8.2 million fish (13.400 tons). Had all this fish reached harvesting size, the

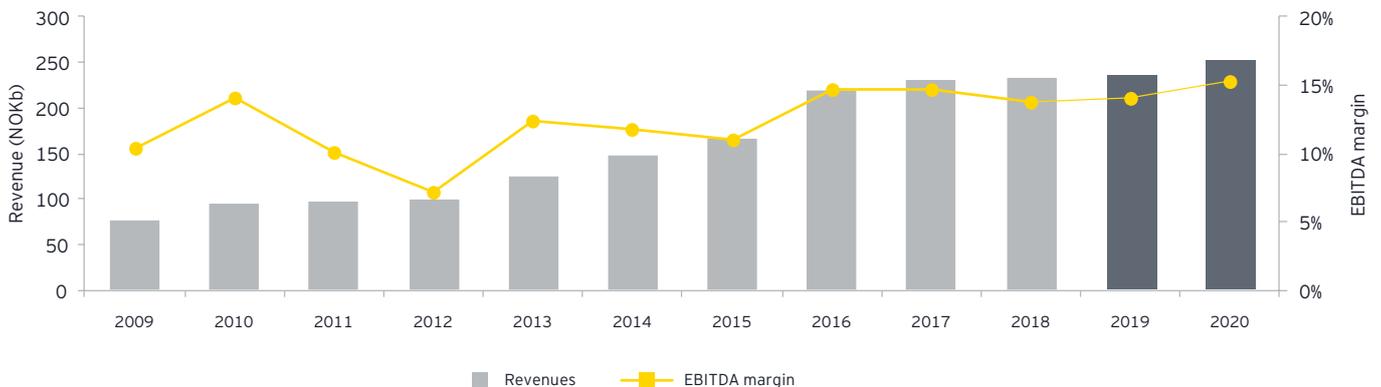
total tons lost would have been even greater. The algal bloom illustrates how vulnerable the sea farmers are to certain external environmental factors. While the larger companies are able to “shake off” the effects of lost volume, there are small farmers that are entirely dependent on a few farming sites. For these farmers, such an event can have catastrophic consequences resulting in lay-offs and potential loss of a full-year income.

Despite of fish lost to the algal bloom, the harvested volume as of 1H 2019 is approximately 5% higher than the same period in 2018 according to the Directorate of Fisheries statistics on extraction of slaughtered fish. The increase is approximately 8% when comparing the harvest in 2Q alone. The high supply has put pressure on prices, pushing them below 50 in both August and September (Fish Pool price).

Feed consumption was as of 1H19 more than 13% ahead of the same period in 2018. Looking at the first two months of 3Q19 in isolation, feed consumption was still 8% higher than for 3Q18. Furthermore, the Directorate of Fisheries reported that the current biomass in sea as of the end of august was 7.9% higher than the same period in 2018.

All of the above supports an expectation of an overall volume increase for 2019 compared to 2018. We have estimated a

The Norwegian aquaculture short-term forecast



full-year volume increase of 5% in our forecast, with continued growth expected going into 2020.

The global demand for salmon is still very much present. We expect that the price dip seen in the summer and fall of 2019 is temporary and that prices will increase throughout the fourth quarter. As for 2020, we expect the average price to be in the high 50s.

Cause and effect

While price and volume are the key input factors for revenue, the cost development is of equal importance but more complex to determine. The fish farmers have been troubled by biological challenges for quite some time. Sea lice, diseases and environmental challenges such as algal bloom, are all components that impact the sector's earnings.

While challenges for the fish farmers in terms of biological issues may negatively impact their margins, the same challenges open up for growth in other parts of the value chain. The combination of high earnings and limited volume growth in the 2012-17 period may have impacted the fish farmers' willingness to pay for various solutions. The biotechnology and technology solution segments have grown with a CAGR of 8.2% and 14.8% in the 2012-18 period, respectively. The transportation on sea subsegment, i.e., well boats, has experienced an impressive revenue CAGR of 22.2% in the same period, with EBITDA margins well over 40% in each of the last four years.

Since there are multiple factors going into fighting the biological issues, the cause and effect relationship is difficult to assess. Several fish farmers have an outspoken post-smolt strategy, meaning that the fish is grown to a larger size prior to being moved to net pens at sea. At the same time, several solutions for fighting sea lice have been developed and put to use. Overall, we do not expect the cost base to continue to grow at the same pace as recent years. While sea lice is still an eminent issue, the current cost base already includes significant expenses related to such treatments. If the post-smolt strategies are successful, we may see a decrease in the overall treatments needed per generation – which will probably reduce cost per kg. At the same time, keeping the fish longer on land requires more opex than

having them at sea, thus this may offset some of the potential cogs reduction. Another effect that the farmers hope to get from their post-smolt strategies is a more efficient use of licenses, i.e., increase the production output per license. However, these strategies are still in their early operational phases and it will be interesting to see to what extent they will have the desired effect.

The sustainable focus communicated by several sea farming companies can impact the financials in a positive way. In addition to post-smolt strategies, technological advancements in terms of for instance automated feeding stations and use of big data and analytics could be applied to reduce the feed conversion ratio. While the feed conversion ratio for salmon farming is low compared to a number of other agriculture farming operations, it is still the single-largest cost component for a fish farmer. More efficient feeding solutions could possibly reduce the feed wastage and advancements in the feed itself could reduce the amount needed.

Standing out from the competition

Branding will become an increasingly important factor for suppliers of salmon as a means to differentiate themselves from each other. The Board of Directors of MOWI stated in their 2Q19 report that, "It will take time to change the commodity driven salmon market into a branded market." This statement illustrates how little the salmon suppliers have focused on branding historically.

Conclusion

The massive growth in the aquaculture industry seen from 2015 to 2016 was driven by price. Since then, top-line growth has slowed down. A similar spike to prices as seen from 2015 to 2016 is not something we expect to see in the short-term. We believe that the top-line growth in 2019 and 2020 will primarily be driven by volume.

We expect margins to increase slightly, driven by stable costs in 2019 and small decrease in cost per kg in 2020. We remain positive and foresee a cost reduction in 2020 as a result of post-smolt strategies and other technology advancements, reducing the cost of fish in sea in the more biological challenged areas.



Global perspective

Norway – the top producer of Atlantic salmon

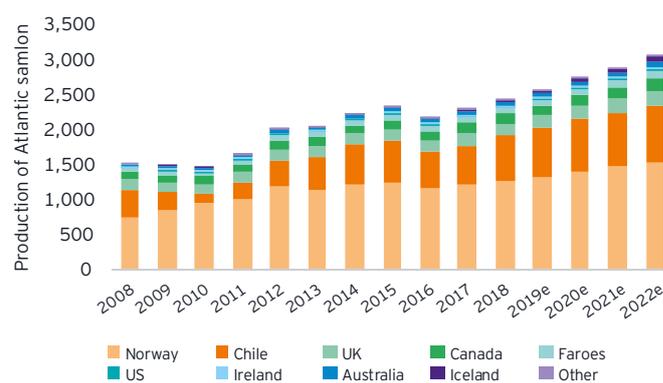
The share of aquaculture in global fish production is estimated to surpass wild catch for the first time in 2022, with an expected CAGR of 2.9% in the period 2018-22.¹ In 2018, 2.9% of global aquaculture production was Atlantic salmon.

Global production of Atlantic salmon reached almost 2.5 million tons in 2018, a 5% increase from 2017. Looking forward, it is expected that aggregate production will have an annual growth rate of 6% and surpass three million tons by 2022.

Although biological challenges and production constraints are causing lower expected future rates, Norway is still expected to remain the main contributor to the production levels, though at a lower rate than previously observed. Chile is expected to follow and experienced a 20% growth from 2017 to 2018. Further, it is predicted that the US and Iceland will be important growth markets going forward. Although they yield relatively low production levels, they are expected to increase annual production by 23% and 52% respectively, by 2022.

Future demand is expected to be driven by global market trends, such as a growing population, health concerns and the ongoing climate change debate. However, future production may be constrained by factors such as geographic limitations, technology and regulatory constraints.

World production of Atlantic salmon (RW 1,000)



Source: Pareto, Kontali 2019

Global market trends driving future demand

Population growth

Results in increased global demand for food

Aging population

Healthy eating increasingly more important with age

Health

Global health authorities are increasingly promoting health benefits of seafood

Growing middle class

Increased consumption of high-quality proteins

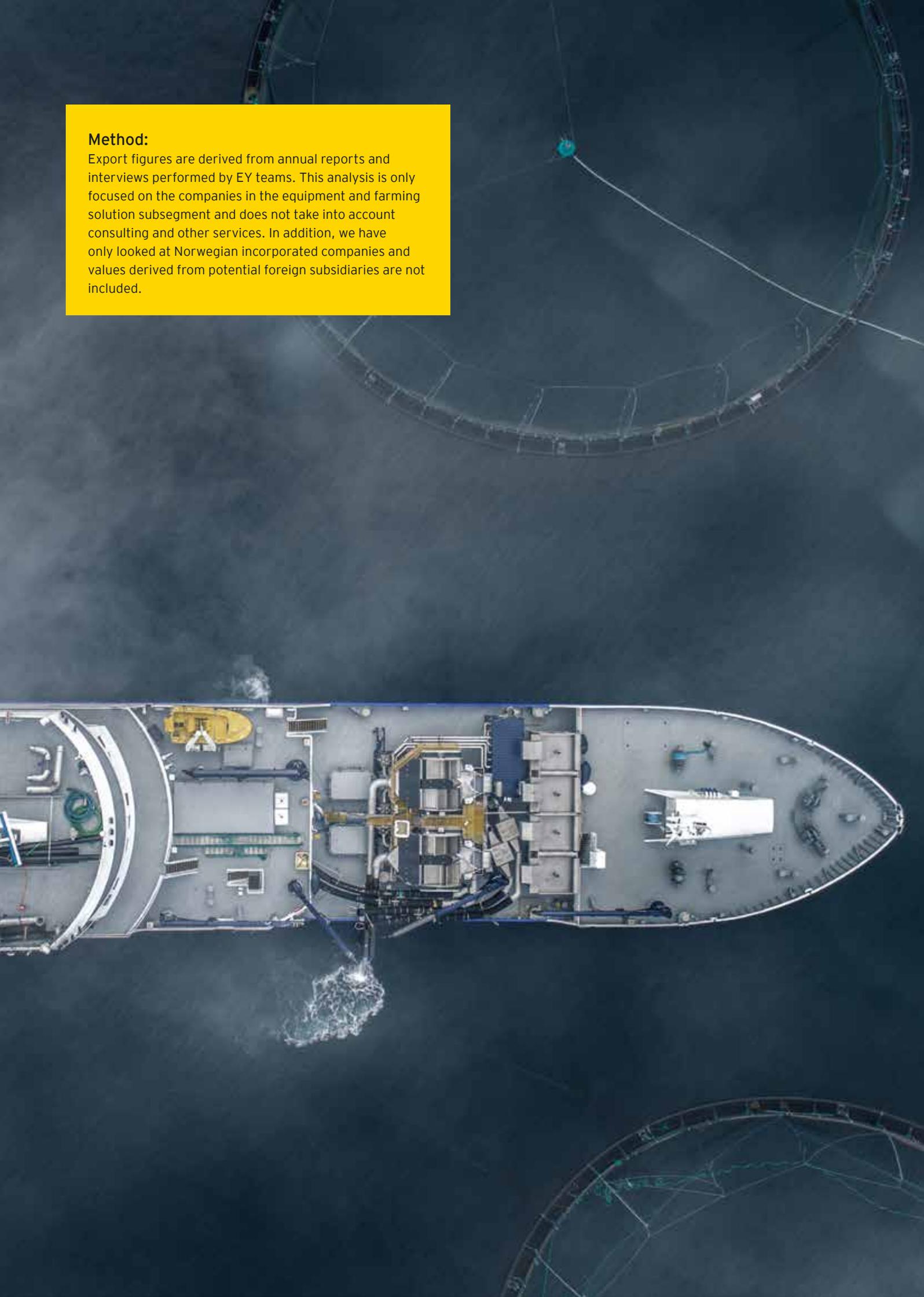
Climate change and resource efficiency

CO₂ emission have to be reduced; farmed fish the most climate-friendly protein source

Exploited resources

Supply of wild fish has limited potential to met the growing demand for marine protein

¹ "OECD-FAO Agricultural Outlook 2019-2028," OECD iLibrary, www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2019-2028_agr_outlook-2019-en, 8 July 2019

An aerial photograph of a fishing vessel at sea. The vessel is oriented vertically, with its bow at the top. The deck is visible, showing various pieces of equipment, including a yellow crane or hoist in the center. The water is dark blue, and there are some white waves or splashes near the vessel's stern. In the upper left corner, there is a yellow rectangular box containing text. The overall scene is captured from a high angle, providing a clear view of the ship's layout and the surrounding water.

Method:

Export figures are derived from annual reports and interviews performed by EY teams. This analysis is only focused on the companies in the equipment and farming solution subsegment and does not take into account consulting and other services. In addition, we have only looked at Norwegian incorporated companies and values derived from potential foreign subsidiaries are not included.

Global technical solutions

How can Norwegian aquaculture technology play a vital role for production levels going forward?

The needed expansion in aquaculture production levels must take place in a sustainable way. Hence, new farming solutions will be imperative in order to scale global market production. Large investments in R&D in the recent years have established Norway as a competence cluster when it comes to new and innovative technology and we have taken a closer look at the export values for companies in the equipment and farming solution subsegment.

To summarize, EY analysis shows that approximately NOK 1.6b worth of aquaculture technology was exported in 2018, which constituted 25% of the revenues for the exporting companies. From 2014 to 2018, we observed a CAGR of 33%, with the greatest growth spurt witnessed from 2015 to 2016 where the values almost doubled.

What are the factors that has enabled growth this far?

There are various reasons that can explain the noteworthy growth rate. First, there are the macroeconomic factors mentioned in the previous section (ref. the "Global perspective" section). In addition, there are long-term cost-cutting initiatives, possible trade sanctions, elimination of tolls, weak Norwegian krone and an increased focus on the environmental impact of the industry.

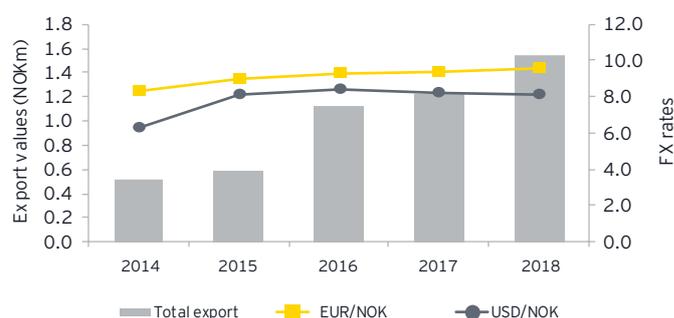
Investing in Norwegian aquaculture technology could open the possibilities for production to happen closer to the consumer market. Local production could enable cost-cuttings within transportation and potential toll rates that would otherwise be applicable. Potentially limiting the transportation also plays an important role in terms of decreasing the environmental footprint for the industry. Lastly, the weak Norwegian krone could also have been an important contributor to the growth, as it yields higher revenues for the exporters.

Which technology solutions have been highest in demand and who are the importers?

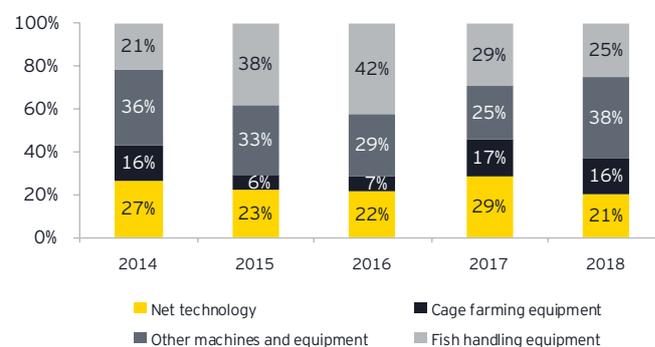
The companies in the farming and equipment solution subsegment offers a wide range of products. Cage farming, net and fish handling technology appears to have generated the most export value. This is perhaps no surprise as Norway has been in the forefront of traditional farming and the R&D spending put into these specific segments have made Norwegian actors pioneers. In addition, there are export of solutions for other species as well as non-aquaculture equipment, such as solutions for wild catch operations.

Though some of the export values are not directly linked to a specific country or region, we observe that European countries are important importers, followed by some of the bigger production countries such as Chile and the US (who is expected to experience significant growth in production levels the coming years).

Norwegian export of equipment and farming solutions



Distribution of exported goods



Who are the exporters?

In 2018 84% of the export companies had revenues above NOK100m, indicating that it is the more established players who are most prominent in the export of technology. As more companies are able to grow and gain a foothold in the Norwegian market, we expect them to contribute to higher export values the coming years.

Norwegian technology is both leading and sought-after. It is likely that there have been a positive impact on export of Norwegian technology from having large Norwegian sea farmers present in abroad markets. That being said, we believe that the export potential for Norwegian seafood technology is significantly higher than the levels observed today.

Tax considerations

Direct and indirect taxes are an increasingly important part of doing business and an increased complexity in the business activity and cross-border trade may also result in unforeseen tax consequences. We have looked at some key areas we believe should be at the center of attention, in particular for the distribution and sales businesses.

Tax – trading, supply and distribution

Conducting business with or in other jurisdictions will often raise potential risks and requirements relating to both direct and indirect taxes. As companies in this segment have increased their business activities abroad, such as movements of products, purchasing of feed, sourcing and supply of fish, tax and customs reporting and compliance requirements in overseas jurisdictions for these companies have increased accordingly.

Many trading and distribution companies purchase fish from processing companies in the EU and on-sell the end product to their customers situated both in the EU and third countries. This activity may trigger indirect tax liabilities in the country where the fish is purchased and in the country of supply. In 2018, several of the sales and distribution companies reported increased indirect tax registration and reporting liabilities in overseas countries.

We have also seen increased exposure to local indirect tax liabilities for distributors through the usage of particular Incoterms in contracts where they take on the local taxes and import obligations and liabilities as part of the cross-border supply.

The increasing requirements around tax transparency and data transmission by tax authorities globally through initiatives such as BEPS and SAF-T reporting, alongside cross-border sharing of information by tax administrations, provides them with extensive information and data about companies' activities, using tools and analysis. The steady growth of indirect taxes through registrations and reporting liabilities globally is expected to continue. It therefore requires companies, particularly those operating across borders with the EU and beyond such as trading and distributor companies, to be aware of the tax and customs reporting and requirements associated with their business activities, to manage their risks and possible compliance obligations.

Tax considerations for vessel operations in the fish farm industry – do they qualify for the Norwegian tonnage tax regime and will they be taxable abroad?

When operating vessels in the fish farm industry, several considerations should be made in order to ensure an efficient operating structure from a tax perspective. Depending on the business plan of the company, it may be beneficial to assess

whether the vessel owning companies qualify for Norwegian tonnage taxation (i.e., operating income is tax-exempt in Norway). However, these considerations should be aligned with potential tax implications abroad and taxation of the maritime and operational crew.

Provided that certain requirements are met, a Norwegian vessel owner may qualify and be tax-exempt under the tonnage tax regime. The tonnage tax regime is a "ring fenced" system, meaning that only certain companies conducting certain activities qualify for the regime. If opting for such taxation, it is therefore important to ensure that all requirements are met at all times. A breach of the requirements will lead to forced exit and ordinary taxation in the year the breach occurred.

One of the main requirements for the Norwegian tonnage tax regime is that the vessel owning company needs to operate a vessel "in motion" that is over 100 register tons. For vessels operating in the fish-farm industry (typically well boats, fish feeding vessels, harvest vessels and work vessels), this is an important consideration to be made. A vessel operating in Norway is deemed to be "in motion" if it sails a distance of 30 nautical miles per trip. The legal practice, however, suggests that the vessel is not required to sail 30 nautical miles for each trip, but that the income year as a whole needs to be considered. Practice suggests that as long as the sailed distance exceeds 30 nautical miles for two-thirds of the fiscal year, the vessel is considered to be a vessel in motion. However, this is subject to ongoing discussions with the tax administration and we recommend that the companies keep track of the 30-mile requirement for each vessel in question.

If a company, or group, own several vessels operating in the fish farm industry, the activities undertaken by each vessel should be assessed in order to see whether the activities qualify. Pure transportation of fish, feed, or equipment rarely cases issues as long as the sailing distance is sufficient. However, for other or additional services provided, this need to be reviewed in detail. It may be deemed necessary to own the vessels in different vessel owning companies to increase the flexibility and sustainability of the structure. If providing other services than operating vessels – e.g., sea lice and amoebic gill disease treatment onboard – it is important to consider whether such services are allowed under the regime or whether they need to be offered by a separate group company. Harvesting vessels can qualify for the regime. However, the company should be careful not to perform fish processing procedures beyond what is necessary to execute the transport engagement, without obtaining an advanced binding ruling from the tax authorities.

If a vessel owning company is tonnage-taxed in Norway, tax effects from any operations abroad still needs to be considered. If the company operates abroad and is not taxed in Norway

because it is covered by the Norwegian tonnage tax regime, the foreign tax payable will be a final tax for the company. No credit is provided in Norway as the income is tax-exempt in Norway. Tax liability for the company abroad may also lead to tax implications for the maritime and operational crew and may impact the funds possible to be received from the New Wage Regime. Thus, when setting up a structure, this should also be subject to careful review in order to fully understand and be able to account for the group's overall tax cost.

Proposed resource rent taxation for the Norwegian aquaculture industry ("grunnrenteskatt")

The Government appointed in 2018 a committee to assess how the tax system for the aquaculture industry should be designed. This was in order for the society as a whole to take part in what is generally assumed to be extraordinary returns from the industry's use of natural resources. At the same time, the tax system should be designed in a way that allows the industry to undertake profitable investments. The committee considered both the introduction of a resource rent system and a production fee system.

The members of the committee were split (6-3) in their proposal presented on 4 November 2019. The majority proposed a resource rent tax of 40 percent of a special tax base called the "resource rent income." This tax will be in addition to the ordinary Corporate Tax of 22 percent of the corporate profits. The proposed taxation model is designed similar to the implemented resource rent taxation for hydropower enterprises in Norway, and will be a profit based, periodic tax where investment cost deductions are distributed over time through depreciations. A special income deduction ("friinntekt") will be allowed when calculating the resource rent tax. This deduction is meant to compensate the cost of not being able to deduct investment costs as they arise.

The majority also proposed that the current auction-based system of new aquaculture licenses should be upheld. Lastly, they proposed that the existing property tax on fish farming installations, in addition to the sector specific export duty, are to be removed.

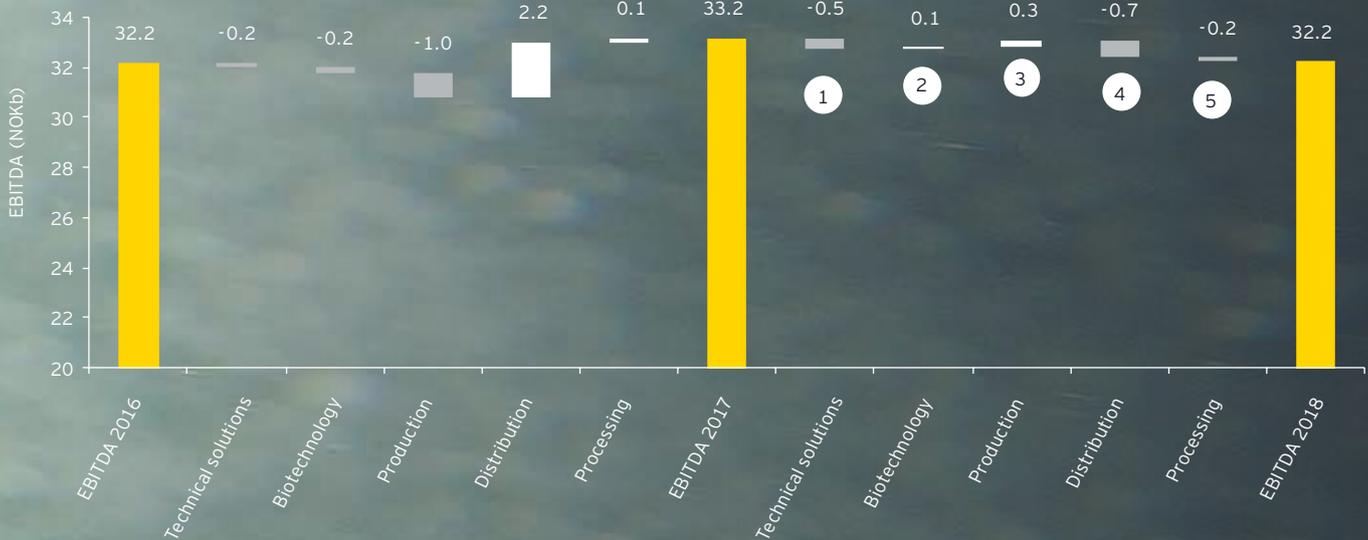
The minority, on the other hand, consider the current auction-based model in relation to production capacity expansion to be an adequate tool to procure resource rent tax. Should the growth within the industry decrease, the minority suggest that a moderate production fee is implemented to secure future tax income from the industry.

Currently the political climate seems unfavorable to the proposed resource rent tax. However regardless of the political climate, the debate on taxation of the aquaculture industry is likely to continue in the years ahead.



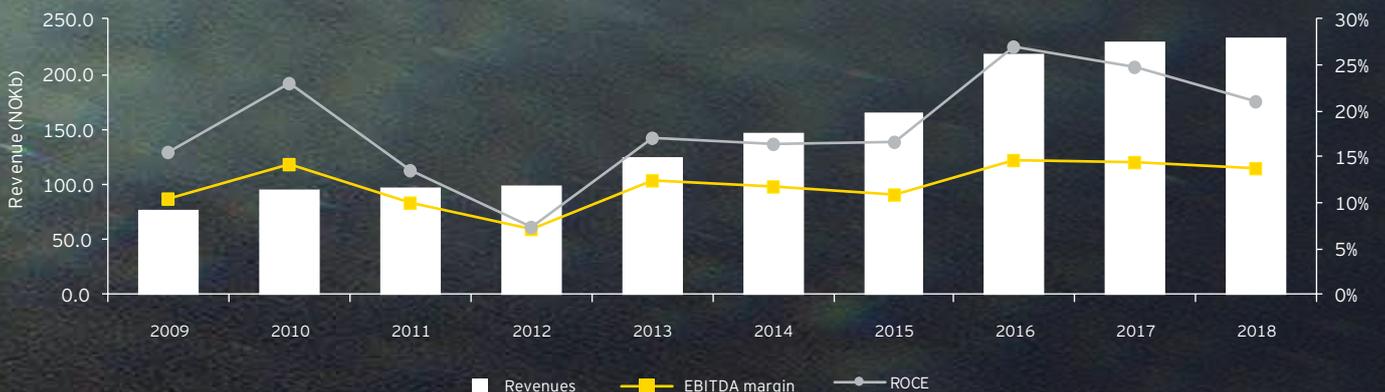
Key segment highlights – Norwegian aquaculture industry 2017-18

EBITDA bridge 2016-18



- 1 Downward trend in 2018, but there are signs that the stagnating revenue growth and decreased margin may be short-lived as many of the larger companies report high-order backlog going into 2019.
- 2 While the high focus on fish health and biology continued to drive the revenue growth and positive EBITDA margin development in the fish health subsegment, the feed segment experience a slowdown in revenue growth relative to earlier years and a slight margin decline mainly due to increased competition.
- 3 Total EBITDA increased from 2017 to 2018, driven by an increase in fish volumes. At the same time, stable prices and a small increase to cost per kg resulted in a reduction to the segment's EBITDA margin.
- 4 Despite both export revenue and volume reaching new heights, the trading subsegment experienced a margin hit – to some degree caused by unfavorable fixed price contracts. On the other hand, EBITDA margins in the transportation at sea subsegment remain at super profit levels.
- 5 Processing remains demanding and costly in Norway, both due to the labor intense production, but also due to the cost of raw material influenced by the continued strong salmon price throughout 2018.

The Norwegian aquaculture industry 2009-18



Segment analysis

Technical solutions

Biotechnology

Production

Distribution

Processing

The value chain

When discussing the aquaculture industry, we primarily talk about the end product – salmon and trout. However, there are many other stages and actors in the industry. The aquaculture value chain includes broodstock (egg and spawn), smolt, edible fish, fish processing (based on farmed fish), export and trade and suppliers of goods and services.

For analytical purposes, the value chain and the value creation can be presented in different ways.

In particular, there are three groups of suppliers – namely technical solutions suppliers, biotechnology suppliers and distributors – which can be challenging to present in a common value chain. These three can also be perceived as diverted or parallel activities.

It is apparent that technical solutions suppliers are needed at every stage of the value chain (as we can see in the illustration on the right side). Hence, presenting them as just one segment can be misleading.

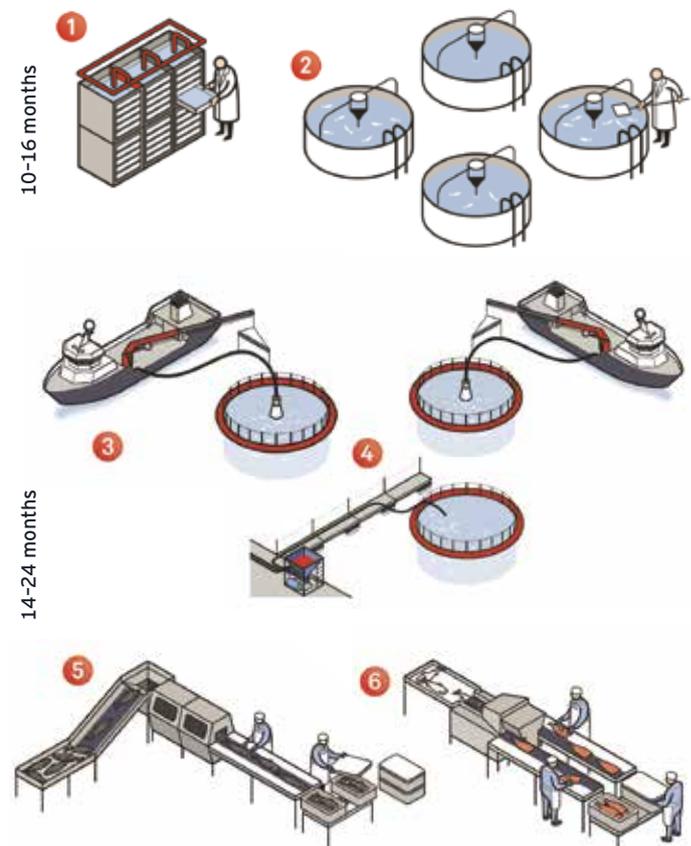
The above-mentioned challenge is almost the same as that for the biotechnology suppliers, who deliver a wide range of products including feed, vaccines, medicines and cleaner fish. The common denominator for these products are the biological or pharmaceutical raw materials. The biotechnology manufacturers supply both egg and spawn producers, smolt producers and sea farmers.

The distribution phase is also complex. Sea transportation is needed for both transporting smolt from freshwater to cages in seawater and transporting harvestable fish to processing plants. In addition, we have traders and exporters who purchase fish from sea farmers and provide it to the end-consumers, either slaughtered or processed.

The primary value-creating activity in the industry is production. The production cycle is about three years. During the first year, eggs are fertilized and the fish are grown to 100 grams in controlled freshwater environments. Subsequently, the fish are transported into seawater cages where they are grown to about four to five kilos. This growing process takes 14-24 months, depending on the seawater temperature.

Despite the methodological challenges, we have decided to present technical solutions, biotechnology and distribution together with production and processing in one single value chain. This is to make the analysis easier to follow and interpret.

The Atlantic salmon life or production cycle



Source: "Fig 6.2 The Atlantic salmon life/production cycle," Salmon Farming Industry Handbook 2016, Marine Harvest, www.hugin.info/209/R/2023118/751659.pdf, 23 June 2016, © 2016 Marine Harvest ASA.

Technical solutions



Exciting growth prospects

About the segment

The technical solutions segment includes companies with approximately 50% or more of its business linked to the aquaculture industry, but which are not directly linked to any of the other segments. Hence, there is a large variety of products and services provided by the companies in this segment.

The largest companies within this segment are producers of technical solutions and services, specifically developed for the aquaculture industry, e.g., barges, well-boats, feeding systems, cages, mooring systems, sea lice treatments and software.

We have divided the segment into two subsegments:

1. Consulting and services
2. Equipment and farming solutions

Segment highlights

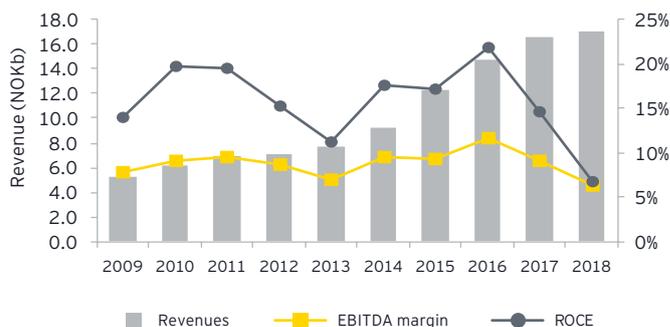
The technical solutions segment continued to yield revenue growth in 2018, though at a lower rate than previously observed. Revenues increased by 3% in 2018, whereas the annual growth rates in 2017 and 2016 were 12% and 20%, respectively.

Despite the fact that demand continued to be high in 2018, increased competition among the companies likely caused lower price points, which in return had a negative effect on revenue growth and margins.

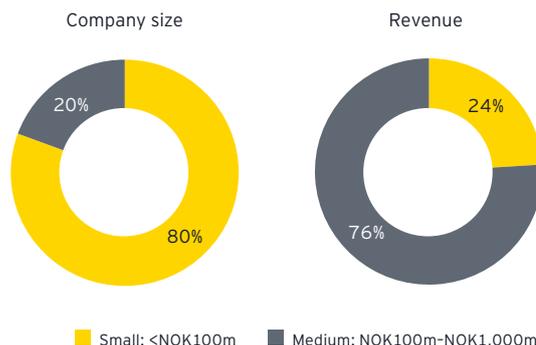
Increasing cost components such as cost of goods sold coupled with lower revenue growth resulted in lower profitability. As much of the material is imported from other countries, there is an exposure to fluctuations in currency rates and following a weak Norwegian krone in 2018, this could in part explain why cost of goods sold experienced a CAGR of 10% from 2016-18. Further, the negative EBITDA development also seems to be driven by the change in product mix for some entities, increased competition and some loss-making contracts. Lower EBIT and high capital employed have also resulted in the lowest ROCE level observed in the historical period.

Although the M&A activity in recent years has been high, with over 30 transactions recorded since 2016, the segment remains rather fragmented and is predominately made up of small-sized companies (of which 80% had revenues below NOK50m). Now we observe more interest from industrial players, which through acquisitions are creating larger companies with a range of specialties. This enables them to offer a superior product portfolio in order to secure stronger market positions.

Key financials



Segment composition (2018)



Increased focus on farmers' environmental footprint, as well as digitalization, has a positive spillover effect on this segment as it incentivizes farmers to invest in new technology. Nonetheless, the technical solution companies have some of the highest R&D spending per company and have experienced a CAGR of 35% in capitalized R&D spending the past five years. Hence, high spending increases their ability to meet market demand and facilitate the growth that this segment is expected to experience going forward.

Consulting and services

Equipment and farming solutions

High investments to facilitate growth

Consulting and services

The companies in this subsegment offer competency on various specializations across the whole value chain and ongoing maintenance and services.

The top five players accounted for 40% of the subsegment's revenue in 2018 and approximately 40% of the reduction in EBITDA came from these companies.

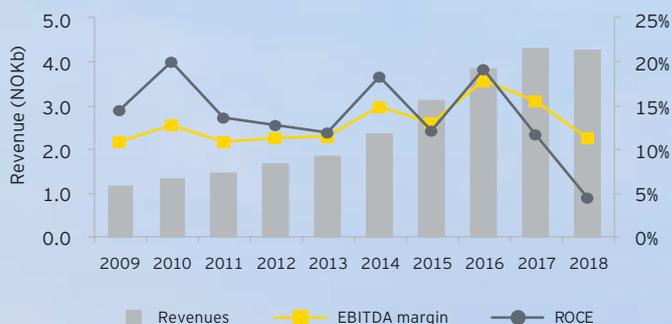
While gross margin has been relatively stable, we observe a reduction to EBITDA margin, driven by an increase to both personnel and other operating expenses. The service segment is competitive and we have observed some mergers taking place in 2018. The competitive environment is most likely the primary driver for the margin reduction.

Part of this subsegment is capital-intensive and CAPEM increased by 15% in 2018. The increase was primarily driven by vessel purchases for some of the service providers.

Top five companies (2018 revenues)

1. SINTEF Ocean AS
2. Gildeskål Forskningsstasjon AS
3. Frøy Akvaservice AS
4. Akvaplan Niva AS
5. Aqs AS

Key financials



Consulting and services

Equipment and farming solutions

Equipment and farming solutions

The companies in this subsegment offer a variety of equipment and solutions – from the largest players, such as AKVA Group offering nearly all kinds of equipment, to smaller and more niche players.

EBITDA margins in the subsegment has plummeted. This reduction is driven by a reduction to gross margin and an increase to personnel expenses. The cause for this development is somewhat complex, where we see a change in product mix, increased competition and some loss-making contracts as the main explanatory factors.

There are signs that the stagnating revenue growth may be short-lived as several companies report high order backlogs. In particular, this relates to the companies associated with newbuilds, equipment add-ons and retrofits for the well-boat industry. As the environmental shift approaches and new technology emerges, the best option in the long-run will likely be to invest in new technology as opposed to utilizing older technologies such as for instance diesel-driven vessels.

Investment levels remained high in 2018, with an increase in CAPEM of 14% from 2017. ROCE continued to decline, indicating that the players have yet to materialize on the investments made.

Capitalized R&D spending increased by 26% from 2017 to 2018 and we observed increased investments toward software solutions and further development of RAS technology. This is closely correlated with the farmers' agenda to secure cost-efficiency, animal welfare and to decrease the environmental footprint.

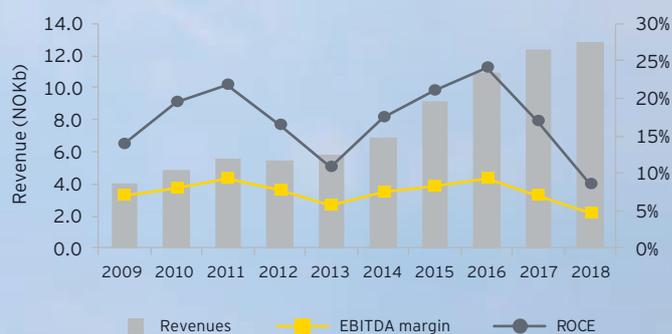
In 2018 and so far into 2019, we observe trends where companies in the subsegment join forces either through M&A or joint ventures. In most cases, the companies continue as separate entities, yet have the advantage of knowledge-sharing opportunities and the ability to strengthen market position through these collaborations.

Top five companies (2018 revenues)

1. Optimar AS
2. AKVA Group ASA
3. Steinsvik*
4. Aqualine AS
5. Egersund Net AS

* Please note that Steinsvik had not filed their 2018 accounts as of the time of completion of this report. For comparability, we have included them with numbers for 2018 equal to 2017.

Key financials

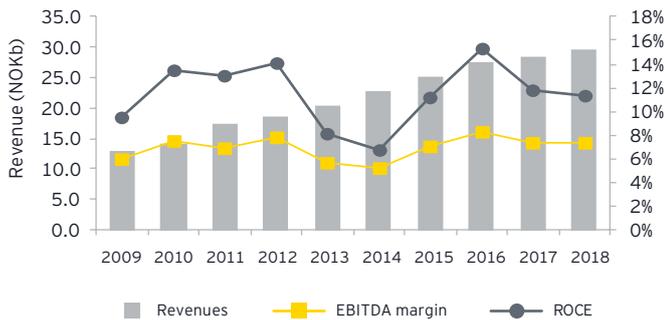


Biotechnology

Technical solutions | **Biotechnology** | Production | Distribution | Processing

While feed producers' margin is under pressure, the search for solving biological challenges fuels the fish health subsegment

Key financials*



* In 2017, one of the entities in the feed subsegment recognized a significant gain in relation to sale of intellectual property. The 2017 revenue and EBITDA have been adjusted for this gain.

About the segment

Biotechnology refers to the application of biological technologies in product research and development. Modern biotechnology has been used in aquaculture with regards to cases such as reproduction control, disease control, environmental management, feed production and biodiversity conservation.

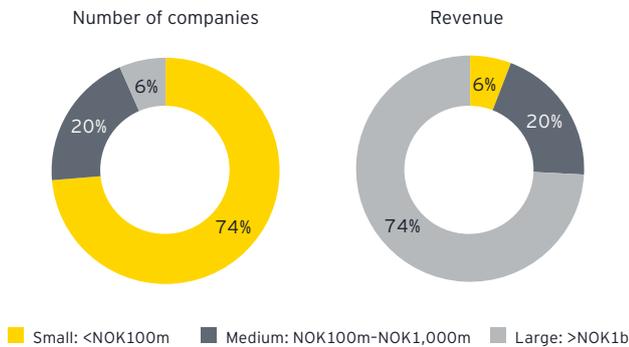
We have divided the segment into two subsegments:

- ▶ Fish health
- ▶ Feed

Segment highlights

Biotechnology not only enhances production to meet demand, but also ensures sustainability and response to environmental threats. Use of technology makes it possible to maintain healthy fish stocks at low prices by contributing to nutritious feed and effective disease prevention.

Segment composition (2018)



The application of biotechnology in the aquaculture industry is a relatively recent practice. The segment has seen a substantial growth in the past decade with a compound annual revenue growth rate of 9.5% from 2009 to 2018. The growth has been positively influenced by high salmon prices and stagnating volume due to biological issues, resulting in an increased demand for healthy and efficient fish feed, fish medicines, vaccines, etc.

Since 2016, the revenue growth in the biotechnology segment has subsided and the EBITDA margin has decreased. This is primarily attributed to the feed subsegment which is dominated by a few large, high-volume/low-margin feed producers. Since Mowi entered the feed market in 2014, the competition has increased and the margins are under pressure. The EBITDA margin decreased from 5.5% in 2017 to 5% in 2018 in this subsegment. Contrary to the feed subsegment, the fish health subsegment experienced both a high revenue growth (11.2%) and a positive EBITDA margin development from 2017 to 2018.

Fish health

Feed

High focus on fish health and biology continues to drive the revenue and margin growth

Fish health

Good financial results in the fish farming industry depends on healthy and high quality fish. Entities within the fish health subsegment provide products, services and research and development projects which are crucial for maintaining and improving the fish health for the global aquaculture industry. Contrary to the feed subsegment, where only a limited share of the produced volume in Norway is exported, companies in the fish health segment have a higher degree of export.

Finding the solution to biological issues

Biological issues remain a significant challenge for the Norwegian salmon farmers. Sea lice still represents the biggest threat to Norwegian fish health, but there are also other significant risks such as Pancreas disease (PD), infectious salmon anemia (ISA) and heart and skeletal muscle inflammation (HSMI).

Solving the sea lice issue demands a combined effort from the entire aquaculture industry, including research into pharmaceuticals and vaccines, breeding technologies and genetics, functional feeds, mechanical and biological methods for lice removals, etc. Several companies within the fish health subsegment have provided medicinal treatments for combatting sea lice. However, the development of resistant parasites has reduced the efficiency of these treatments and the number of medicinal treatments has been significantly reduced since the top in 2014.

Entities within the fish health subsegment invest heavily in research for finding new, sustainable and efficient solutions for battling sea lice and the other aquaculture related biological issues. There is among other research ongoing for developing a viable commercial protective sea lice vaccine. If successful, this will be an international break-through in vaccinology that will help the industry reduce the need for chemical treatments.

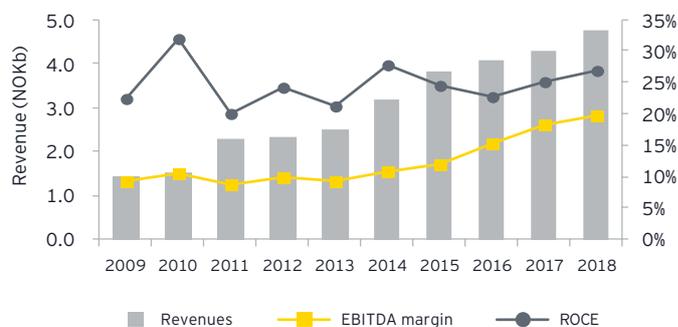
Revenue and margin growth

The focus on fish health and biology in the aquaculture industry has fueled the revenue and margin growth in the fish health subsegment over the last decade. 2018 was yet another strong year, with a revenue growth of 11.2% (from NOK4.3b to NOK 4.8b) and an EBITDA margin growth of 1.6pp. to 19.8%. It is, however, worth noticing that the profitability varies significantly between the entities within the subsegment.

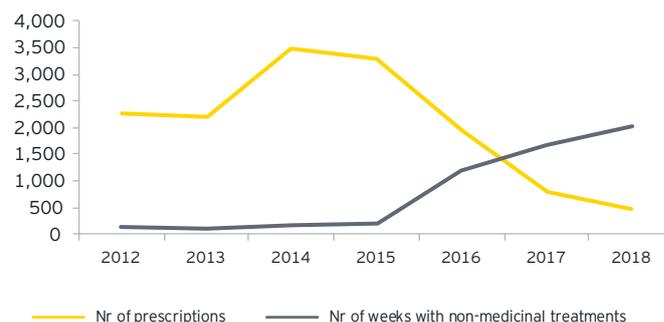
Top five companies (2018 revenues)

1. PHARMAQ AS
2. Stim. AS
3. Nofima AS
4. Veterinærmedisinsk Oppdragscenter AS
5. MSD Animal Health Norge AS

Key financials



Number of prescriptions and number of weeks when farmers have reported non-medicinal treatments of sea lice*



Source: "The surveillance programme for resistance to chemotherapeutants in salmon lice (*Lepeophtheirus salmonis*) in Norway 2018", The Norwegian Veterinary Institute website, www.vetinst.no

Increased competition puts pressure on the margins

Feed

Feed represents about half of the total production cost for salmonids and as commented upon in the sustainability chapter of this report, makes out approximately 95% of the carbon footprint in traditional salmon farming. Also, the correct ingredients are vital for both the health and quality of farmed fish. Thus, feed is a key focus area in the industry from both an economical, environmental and biological point of view. While the feed producers included in the feed subsegment produce feed and products to other species as well, salmonid feed makes out the material volume and revenue in this subsegment.

Shortage of conventional marine materials (mainly fish meal and fish oil) has resulted in a shift toward vegetable materials. While fishmeal and fish oil made up more than 80% of salmon feed in the 90's, today, conventional marine materials only constitutes between 25%-30% of the average Norwegian fish feed. As a consequence, the long chain omega-3 fatty acid content in the farmed salmon has declined. However, the feed procurers are investing heavily in finding alternative sources of omega-3 including the use of biproducts from conventional fisheries, krill, algae, etc.

Consolidated feed production

The salmonid feed industry is largely consolidated and consists of a few large producers controlling the majority of the salmon feed output. Over the last five years, the top four companies have accounted for between 80%-90% of the revenues in the feed subsegment.

Revenue growth and margin decline

The revenue growth continued in 2018, however at a slower pace compared to earlier years. The revenue growth from 2017 to 2018 was 2.8%, ending at a total revenue of NOK24.9b. The EBITDA margin continued its decline from 2016 and ended at 5% in 2018. Since Mowi Feed entered the market in 2014, there has been increased competition and margin pressure in the feed subsegment.

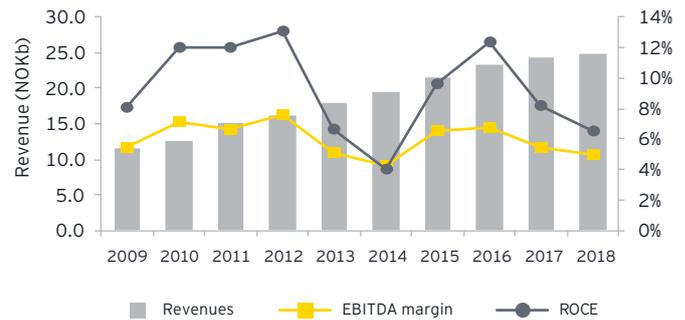
Whereas we see increased digitalization and knowledge-gathering through big data and machine learning in the sea farming subsegment, it is imperative that also the feed producers take on the role as purveyors of feed data and related knowledge. If not, the feed producers may experience an even higher pressure on the margins going forward. As Dag Sletmo,

senior vice president and seafood analyst in DNB, said to undercurrentnews.com in February 2019¹, "If the sea farmer's knowledge becomes as strong as the feed producers, they may come to see the feed producers only as a supplier – that would have a very negative impact on the feed industry's margins."

Top five companies (2018 revenues)

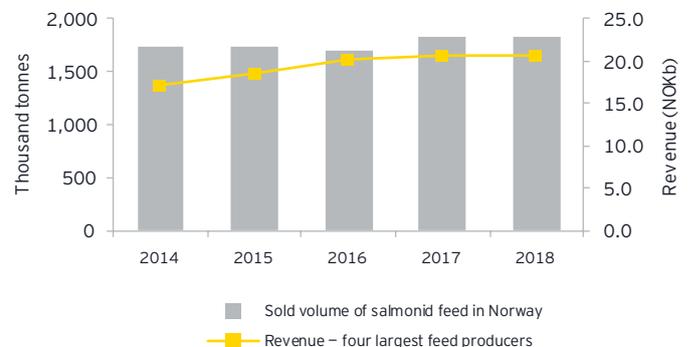
1. Skretting AS
2. EWOS AS
3. BioMar AS
4. Mowi Feed AS
5. Aker BioMarine Antarctic AS

Key financials*



* In 2017, one of the entities in the feed subsegment recognized a significant gain in relation to sale of intellectual property. The 2017 revenue and EBITDA have been adjusted for this gain.

Sold volume salmonid feed* and revenue for the four largest feed producers



* Source: "Salmon Farming Industry Handbook 2019", Mowi website, <https://mowi.com/investors/resources/>.

1 "DNB: Record margins make salmon sector ripe for digitalization in coming years," undercurrentnews, www.undercurrentnews.com/2019/02/20/dnb-record-margins-make-salmon-sector-ripe-for-digitalization-in-coming-years/, 20 February 2019.





Production



Increasing costs keeps eating up profits, but high salmon prices have opened the door for new, innovative farming solutions

About the segment

The production segment consists of the fish' life cycle from the breeding and fertilization of eggs, through nurturing of fry to smoltification, to finally putting it to sea for growing to harvest size.

To reflect the various stages of the production cycle, we divide this segment into three subsegments:

- ▶ Egg and spawn production
- ▶ Smolt production
- ▶ Sea farming

As quality in the first stages of the cycle is crucial to successful sea farming, there has been a large degree of vertical integration in this segment. The sea farming companies expand into upstream activities to facilitate access and high quality, both in the broodstock or eggs and in the handling and vaccination of fry during the freshwater stage.

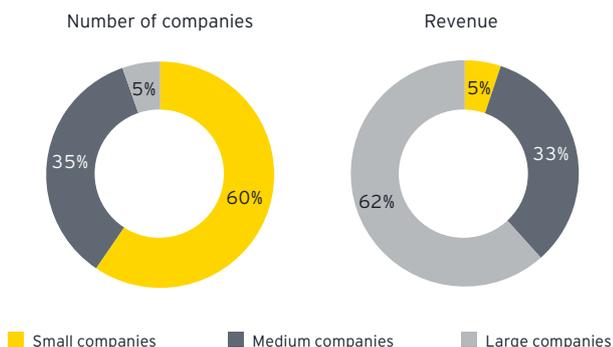
The segment in total consists of about 260 companies.*However, a relatively small number of companies account for the majority of the value creation. In 2018, the ten largest companies had a market share of about 55% in terms of revenue.

Segment highlights

The production segment has experienced a substantial growth from 2009 to 2018, with a notable acceleration from 2013, driven by a significant increase in prices and favorable currency exchange rates for exports.

The relatively stable volume and the continued all-time high prices resulted in an aggregated increase in revenue of 5% in the segment from 2017 to 2018.

Segment composition (2018)*



* Note that many of the legal entities in this report are, in reality, part of the same group.

The sea farming subsegment is the main contributor to the segment with a share of over 94%, both in terms of revenue and EBITDA.

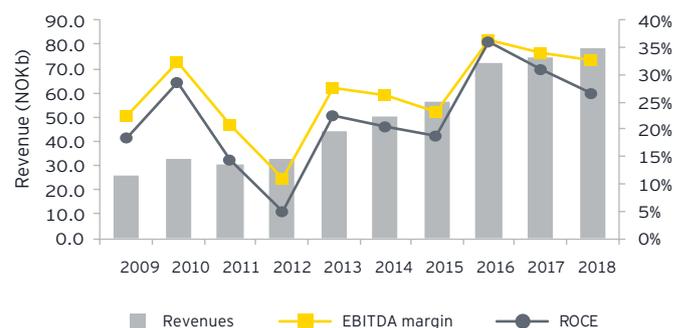
While the segment has been highly profitable for quite some time, previous periods fall short compared to the all-time high prices and profits seen from 2016 to 2018.

As a result of the increased profitability and increasing demand for various supporting services, the sector has become a major contributor to value and job creation along the Norwegian coast.

There is a continuous concern about the sector's challenges related to sea lice and other environmental issues. These challenges materialize in higher cost and are the main reason for the small decline in the EBITDA margin from 2017 to 2018. These challenges have plateaued the growth in production volumes in the past few years, paradoxically driving up prices and profits in the short term. In the long term, however, there is a need for a sustainable growth in volume. Biological challenges and diseases are two of the major concerns the industry faces going forward.

As an attempt to tackle the challenges facing the industry today, there has been a significant increase in research and development (R&D) over the last years. Most of the new innovations are focused on making aquaculture more sustainable, decreasing biological challenges while at the same time increasing volumes in the long run. Please refer to the sustainability section of this report for further details and insight.

Key financials



Egg and spawn production | Smolt production | Sea farming

Increasing costs keeps eating up profits, but high salmon prices have opened the door for new, innovative farming solutions (cont.)

Egg and spawn production

The companies in this subsegment are specialized in spawning and egg production. Their primary product is fertilized fry. In addition, these companies often sell other products, such as fry, smolt and broodstock, as a result of the breeding business.

Many of these companies also cross over into smolt production and even sea farming on a smaller scale. Some of the companies operate on a stand-alone basis, while others are owned fully or partially by sea farmers or other industry players.

Research and development

As the industry faces increasing production challenges related to sea lice and diseases, this subsegment puts a lot of effort into research and development (R&D). These companies work extensively to develop knowledge in areas such as breeding, spawn production and disease control. They aim to strengthen the breeding material and utilize genetic technology to improve resistance to diseases and enhance growth rate.

Revenue growth

The egg and spawn producers have experienced a strong revenue growth over the last ten years. A sharp increase in the sale of mature salmon grown on the egg producers' own licenses drove much of the revenue growth in 2016. After the spike in 2016, revenues have plateaued.

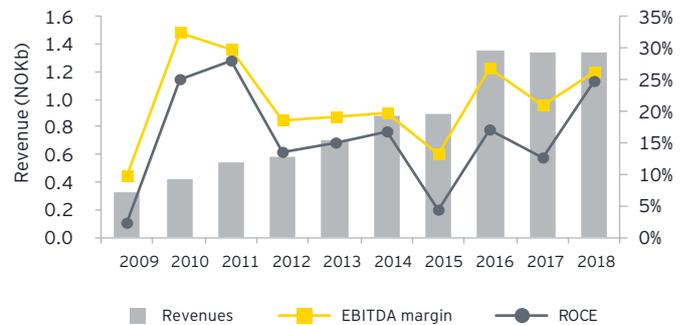
Margin development

The EBITDA margin for egg and spawn producing companies has a 10-year average of 21.7%. The positive development has primarily been driven by increased prices. The EBITDA margin surged to a peak of 26.3% in 2018, mainly as a result of lower costs compared to 2017.

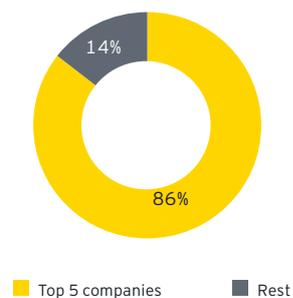
Top five companies (2018 revenues)

1. AquaGen AS
2. Nordnorsk Stamfisk AS
3. Benchmark Genetics Norway AS
4. Svanøy Havbruk AS
5. Salten Stamfisk AS

Key financials



Top five companies: share of subsegment revenue





Smolt production

The process from fertilization of eggs to when mature fish are ready to be put to sea is called smolt production. This is the middle stage of the production cycle and is operated by the smolt producers.

Smoltification is the biological process that makes young fish ready for the transition from freshwater to seawater and fish that has undergone this process is called a smolt. This is the primary product of this subsegment.

The natural smoltification takes two to four years, depending on feed and temperature. However, in specialized fish farms where conditions are optimized, this process is shortened and usually takes 6-12 months.

Stable growth

Over the last ten years, the smolt-producing companies have experienced a continuous revenue growth. However, the EBITDA margin has remained relatively stable, varying between 20% and 24% over the same period.

Vertical integration

All the top five companies by revenue in this subsegment are fully or partially owned by sea farming companies. Being present in the entire value chain enables the sea farming companies to control more of their production cycle. The high degree of cross-ownership and intergroup trade, along with other long-term business relations, is believed to contribute to the stable revenue growth and EBITDA margin observed in this subsegment. However, this is difficult to verify without direct insight into bilateral purchases and contracts.

Larger post-smolt

Over the last years, the production of larger smolts (up to 250 grams) has been introduced to the market. These larger smolts are called post-smolt. Today, several smolt producers are looking into producing even larger smolt of up to one kg. The reason for using larger post-smolt is to reduce the time in sea, thus minimizing the time the fish is exposed to uncontrollable risk factors such as sea lice and diseases. However, increasing smolt size requires extensive investments in R&D and new facilities. Please refer to the sustainability section for more details regarding the post-smolt development.

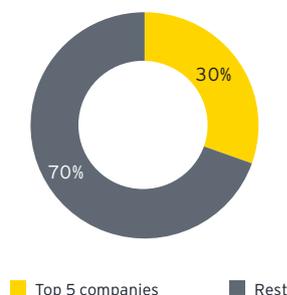
RAS technology

As RAS technology is becoming developed, we see an increase in land-based smolt facilities based on this technology. RAS is a way of recirculating water in the fish tanks, enabling companies to produce large quanta of fish with a relatively low water consumption. Most of the existing smolt facilities in Norway are based on traditional FTS. However, most new smolt facilities are built using RAS technology today.

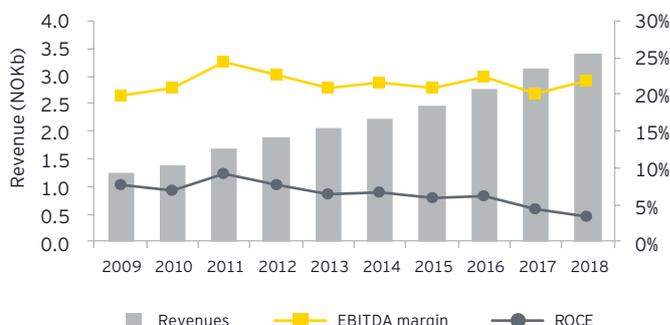
Top five companies (2018 revenues)

1. SalMar Settefisk AS
2. Helgeland Smolt AS
3. Nordlaks Smolt AS
4. Laksefjord AS
5. AS Sævareid Fiskeanlegg

Top five companies: share of subsegment revenue



Key financials



Egg and spawn production

Smolt production

Sea farming

Sea farming

The final step in the production process is the sea farming, which is by far, the largest subsegment in the aquaculture industry. This is where the fish are put into seawater and grown until harvest size (about 4-5kg). This process takes about 14-24 months, depending on smolt size and other growth factors.

Salmon prices remain high

Over the last years, the sea farming segment has experienced record-high profitability as a consequence of all-time-high salmon prices. This has resulted in an EBITDA margin above 33%, since the salmon price increase in 2016. The slight reduction to EBITDA margin in 2018 was due to higher costs.

While demand has increased in recent years, sea farmers have not been able to increase supply correspondingly due to production constraints, sea lice and diseases. Consequently, the average salmon price for farmed Atlantic salmon has increased by more than 50%, from 2013 to 2018. The weakening of NOK vs. EUR in the period has also positively affected the price. The average salmon price remained stable at 60.7 NOK/kg from 2017 to 2018.¹

Continued growth in cost per kg

Over the last years diseases, sea lice, extreme weather and other operational challenges have led to a significant increase in cost per kg. These challenges has also been the main reason for stagnating volumes. Cost per kg fish grew by more than 50% in the 2013-18 period, while the corresponding increase in harvested volume was as low as 9%. By using the numbers for sea farming companies in our database, we have illustrated the development in cost per kg in the bottom-right graphics.

Sea lice continues to drive cost

Increasing costs can, to a large extent, be explained by costs related to feed and health issues, primarily sea lice. Increased use of lice treatments, cleaner fish, specialized feed, service boats and investments in R&D drives operating costs. Delayed growth, starvation and forced early harvest curtails harvest volumes and represents less visible costs that are also present due to sea lice. These sea lice-related costs are the main drivers for the increase in OPEX we see over the past years.

Consequences of stagnating volumes

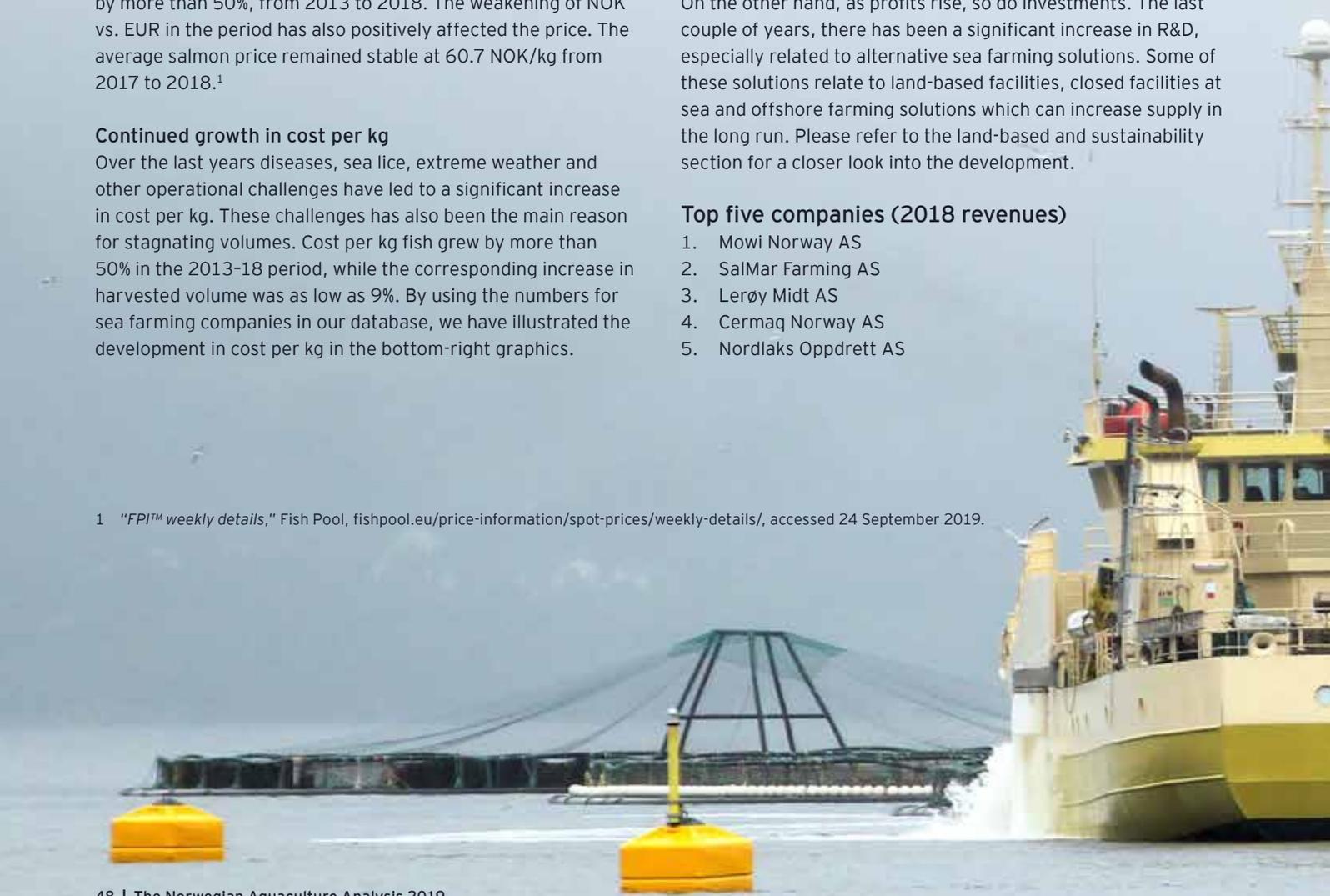
The stagnating volumes, combined with increased demand over the last years, has lead to all-time high prices and profits. However, high prices can turn away customers, making them look for substitute products in other markets. This will in turn reduce demand. Hence, the effect of high prices due to lack of supply can be unfavorable in the long run.

On the other hand, as profits rise, so do investments. The last couple of years, there has been a significant increase in R&D, especially related to alternative sea farming solutions. Some of these solutions relate to land-based facilities, closed facilities at sea and offshore farming solutions which can increase supply in the long run. Please refer to the land-based and sustainability section for a closer look into the development.

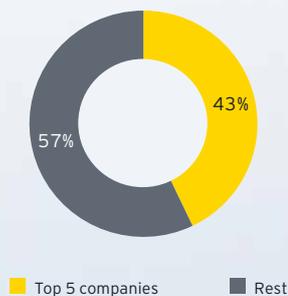
Top five companies (2018 revenues)

1. Mowi Norway AS
2. SalMar Farming AS
3. Lerøy Midt AS
4. Cermaq Norway AS
5. Nordlaks Oppdrett AS

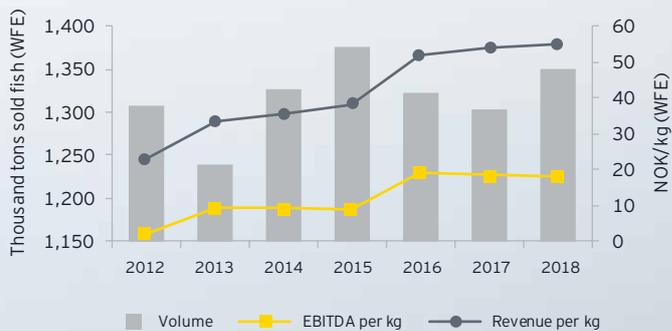
¹ "FPI™ weekly details," Fish Pool, fishpool.eu/price-information/spot-prices/weekly-details/, accessed 24 September 2019.



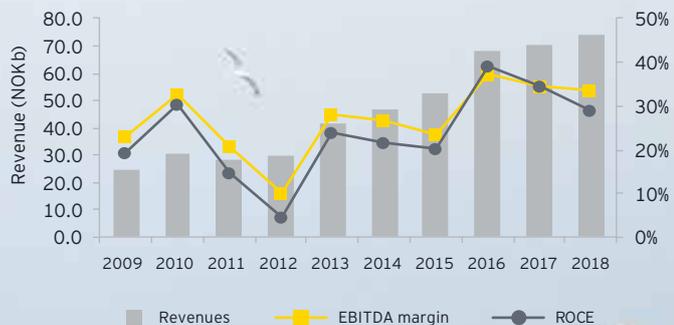
Top five companies: share of subsegment revenue



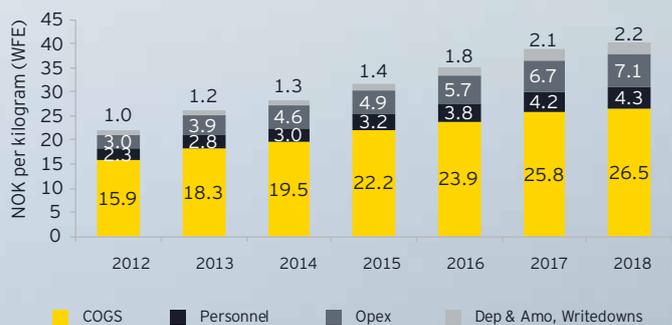
Volume of fish, average value and EBITDA per kg (WFE)*



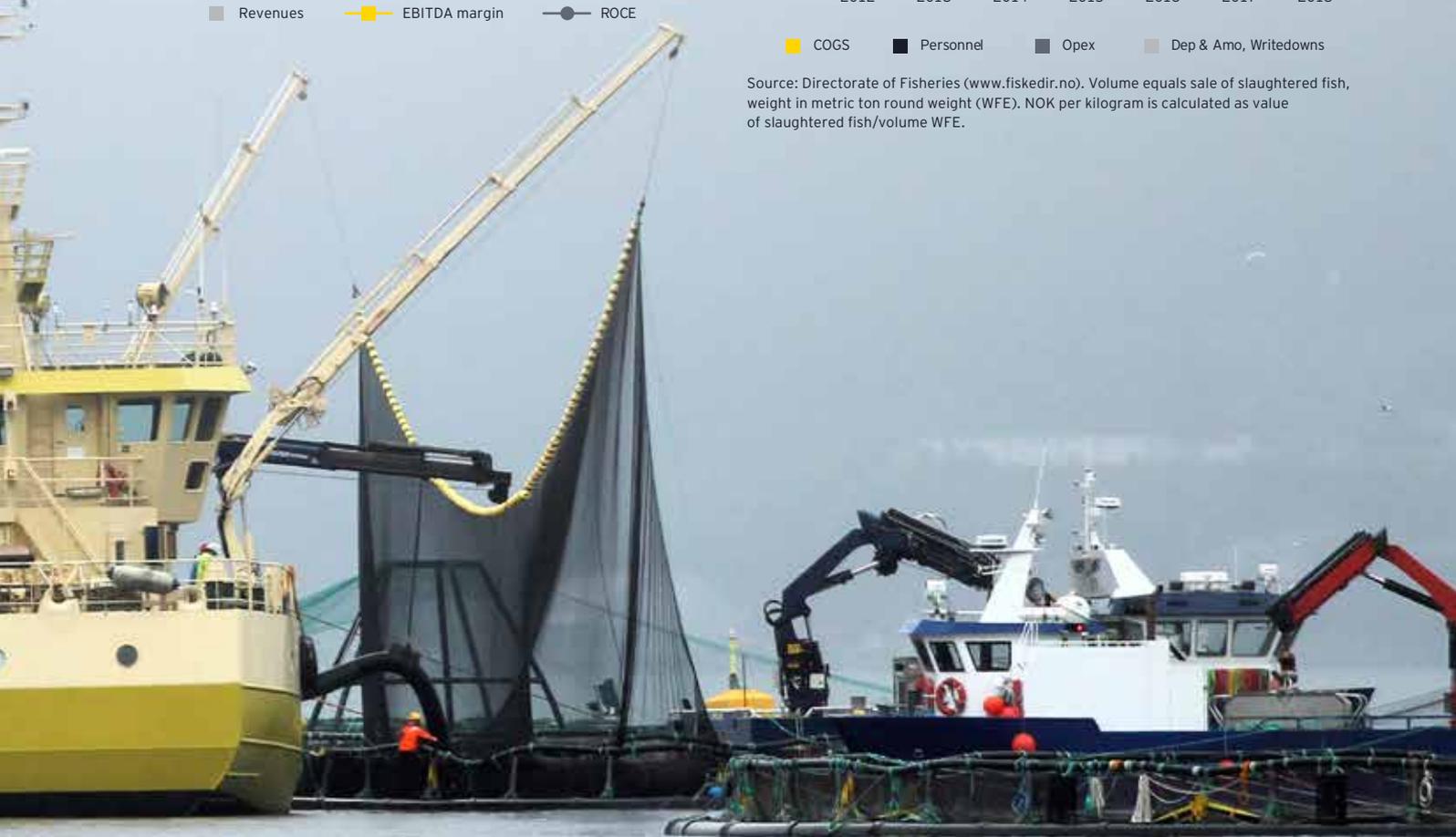
Key financials

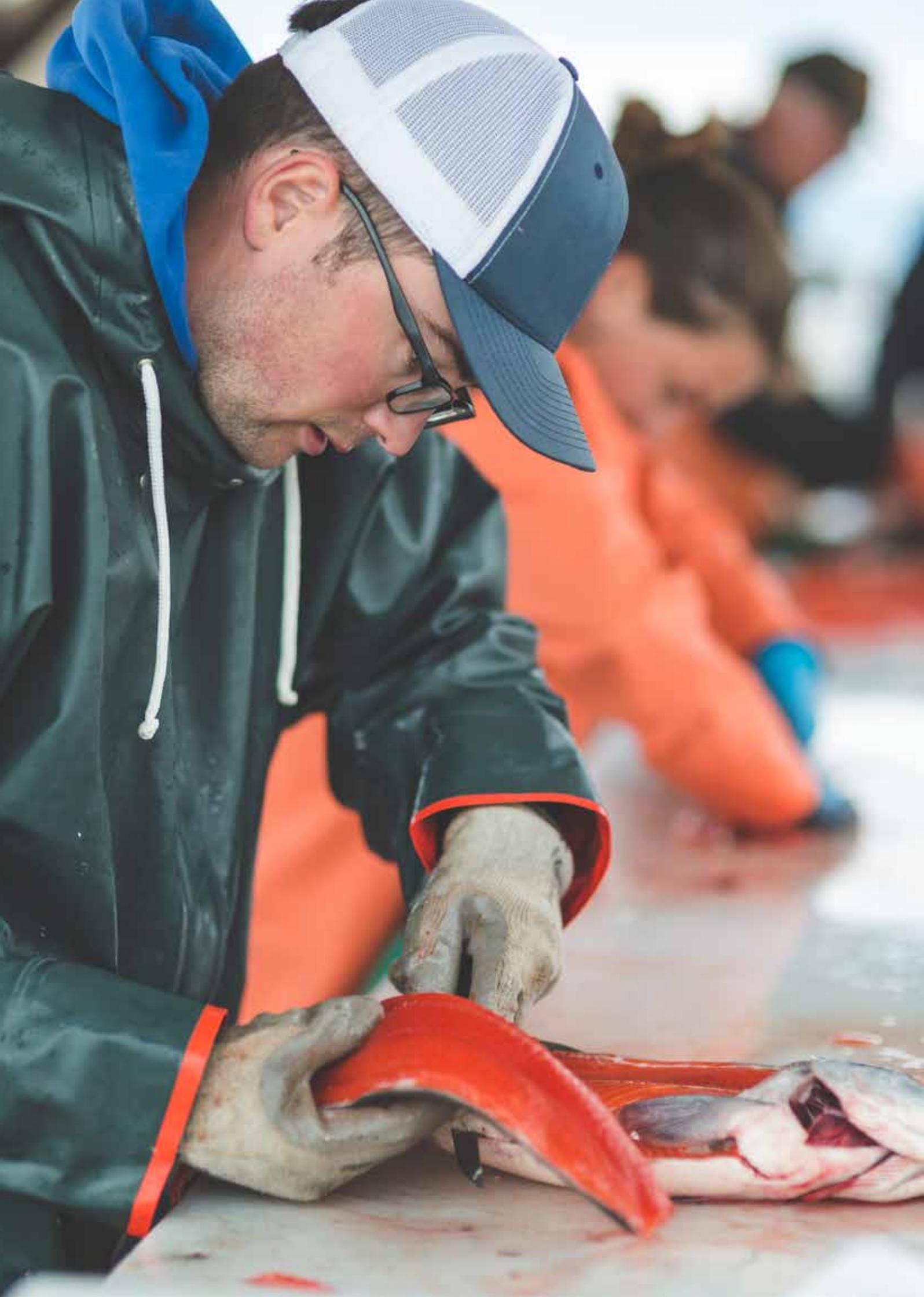


Cost components per kg fish (WFE)



Source: Directorate of Fisheries (www.fiskedir.no). Volume equals sale of slaughtered fish, weight in metric ton round weight (WFE). NOK per kilogram is calculated as value of slaughtered fish/volume WFE.





Distribution

Technical solutions

Biotechnology

Production

Distribution

Processing

Record high exports of Norwegian salmon

Segment highlights

Sustained revenues and margins

- ▶ Total revenue for the distribution segment is heavily influenced by the fact that the trading subsegment makes up almost 95% of revenues. Trading is driven by volume and price of fish sold. While part of the jump in revenue from 2015 to 2016 can be explained by volume and price, MOWI also split their trading business into a separate legal entity this year.
- ▶ As the past three years have had a relatively modest change in both volume and price, the revenue changes have been limited. However, while a growth of 4% from 2017 to 2018 is relatively modest, it is still the largest year-on-year volume growth since the 2014-15 period.

Norwegian export market reaches yet another peak

- ▶ In 2018, export of Norwegian salmon reached an all-time high once again, with a 5% increase in exported volume. Total revenue from export of Norwegian salmon was NOK67.8b in 2018, an increase of NOK3.2b from 2017.¹ The weak NOK as compared to EUR was favorable for the exporters.
- ▶ The overall export development is not surprising, as there is continued high demand for Norwegian salmon. Thus an increase in salmon supply through more farmed fish will be welcomed in the market.

Potential disruption from processing vessels

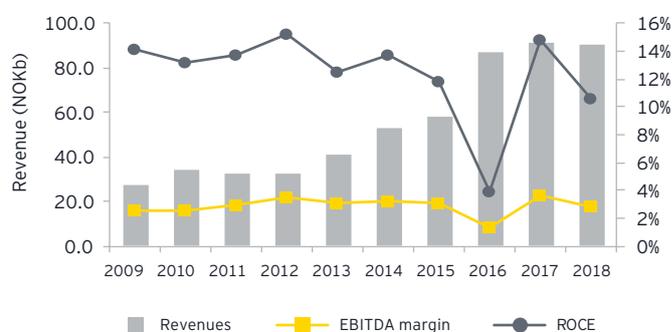
- ▶ The slaughtering subsegment had approximately NOK1.1b in revenue in 2018 and an EBITDA margin of 8%. As for the transportation subsegment, revenues reached NOK3.6b with an EBITDA margin of 45%. The entrance of vessels equipped with slaughtering facilities may disrupt the balance between these subsegments going forward. In the event that such vessels become the new norm, we would expect to see a decrease in both revenue and margins for some of the established players in the slaughtering and transportation at sea subsegments.

About the segment

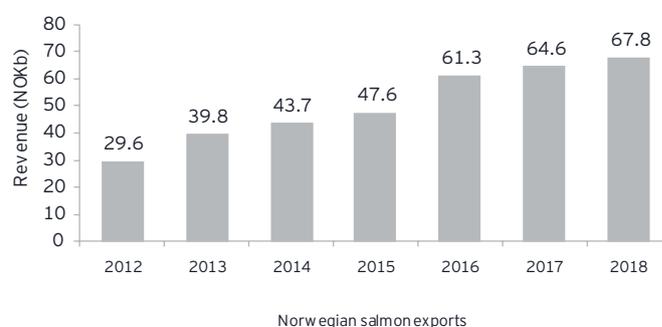
The distribution segment includes companies offering services within the subsegments:

- ▶ Trading
- ▶ Slaughtering
- ▶ Transportation on sea

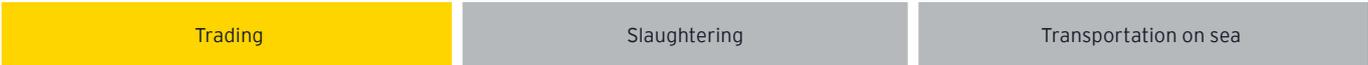
Key financials



Norwegian salmon exports



¹ "Nøkkeltall fra norsk havbruksnæring 2018," Directorate of Fisheries, 11.07.19.



Trading companies

Norwegian-registered trading companies for farmed salmon and trout include both independent trading companies and trading companies owned by salmon producers that have organized this activity in separate companies. Salmon producers that include trading as an integrated part of their production companies are not included in the analysis, with the exception of Norway Royal Salmon ASA.

Volume growth

Revenue in the trading segment is closely linked to the volume of fish sold and price achievement. Despite the volume increase from 2017 to 2018 and the average annual sales price being almost equal, the revenue decreased from 2017 to 2018. This has to do with a change in revenue recognition in one of the top ten companies in the subsegment. Excluding this company from the analysis in both 2017 and 2018, we in fact see a moderate revenue increase in the subsegment of approximately three percent, which is more in line with our expectations, given the underlying volume growth and stable sales prices.

The trading subsegment is a low-margin business. The companies typically sell fish both in the spot market and on fixed price contracts. In 2018, some companies experienced unfavorable fixed contracts, impacting the achieved margins. While we in 2017, observed the highest EBITDA margin achieved the last decade (2.1%), the 2018 EBITDA margin was down to about 1%.

Norwegian exports

Increased farmed volume lead to record-high export of Norwegian salmon in 2018. According to the Directorate of Fisheries, the value of exported salmon in 2018 was NOK67.8b, an increase of NOK3.2b compared to 2017.¹ The average EUR/NOK was 9.6 in 2018, compared to 9.3 in 2017. Considering that a significant amount of the salmon is sold in EUR, this represents a favorable development for the exporters. The demand for salmon remains high and Poland and France remain the largest buyers of Norwegian salmon. The two countries increased their import of Norwegian salmon with 8% and 14% in 2018, respectively.

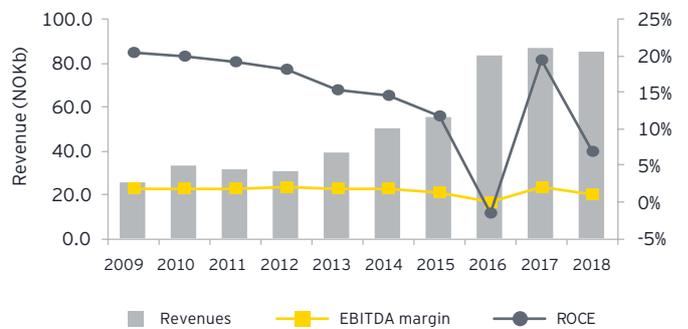
After several years of substantial growth in the US and Japanese markets, the export of Norwegian salmon to these markets was slightly reduced with 2%-3% in 2018. However, export to the South-Korean market increased with 22% from 2017 to 2018.

Top five companies (2018 revenues)

1. Lerøy Seafood AS
2. Mowi Markets Norway AS*
3. SalMar AS
4. Ocean Quality AS
5. Norway Royal Salmon ASA

* Recalculated from EUR to NOK

Key financials

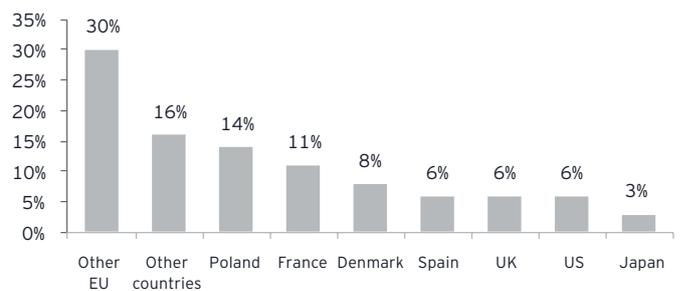


Sold volumes of slaughtered fish (round weight)



Source: Directorate of Fisheries

Export markets for salmon: share of value (2018)



Source: Directorate of Fisheries

1 "Nøkkeltall fra norsk havbruksnæring 2018," Directorate of Fisheries, 11.07.19.



Slaughtering companies

Companies in this subsegment offer slaughtering services. Similar to trading, slaughtering is offered by both independent suppliers and salmon producers as an integrated part of their value chain. This analysis includes only slaughtering businesses that are organized in separate legal entities and it will, therefore, underestimate the total size of the subsegment.

Revenue growth and tighter margins

Revenue continues the upward trend. Since 2015, the subsegment has grown with a CAGR of 12.5%. As the subsegment is relatively small, relatively few players make up the majority of the growth.

Larger harvest volume will naturally give the slaughtering subsegment more work and as such an increase in revenue is expected. At the same time, we observe a reduction in EBITDA margin from last year. The gross margin decreased from 2017 to 2018 and personnel expenses increased as higher volumes may have brought on the need for personnel to work overtime. The higher cogs may suggest that the subsegment has not been able to increase their prices sufficiently.

Investment trends and stronger regulations

The number of plants have gone up from 57 to 61. Anticipated higher harvested volumes may fuel the need for more plants going forward. We notice a willingness to invest in the subsegment. For instance, Salten Aqua¹ is investing NOK250m in a new slaughtering plant that is planned to be completed in 2020.

A vital trend in determining the future of this subsegment is the entrance of slaughtering vessels. In 2018, Hav Line introduced a vessel with slaughtering facilities onboard. The vessel's capacity is up to 100 tons salmon per hour (160,000 tons per year), with a workforce of 45 per shift. By slaughtering the fish as they are harvested, both costs related to transportation and slaughtering are reduced.

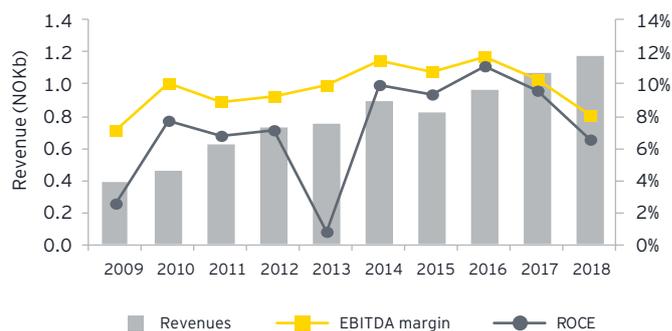
This vessel has brought on some political turmoil and led to the introduction of a regulatory requirement to sort farmed fish in Norway before export. This puts significant operational restrictions on Hav Line and similar vessels going forward, if upheld.

While protecting work places along the Norwegian coastline, this amendment will make it very challenging to take full advantage of the combined transport and processing characteristics of such vessels. Such regulatory restrictions may be able to slow down the development, but is unlikely to stop these kind of innovative solutions over time.

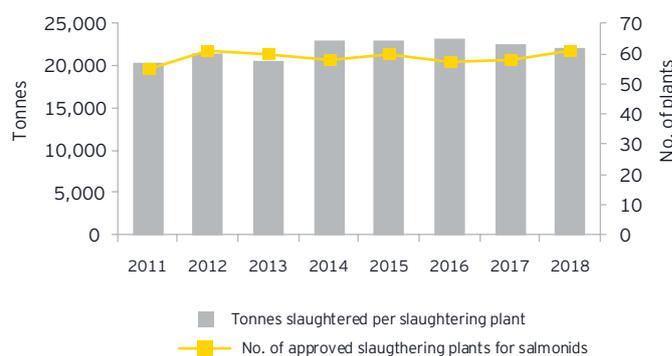
Top five companies (2018 revenues)

1. Pure Norwegian Seafood AS
2. Viking Fjord AS
3. Martin E Birknes Etft AS
4. Slakteriet AS
5. Arnøy Laks Slakteri AS

Key financials

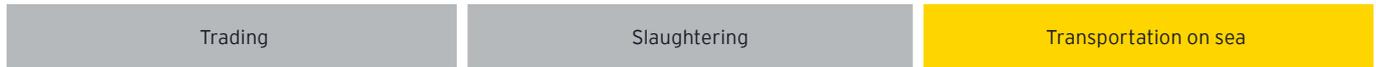


Development in slaughtered volume and number of plants



Source: The Food Safety Authority Norwegian

1 "Bygger nytt slakteri, nytt settefiskanlegg og ny filetfabrikk," Fiskeribladet, fiskeribladet.no/teknisk/nyheter/?artikel=64033, 12 December 2018.



Transportation on sea

The subsegment consists of well-boat companies transporting smolt to sea farms and live salmon and trout from farming cages to harvesting and processing plants. The segment also includes companies that focus on freight of feed. Most of these companies also offer sea lice and amoebic gill disease (AGD) treatment onboard well-boats, as well as services such as sorting and counting of fish.

Never ending story of growth

With a revenue growth of 19% from 2017 to 2018, the subsegment delivers an impressive five year CAGR of 21.4%. The subsegment has thrived on the biological issues in the production segment, as a large share of the revenue growth has come on the back of increased treatment of AGD, sea lice and such. We note that several vessels have been sold, impacting the reported revenue of the subsegment positively through gain on sold vessels.

Continued super profit

The high EBITDA margins have continued, peaking at an all-time high of 45% in 2018. As barriers to entry are high in terms of required capital expenditure, the segment remains dominated by a few players. The five largest companies make up close to 80% of the revenue and 84% of the EBITDA in the subsegment. The increase in ROCE from 2017 to 2018 was driven by higher EBIT, as the capital employed has remained relatively stable.

Investment patterns

High margins fuel the willingness to invest. We note that at least nine new well-boats will be delivered to Norwegian shipowners in 2019.¹ It is estimated that by late 2019, there will be approximately 80 active well-boats in the market.

Whether the new vessels are going to replace existing vessels or increase the active Norwegian fleet could have different effects on the margins for this subsegment. If the newbuilds replace existing vessels, which could mean that the replaced vessels are either sold or moved to other markets (Chile, Scotland, Canada, etc.), the supply dynamics will not change much, thus we would not expect this to lead to reduced margins. If the newbuilds come in addition to the existing fleet, this could lead to increased competition impacting margins negatively.

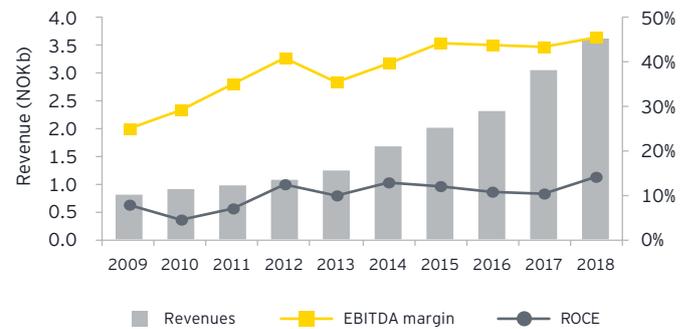
The market demands well-boat capacity with more flexibility. A regulatory requirement² has been put in place which states

that closed systems (on board the well-boats) are mandatory for transportation through and in between, areas with disease free status for ISA (Infectious salmon anemia).

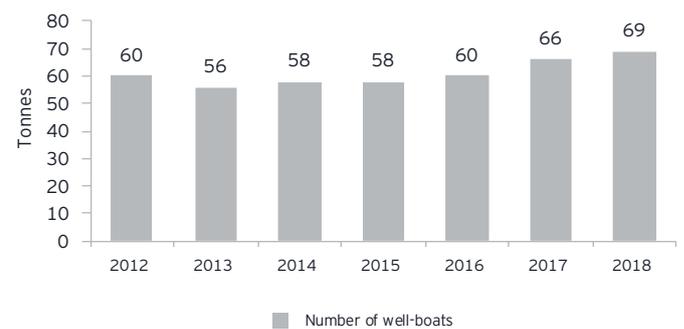
Top five companies (2018 revenues)

1. Rostein AS
2. Sølvrans Rederi AS
3. Norsk Fisketransport AS
4. Frøy Rederi AS
5. Oppdretternes Miljøservice AS

Key financials



Number of well-boats*



* Based on the number of members in Fraktestartøyenes Rederiforening

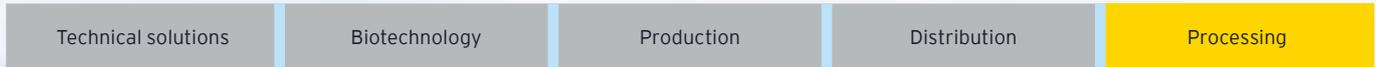
Innovation vs. regulation

A key operation for the transportation subsegment is to transport farmed salmon and trout from fish cages to processing plants. The entry of vessels combining processing and transport may impact the demand for traditional well-boats offering purely transport solutions. However, a regulatory enforcement forcing shipowners to process domestically may impact the demand for such vessels.

1 "Disse nye brønnbåtene leveres i løpet av året," Fiskeribladet, fiskeribladet.no/teknisk/nyheter/?artikkel=68440, 16 August 2019.
 2 "Krav om lukket transport gjennom og mellom områder med sykdomsfri status for ILA," Mattilsynet, www.mattilsynet.no/fisk_og_akvakultur/akvakultur/brønnbat/krav_om_lukket_transport_gjennom_og_mellom_omraader_med_sykdomsfri_status_for_ila.35636, 17 July 2019.



Processing



Declining revenue growth, continued high cost and reduced margins

About the segment

The processing segment includes companies offering services primarily related to secondary processing and companies producing different types of packaging.

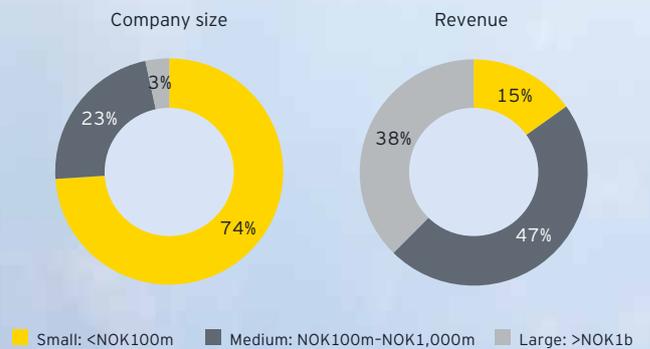
We have divided the segment into two subsegments:

- ▶ Processing
- ▶ Packaging

Key financials



Segment composition (2018)



Processing

Packaging

Processing

For the purpose of this report, we distinguish between primary and secondary processing. Primary processing is defined as slaughtering and gutting, while secondary processing is filleting, filet trimming, portioning, smoking and the like. In this section, we will take a closer look at the secondary processing, as primary processing is mainly covered under the presentation of the slaughtering subsegment. Secondary processing leads to products normally referred to as value added products (VAP).

Processing is offered both by individual entities and salmon producers as a part of their value chain. However, our analysis includes only separate legal Norwegian entities and the analysis, therefore, underestimates the total size of the subsegment. Another factor is that the majority of Norwegian salmon is exported for further processing. In 2018, more than 80% of salmon exported was fresh unprocessed salmon (round weight).

Reduced revenue growth

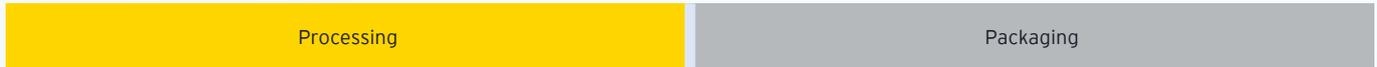
The revenue growth of the subsegment saw a slowdown in 2018, with a revenue growth of only 1.5% compared to 6.2% in 2017. A general increase to operating expenses reduced the EBITDA margin to the lowest level since 2013.

Top five companies (2018 revenues)

1. Sekkingstad AS
2. Hofseth AS
3. SalmoSea AS
4. Hofseth Ålesund AS
5. Sjømathuset AS

Key financials





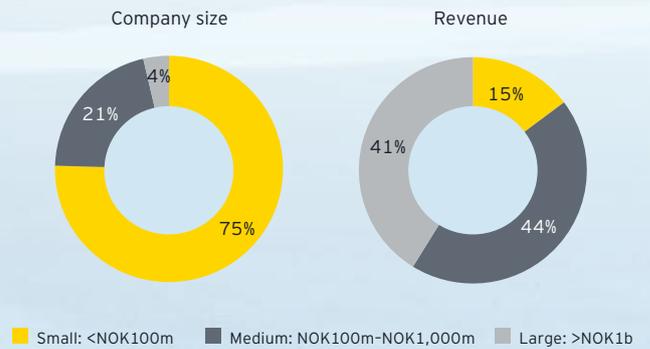
High cost segment

As evident by the EBITDA margin, secondary processing is still demanding and costly in Norway, both due to the labor intense production, but also the cost of raw material influenced by the continued strong salmon price throughout 2018.

There have been discussion in regards to whether more secondary processing, i.e., value added products (VAP), should be performed in Norway as opposed to abroad. This is a topic with a wide range of opinions. High labor costs, low unemployment in Norway (e.g., potential import of workers will be needed) and environmental impact are some of the focus points in this discussion. Today, Poland and Denmark are two of the countries that receive round weight fish and process these to filet and such prior to redistribution.

Similar to other segments, the processing subsegment is to an increasing extent, affected by innovation in terms of fish processing. As with the slaughtering subsegment, the processing subsegment will be affected by solutions such as the Norwegian Gannet vessel from Hav Line. Currently, the vessel has dispensation to operate from the Norwegian regulatory authorities, although with some limitations compared to their intended use. Thus, the total impact of such vessels on the processing subsegment has yet to materialize.

Segment composition (2018)



Processing

Packaging

Packaging

The packaging subsegment consists of small to medium-sized companies producing and providing all sorts of packaging and wrappings for fish and feed. While the companies generally produce for the aquaculture industry, a vast share also delivers products to other industries. Due to this, the subsegment may partly be overstated in absolute terms. However, at the same time, there will be companies that are not included due to the fact that they deliver the majority of their revenue to other segments than aquaculture.

Stable revenue

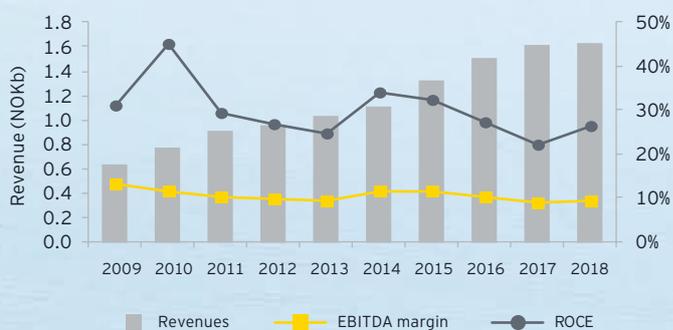
Revenues in the subsegment were relatively stable from 2017 to 2018, with a growth of 1%. EBITDA margins increased slightly despite a fall in gross margin, driven by a reduction in other operating expenses.

The products of the packaging subsegment are vital in keeping fish and fish products fresh during transportation and storage. Such products enable longer shelf longevity for the final fish products. Increased focus on sustainability will impact the subsegment going forward and innovations in this area may impact the segment substantially in the event the subsegment is able to come up with new solutions.

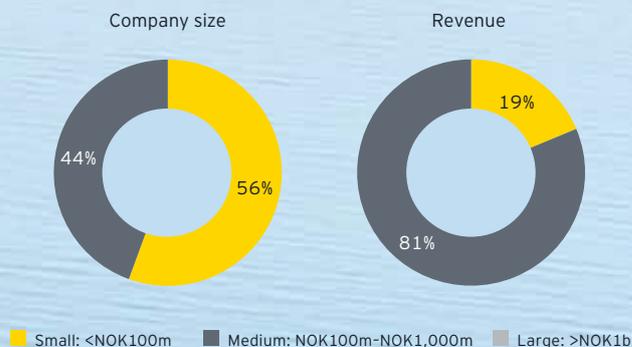
Top five companies (2018 revenues)

1. Vartdal Plastindustri AS
2. Bewi Produkter AS
3. Accon AS
4. A/S Nesseplast
5. Strøbergers Plast AS

Key financials



Segment composition (2018)



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