

The Norwegian aquaculture analysis 2022

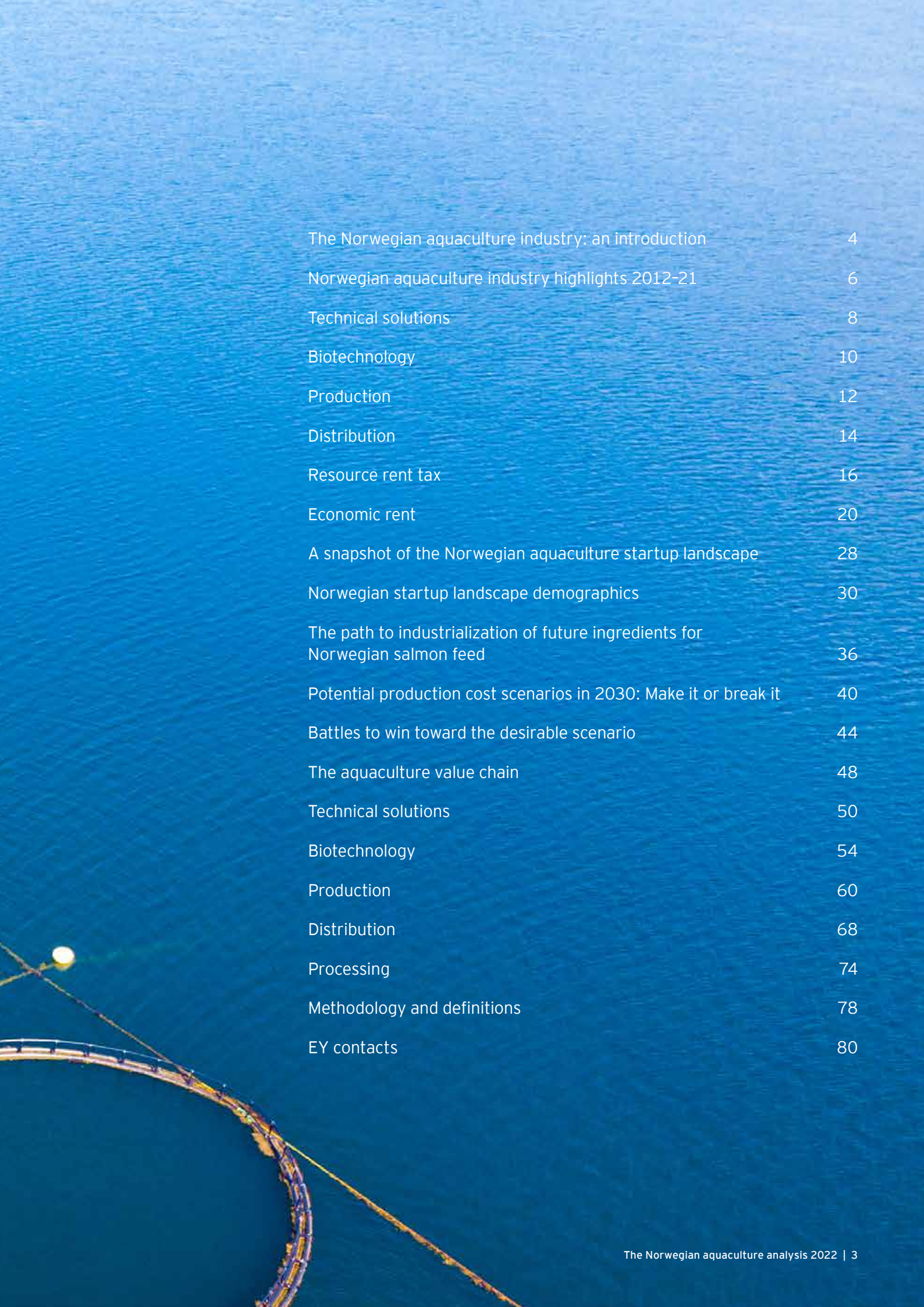
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The Norwegian aquaculture industry: an introduction

Dear reader,

We are delighted to introduce the seventh annual edition of the Norwegian aquaculture analysis. It is inspiring to receive feedback on our annual analysis. Furthermore, we are pleased that it has become a source of information not only for the people already in the industry but also for various stakeholders interested in getting an in-depth insight into the industry.

In this year's edition, we have naturally included articles on the suggested resource tax rate that will become effective from 1 January 2023. The introduction of a 40% resource rent tax is dramatic for the Norwegian fish farming industry, possibly at one of the most defining moments since its inception. The change in tax regime will apply to the in-sea phase, i.e., the fish farming companies. However, it will affect the entire value chain of the industry. Due to uncertainty about how the actual tax will be implemented, we have already seen significant consequences for technical suppliers as well as the processing industry, in addition to the substantial drop in market caps for listed fish farming companies. We will continue to follow the development closely, hereunder any revisions of the original tax reform presented by the government in September 2022.

In addition to our discussion on the suggested resource tax, we have also included what we hope are interesting topics.

Innovation is key to solving the challenges the industry faces, e.g., with regard to sustainable biology and driving efficient operations. We have taken a closer look at the aquaculture startup landscape and provided some observations on what industry challenges they aim to address and how they are funded.

In order to continue to grow sustainably, the industry depends on finding new and sustainable feed sources. This is critical to ensuring reduced emissions and costs. We have included views on critical success factors that must be addressed in order to realize the potential for novel feed ingredients.

Finally, we are presenting an interesting production cost scenario analysis – what will impact the cost development in the coming years and where should the efforts be focused in order to secure the cost competitiveness for the Norwegian aquaculture industry?

As always, the fundament of our publication – the value chain analysis – is included. 2021 was a great year for the industry, and the industry appears to have bounced back from the slow-down caused by the COVID-19 pandemic in 2020.

The unique and extensive EY Seafood Company Database (EY-SCD) – with a comprehensive volume of key financial figures – has been expanded with key data for 1,250 companies within various segments of the aquaculture value chain. The key data ranges from technical solutions to the production and export of salmon and trout and substantiates the quantitative and qualitative analysis presented.

As a multidisciplinary provider of professional services to the industry, the EY team possesses in-depth knowledge about the characteristics of each segment of the aquaculture value chain. The segments are seamlessly tailored with EY's core professional services within Advisory, Strategy and Transactions, Tax and Legal Services, Audit and Accounting. Specialist seafood sector teams are located in numerous seafood clusters and marketplaces around the world.

We sincerely hope you find our report useful and interesting. Please don't hesitate to contact us to discuss the aspects of this exciting industry.

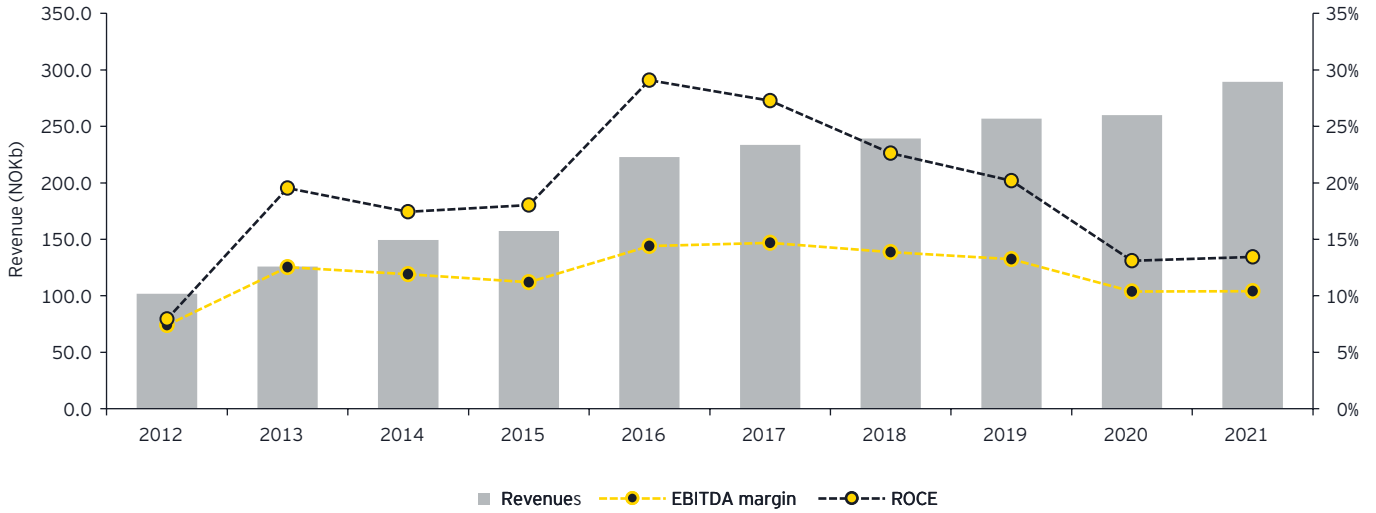


Eirik Moe
Sector Leader, EY Aquaculture and Fisheries

Norwegian aquaculture industry highlights 2012-21

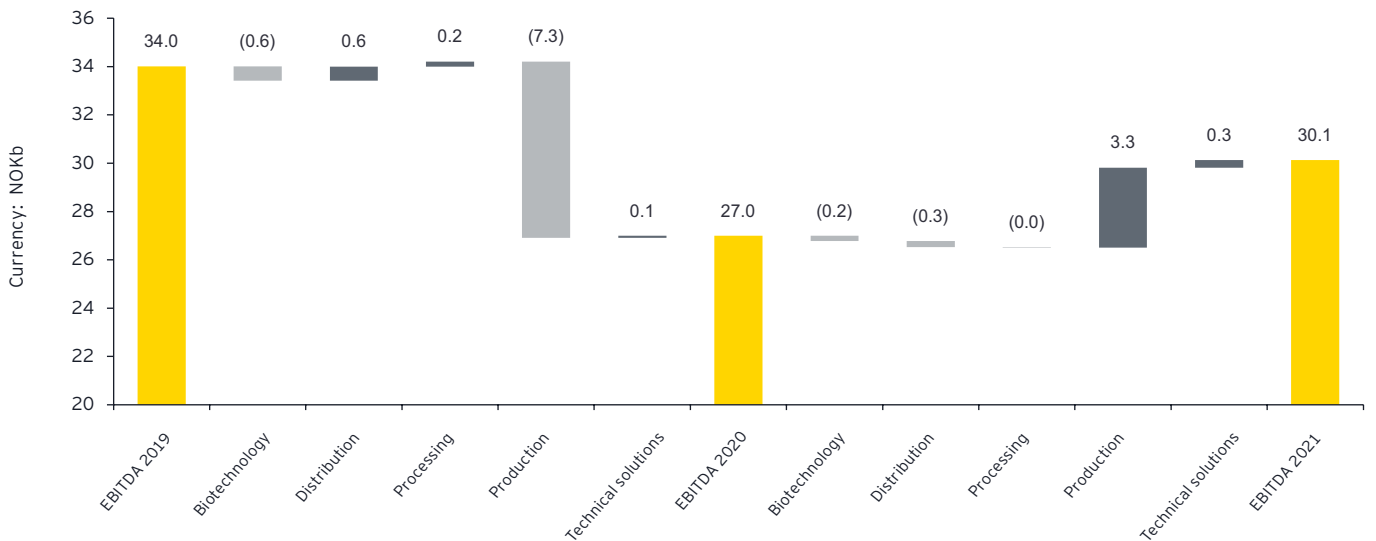


The Norwegian aquaculture industry 2012-21



- ▶ Following the slowdown caused by the pandemic in 2020, the industry has bounced back and achieved all-time high revenues in 2021.
- ▶ Taking a high-level view of the industry’s profitability, the primary driver for the increased EBITDA was the production segment, more specifically, the salmon farmers. High production volume combined with higher salmon prices than in 2020 resulted in increased profitability.
- ▶ In the upcoming pages, we will comment on the key changes that have come into effect since last year’s edition. We will also cover a complete 10-year history, further description and analysis toward the end of this report.

EBITDA bridge 2019-21



Technical solutions

Transactions

- In 2021 and 2022 (as per November 2022 data), 35 deals involving companies in this segment were announced, of which the majority occurred in 2021. These companies were the target in 75% of the transactions. We have seen increased interest from financial investors, resulting in a good balance between strategic and financial buyers. This is in line with a historical trend of increased deal activity in the segment, demonstrating the attractiveness of the segment for financial investors as well as the continued importance for strategic players to use M&A to gain market share, complement their product portfolio and enjoy economies of scale.

Higher revenue and margins

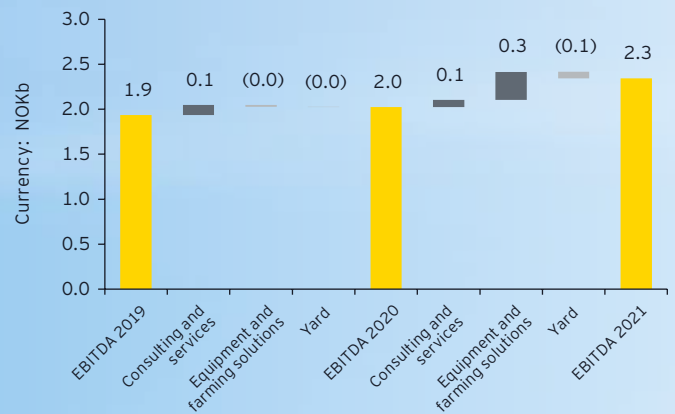
- Technical solutions companies have experienced double-digit revenue growth over the past six years (11.7% p.a. from 2015-20), except for 2018 and 2020. After a weak revenue growth in 2020 at 4.5%, the growth in 2021 almost reached double-digit, ending at 9.3%. This can partly be explained by a ramp-up of activity following the pandemic combined with the effects of inflation and higher prices.
- Combined with the improved revenue growth, high activity and ongoing cost or project management initiatives resulted in EBITDA margins increasing to 7.9% in 2021, compared with 7.5% in 2020. Equipment and farming solutions stood for most of the EBITDA improvement.
- Activity in the yard subsegment continues to be strong, and 2021 marked the highest revenue seen during the last ten years, up 5.4% from 2020. This is driven by a high number of orders, including well-boat newbuilds. Margins have, on the other hand, been under pressure and resulted in an EBITDA margin of 2.4% in 2021, compared with 4.7% in 2020. Companies report challenges due to the pandemic, resulting in delays and margin pressure.
- With the recent Norwegian government's proposal to introduce a resource rent tax on aquaculture from 1 January 2023, several fish farmers have announced that



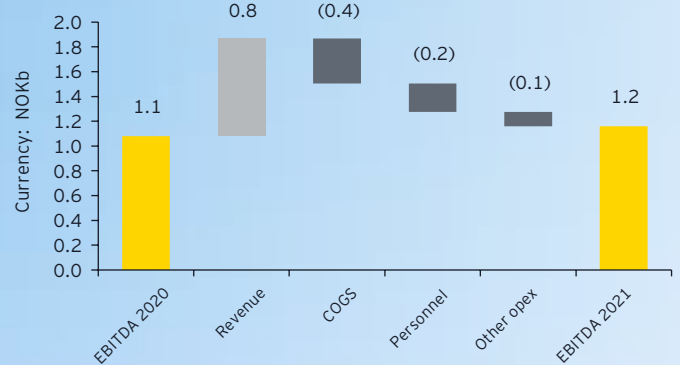
they will put investments on hold. This is expected to hamper the short-term revenue prospects for the technical solutions segment, especially equipment and farming solutions and yard.

- In 2021, consulting and services reported an EBITDA margin of 15.6%, a small drop compared with 16.5% in 2020. 61% of the companies experienced revenue growth from 2020 to 2021, and 53% achieved a positive EBITDA development. Consulting and services remain the subsegment within technical solutions with the highest EBITDA margins.
- The subsegment was also the one with the highest revenue growth, which came in at 11.9% in 2021, up from only 3.2% in 2020. This is still far below the historical CAGR of 16.7% from 2014 to 2020. Companies within the subsegment report high activity, positive interest and market development for their services.
- The equipment and farming solutions subsegment experienced strong revenue growth in 2021 of 9.1%, compared with 6.1% in 2020.
- The growth is primarily the result of a 43% increase in revenue among large-sized companies. One of the top players within the subsegment completed a reorganization in 2021, resulting in a redistribution of revenue from a few mid-sized company to one large-sized. The total number of large-sized companies also increased in 2021. Companies in the subsegment have reported high activity and strong demand for their equipment and solutions, particularly within land-based farming but also within the well-boat segment.
- Profitability continued to improve with an EBITDA margin of 5.9% in 2021 (4.3% in 2020), driven by medium- and small-sized companies. Leading this trend is a handful of companies reporting very high margin levels (>20%), partly due to niche product offerings and high market demand for certain products (such as delousing systems).
- Equipment and farming solutions was the largest contributor to EBITDA in the technical solutions segment, with an increase of NOK310m. However, in 2022, many companies report that they are affected by global supply chain bottlenecks and postponements due to the war in Ukraine, post-pandemic effects, as well as postponements due to the introduction of resource rent tax.

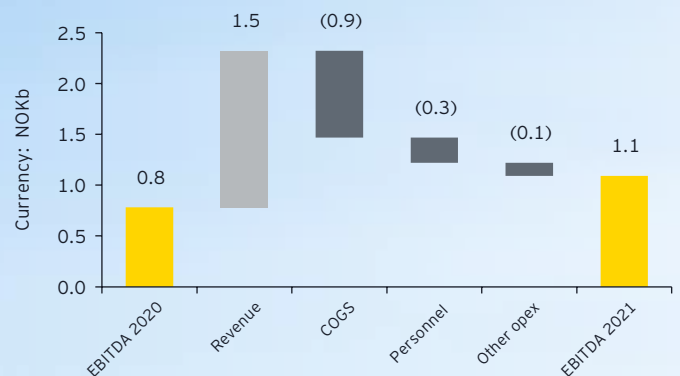
Segment EBITDA bridge



Consulting and services EBITDA bridge



Equipment and farming solutions EBITDA bridge



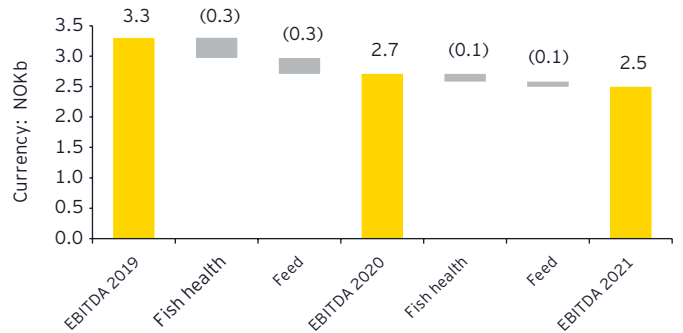
Biotechnology



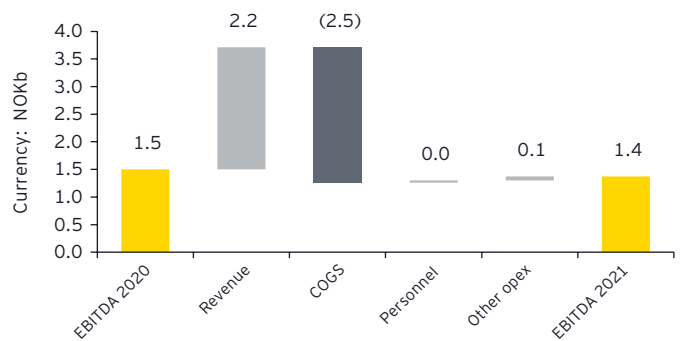
Lower growth pace and EBITDA margins

- ▶ While the 2021 revenue growth of 6.7% for the biotechnology segment is relatively high, it is behind the double-digit growth seen in both 2019 and 2020. However, the continued growth ensured that the segment reached an all-time high revenue of almost NOK42b.
- ▶ Both subsegments achieved relatively equal year-on-year growth between 6% and 7%. Given the size of the two subsegments in terms of revenue, feed was the primary driver for the segment’s revenue growth. Both segments saw their margins decrease, in combination, from 6.9% in 2020 to 5.9% in 2021, the lowest level seen since 2014.
- ▶ Both produced and sold feed was on a five-year high but compared with previous periods, we observe that the produced amount and the sold amount were quite equal. In contrast, we have typically observed produced feed to be higher in the historical period. Considering the biomass growth in the Norwegian sea farming subsegment, high feed volumes are expected.
- ▶ Cleaner fish companies once again saw their revenues decline, combined with what appears to be a margin in free fall. In 2021, EBITDA margins ended up at around 8%, significantly down from margins between 30% and 35% in the 2015-18 period. According to the Directorate of Fisheries, there was a 19% reduction in the number of cleaner fish sold in 2021. As the majority of cleaner fish released into net pens is never recovered, there has been public attention on the use of cleaner fish in the past year, which may have had an impact.
- ▶ The breeding and genetics industry had a great 2021, bouncing back from a tough year during the pandemic. As a result, margins increased to the historical average, a significant improvement over the 2020 margins that were the second-lowest observed in our 10-year historical data set.

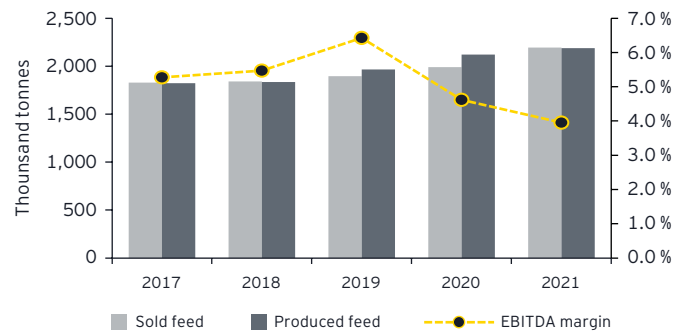
Segment EBITDA bridge



Feed EBITDA bridge



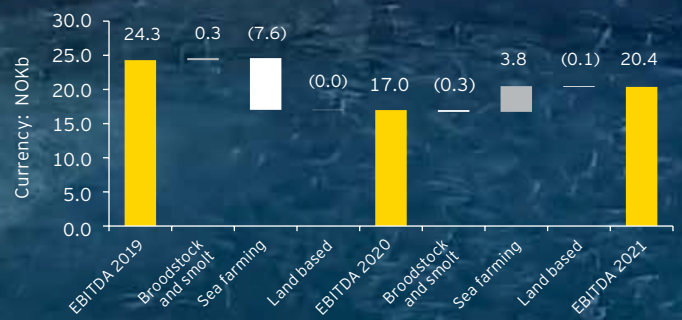
Feed EBITDA margin and volume development



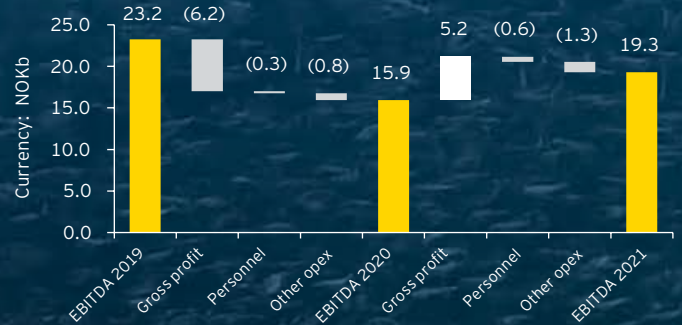
Source: "Mowi Salmon Farming Industry handbook 2021," Directorate of Fisheries, EY

Production

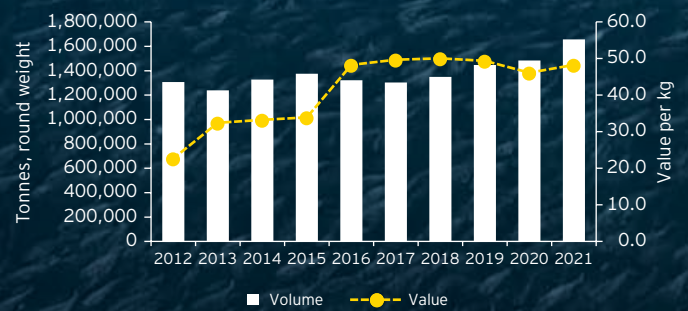
Segment EBITDA bridge



Sea farming EBITDA bridge



Price and volume development

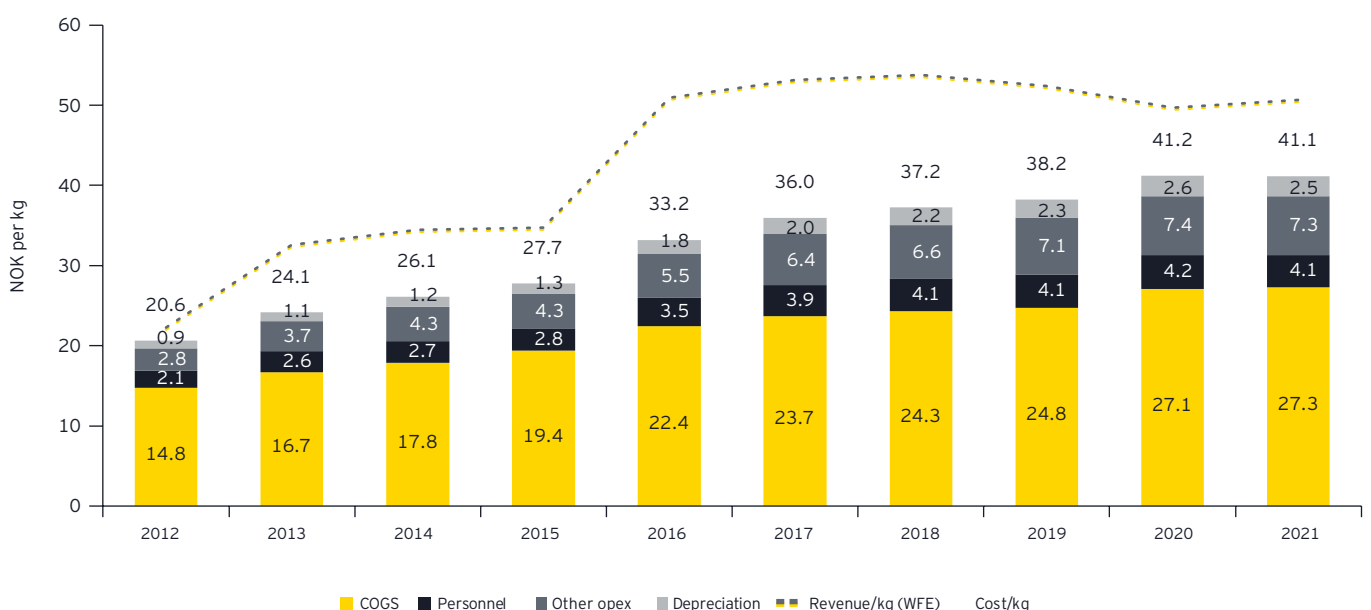


- ▶ 2021 was a great year for the fish farmers in terms of topline growth. This development was driven by record-high harvest volumes combined with an increased salmon price compared with 2020.
- ▶ This resulted in an EBITDA increase of more than NOK3.3b, or around NOK2.9b, after adjusting for the fair value of biomass that is performed by one entity that reports their local accounts in accordance with IFRS.
- ▶ Using our methodology to find the simplified cost per kg estimate, we observe a slight reduction from 2020 to 2021. Please note that our cost per kg is based on the financial statements of each entity. It will be higher than the cost per kg reported by the Directorate of Fisheries since they have pure-play production costs. As a comparison, the Directorate of Fisheries reported a cost per kg increase between NOK1.0 and NOK1.5 depending on whether slaughtering and freight costs are included. While this trend in isolation is great, we expect it to be short-lived. However, the increasing cost of feed and generally high inflation will push the costs significantly up in 2022 and onward.
- ▶ One of the worries during the pandemic was the closedown of the hotels, restaurants and catering (HoReCa) market, with this being a key market for Norwegian salmon producers. Throughout the pandemic, we saw that the home consumption of salmon went up. As such, when the HoReCa market once again opened, it was expected that the overall demand for salmon would be higher than in previous periods. This appears to be true, and the record high volumes throughout 2021 did not result in a price decrease compared with 2020.
- ▶ In 2022, supply has been somewhat more constrained and exported volumes were behind in 2021, but demand has remained high. This has resulted in record-high salmon prices throughout the year, reaching a monthly average price above NOK100 per kg for April, May and June. The full year is expected to close in an annual average price around NOK82-NOK83, approximately NOK20 higher than the previous record of NOK63 in 2016.
- ▶ As we will discuss in more detail throughout this year's analysis, the Norwegian government has imposed a resource tax on the commercially licensed sea-based production of salmon starting from 1 January 2023. There is still uncertainty around several details regarding the practicalities of the new tax, but it is highly likely that an additional tax will be imposed on the salmon producers. We expect this may have consequences for the structure of the industry going forward.

Transactions

- ▶ There are usually a limited number of transactions within the sea farming subsegment. But there have been multiple transactions in 2021, primarily related to the listed entities.
- ▶ Salmar acquired 51% of Nekton Havbruk and 45% of Refsnes Laks.
- ▶ Måsøval acquired Pure Farming and Aqua Farms Cartdal.
- ▶ Salmonor and Midt-Norsk Havbruk merged. NTS acquired 65% of Norway Royal Salmon.
- ▶ Gåsø Nøringutvikling acquired 33.35% of Erviks Laks og Ørret AS.

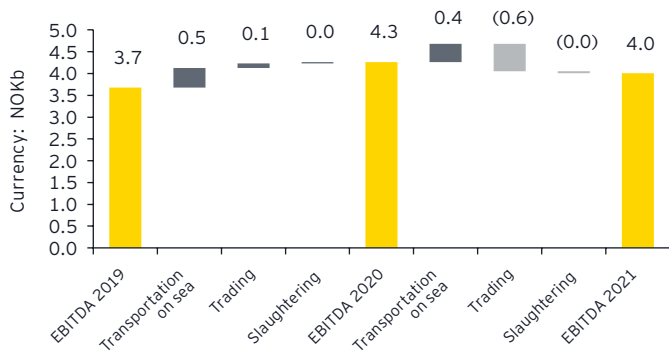
Cost per kg (WFE) development



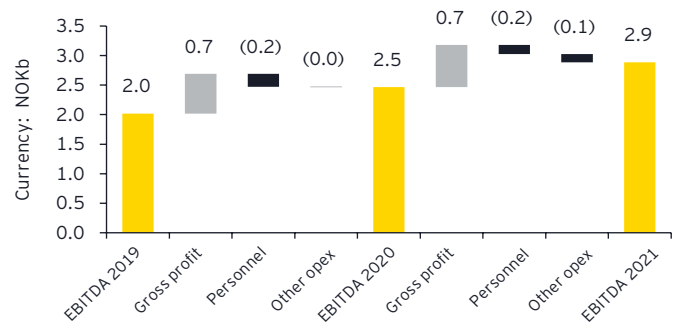
Distribution



Segment EBITDA bridge



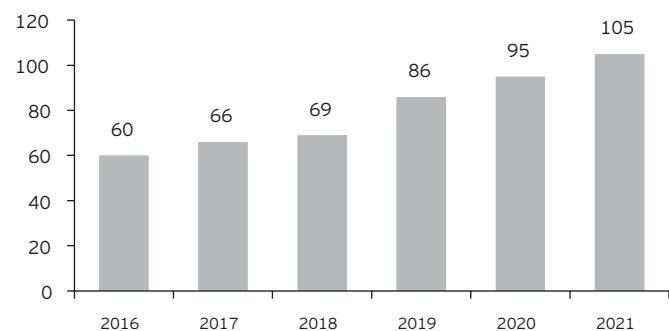
Transportation on sea EBITDA bridge



- ▶ The distribution segment experienced a negative EBITDA development in the 2020 to 2021 period, driven by the trading and slaughtering subsegments. However, we have yet to observe a negative year-on-year revenue trend for the transportation on sea subsegment (and only one year with negative EBITDA development), and 2021 was once again a year with revenue growth in the double-digits.
- ▶ Adjusting for the sale of vessels, we observe an EBITDA margin improvement of almost two percentage points. At the same time, we observe a close to one percentage point reduction in return on capital employed (ROCE). The ROCE reduction must be seen in context with the number of new deliveries, as illustrated in the graphics below. Capital employed has increased with almost NOK5b, a 25% increase from 2020. It is to be expected that there is a lag between the increase in capital employed and a corresponding growth in EBIT (i.e., the ship is delivered before it starts to generate cash flows).

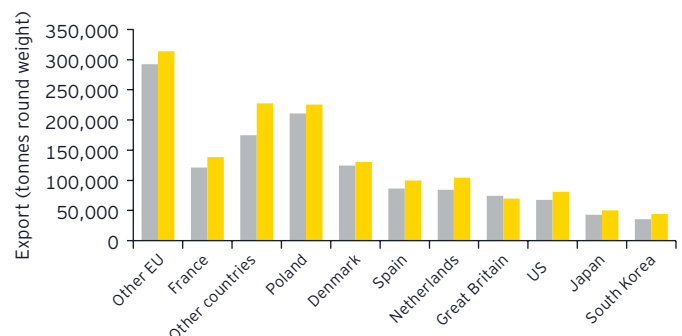
- ▶ Record high production volumes, and correspondingly high export, ensured an all-time high revenue for the trading companies, but the profitability went significantly down from 2020. This is seen in context with a selection of large companies reporting a loss on receivables and unsatisfying margins on poor price achievement on fixed price contracts. Currency fluctuations have also resulted in some challenges for trading companies.

Number of well-boats in Norway



Source: Directorate of Fisheries, Kystrediereiene

Norwegian export of salmon



Source: Directorate of fisheries

Resource rent tax



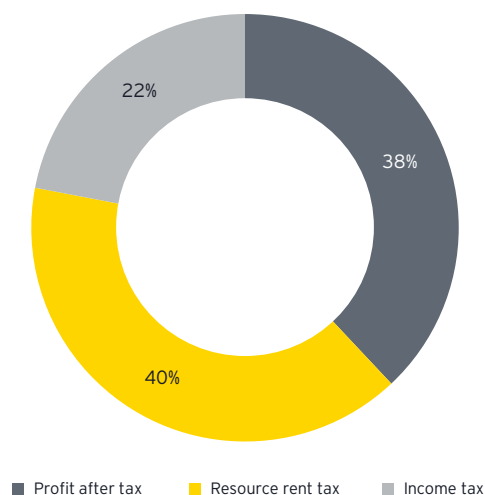
Resource rent tax on aquaculture

On 28 September 2022, the Norwegian government presented its plan to introduce a resource rent tax on aquaculture effective from 1 January 2023. The proposal has been a source of criticism from the industry, mainly due to the structure of the resource rent tax combined with multiple uncertainties. Nevertheless, the proposal is part of the National Budget for 2023, and a majority of the parliament has voted in favor of the proposal.

The aquaculture proposal is as follows:

Resource rent tax

- ▶ Effective tax rate of 40%, increasing the total effective tax rate for the industry to 62%.
- ▶ Tax-free allowance of between 4,000 and 5,000 tonnes.
- ▶ The consultation deadline is 4 January 2023.
- ▶ It is in effect from 1 January 2023.
- ▶ The resource rent tax will apply to the production of salmon, trout and rainbow trout in the sea.
- ▶ According to the Ministry, the tax revenues are estimated to be approximately NOK3.65 to NOK3.8b annually. This estimate is uncertain, and the industry argues that the actual tax contribution will be significantly higher.



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Background for the proposal

The salmon producers utilize fjords and sea areas that belong to the public. As such, the background for the proposal is that the government argues, through a resource rent tax, that the public should retain more of the value generated by the exploitation of these resources. According to the Ministry, the production of natural resources often generates a return in excess of what is normal through the utilization of public areas, often referred to as resource rent. By introducing a resource rent tax, the government wants some of this excess profit to be returned to the public. The proposal includes the production of salmon, trout and rainbow trout and introduces an effective tax rate of 40%. Furthermore, it is proposed that the tax proceeds from the resource rent tax should be distributed equally between the state and the local municipalities.

What is the content of the proposal?

The Ministry proposes to design the resource rent tax as a cash flow tax. If introduced, income and investments will be taxed in the year in which they are earned or incurred. When determining the income, one model is proposed for salmon and another for trout and rainbow trout. It is proposed that revenues from salmon shall be determined on the basis of a norm price to counteract tax-motivated pricing. It has been proposed that the norm price should be set on the basis of prices obtained for salmon on a public exchange (Nasdaq). For rainbow trout and trout, there are no listed commodity prices, and therefore, the income will be based on actual sale prices.

The norm price proposal has created huge uncertainty in the industry. On this background, the government issued some clarifications as to the price at which the tax will be calculated in its press release on Friday, 18 November 2022. In the press release, the government states that the real income should form the basis for the resource rent tax, but the price must reflect an independent market price. To ensure that the norm price corresponds to what the salmon could have been traded for between independent parties, the government is considering establishing an independent body – a norm price council – to set the norm prices that will form the basis for the tax. However, this will still not allow the tax to be determined based on the price achieved by the companies in the market.

It was further confirmed that a norm price should also consider the quality differences and sizes of the fish and that the government does not intend for all salmon to be valued at the same price.

The government’s latest clarifications and the proposal to establish a norm price board is an improvement of the tax proposal. However, it does not take away the risk that the companies have to pay tax on an income that does not reflect their actual earnings.

Who is affected?

The resource rent tax will apply to income from commercial licenses for producing salmon, trout and rainbow trout in the sea for consumption, regardless of how the license holder is organized. The resource rent tax will not affect production at land-based facilities or development licenses unless such a permit is converted to an ordinary license for fish consumption. The proposal includes a tax-free allowance of between 4,000 and 5,000 tonnes of biomass at a given profitability level. According to the proposal, this will ensure that approximately 65%-70% of the aquaculture companies are not affected by the new rules (having production below 4,000 or 5,000 tonnes). This group represents a significant number of companies operating in the aquaculture industry, but the companies only account for 15% to 17% of the total biomass. Thus, the main part of the Norwegian aquaculture industry will be affected by the new proposal. Both the largest companies and those that are relatively small compared with the large players will be affected. We note that a small company that produces below 4,000 or 5,000 tonnes may still have to pay resource rent tax if the realized profitability per kg is higher than the level that the tax-free allowance threshold is based on (NOK13.5/kg referred to in the proposal).

The tax-free allowance

The government proposes a tax-free allowance based on an estimated average profit per tonne of biomass, which can be deducted from positive resource rent income. The tax-free allowance amount means that the smallest players may be exempted from resource rent tax and can also be seen as a standard deduction for historical purchases of permits. The government proposes to set a tax-free allowance at 4,000 or 5,000 tonnes of biomass in 2023. According to the proposal, the tax-free allowance is granted at the group level to counteract adjustments through splitting into several companies. It is also proposed to establish rules at the ownership level so that companies owned by the same person and their close associates only receive the tax-free allowance once. Related parties will be defined in section 19-3 (3) of the Norwegian Tax Act.

Example of tax-free allowance:

Tax-free allowance 4,000 tonnes of biomass	*	Average earnings NOK13.5 per kg	=	This will give a deduction amount of NOK54m
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**Related parties
(proposal for new section 19-3 of the Norwegian Tax Act):**

- An entity in which the personal owner owns so many shares that it represents more than 50% of the votes or that entity’s subsidiary
- The personal owner’s parents, siblings, children, grandchildren, spouse, cohabitant, spouse

Tax model and tax rate

The ministry proposes a tax model similar to the models used for hydropower and petroleum, i.e., a cash-based model with immediate deduction for new investments.

The tax is aimed at the part of the industry assumed to benefit from extraordinary income due to the utilization of a limited available resource, i.e., the sea part of the total production process. As such, it is aimed at the value creation taking place in the sea cage.

It is proposed that fixed assets acquired before the introduction of the resource rent tax should be deductible through the depreciation of remaining tax values. No deductions will be given for the cost of the fish licenses or costs incurred in connection with the acquisition of a license. On the deduction side, actual costs are used as a start, but a standard deduction may be considered for some costs.



The ministry proposes that if a company has a negative estimated resource rent income, this should be carried forward with interest and be deducted from positive resource rent income in the future.

It is proposed that the effective resource rent tax rate be set at 40%. In conjunction with the ordinary corporate tax, this leads to an overall effective marginal tax of 62% on proceeds from salmon, trout and rainbow trout ($0.22 + 0.4 = 0.62$). For example, if the tax-free allowance amount in a year is NOK54m, profits exceeding this amount will be taxed at 62%.

How will the tax increase impact the industry?

The effects of the resource rent tax on aquaculture have already started to unfold in the industry. Immediately after the proposal was introduced, the share prices fell for most of the leading fish farming companies. Furthermore, some companies may scale down future projects, and we have already seen that investments of more than NOK35b have been put on hold – mainly land-based investments. Lastly, as the government has not sufficiently considered the actual obtained market prices in the proposal, i.e., the risk of being taxed for an income above actual earnings, we have already seen around 1,400 temporary layoffs in the processing industry, which heavily rely on fixed price contracts.

Significantly Increased tax cost

The resource rent tax proposal introduces an additional effective tax of 40% on the aquaculture industry. In the tax proposal, the estimated total tax amount for the industry has been calculated to be between NOK3.65b and NOK3.8b. However, the industry has argued that this estimate is too low, and our analysis supports that the government's tax estimate is too low.

On the basis of the accounting information analyzed in this paper, the industry tax cost for 2021 has been calculated to be between NOK4.4b and NOK5.0b. This is a conservative amount, as the available accounting information includes cost elements that are not tax deductible on the resource rent basis and because we have applied a full tax-free allowance amount to all companies in the industry. As such, the final tax numbers will likely be somewhat higher than the estimated NOK4.4b–NOK5.0b. Further, the sales price of salmon is higher in 2022 compared with 2021, resulting in an expected higher tax for 2022 than the currently available 2021 accounting numbers.

Impact on the net wealth tax

The new resource rent tax will affect the net wealth taxation of aquaculture licenses for non-listed companies. Today, the

tax value of time-unlimited aquaculture permits in non-listed companies is calculated according to the market value of the licenses as of 1 January in the tax year, as a starting point represented by the latest available auction prices. From 2022, aquaculture licenses acquired before 1998 will also be included in the net wealth tax basis. In the auction held after the resource rent tax was announced, the market value of the licenses was heavily impacted by the tax proposal. Such a reduction in the basis for net wealth tax may be beneficial for the owners of aquaculture companies.

Possible unpredictability

As described, it is proposed that the tax-free allowance is set at 4,000 or 5,000 tonnes, based on average profit per kilogram. Furthermore, the proposed amendments to the Norwegian Tax Act provide that the tax-free allowance amount should be “decided for each year by the parliament” cf. proposal for section 19-7, first paragraph. The tax-free allowance could thus be reassessed each year, reducing predictability when estimating future tax costs.

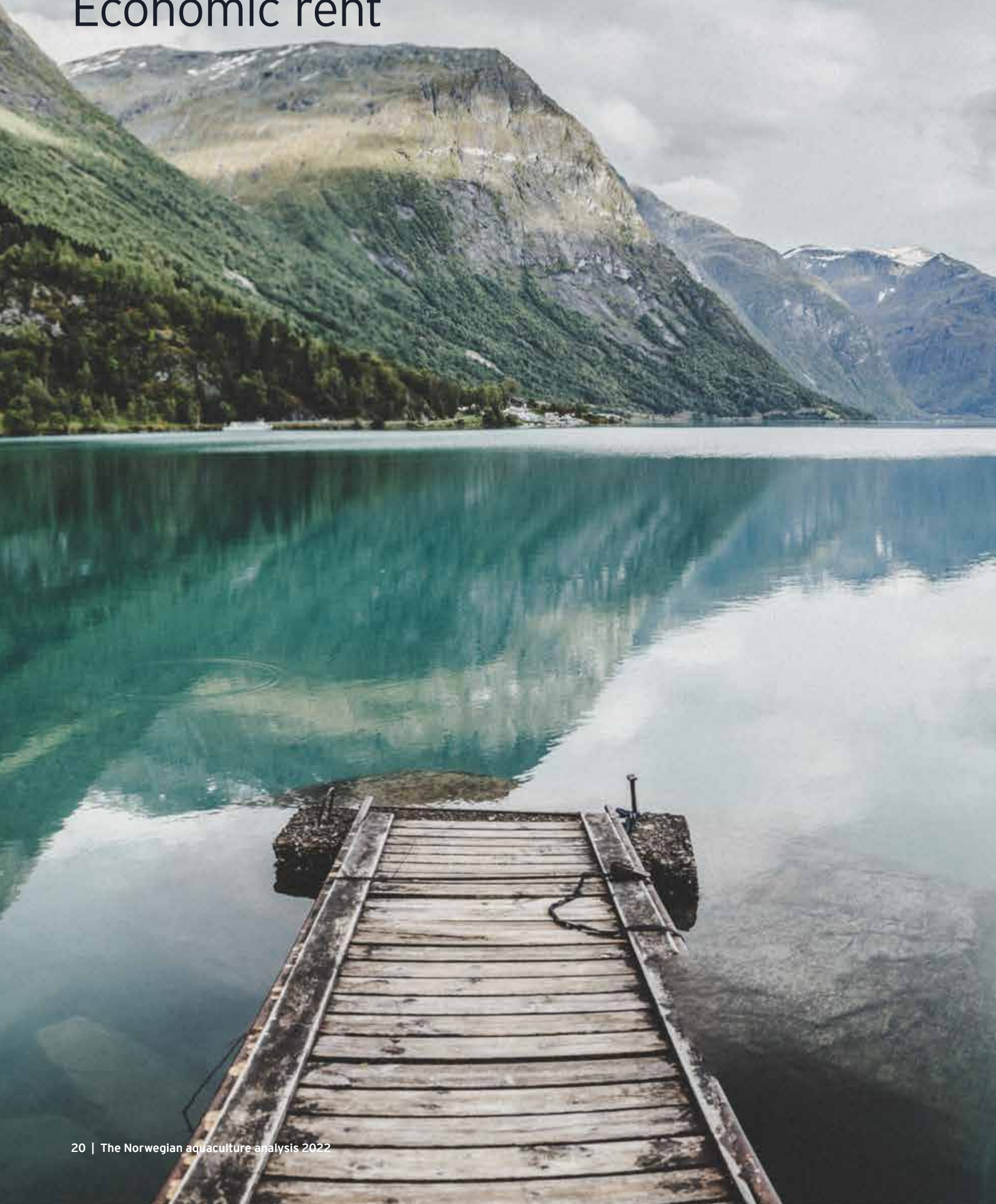
Taxation of a deemed profit in excess of actually obtained income

As highlighted, there is significant uncertainty around the deemed income, i.e., the norm price, proposed as the basis for calculating the resource rent tax.

Using a norm price for salmon has led the industry to fear it will have to pay tax on income they do not receive. In particular, this has been the case with salmon sold on fixed-price agreements, as this price will not be reflected in the auction prices. In the current salmon market, salmon is sold both on spot and in fixed-price contracts. Fixed-price agreements vary in length, and some last for several years. This may affect the effective tax rate as the pricing of such contracts may deviate from the norm price. As such, if the norm price is set higher than the agreed fixed price, which typically will be the case, the company will, in practice, have to pay more than 40% resource rent tax. For example, if the norm price is set at NOK70 per kg, while the agreed price is NOK60 per kg, the company must pay tax on NOK70 even though the salmon was sold for less. Fixed-price agreements have so far provided companies with a predictable income limiting market fluctuations. However, if the resource rent tax is implemented as proposed, the consequence is that fixed-price agreements will result in tax uncertainty. The fact that the tax proposal will be implemented by the beginning of 2023 and, therefore, before the deadline for industry comments on the proposals, adds to the tax uncertainty.



Economic rent



It isn't all economic rent: Norwegian salmon farming

Introduction

The Norwegian salmon farming industry converts marine oils into human food more efficiently than alternative uses for this oil. Although salmon feed also comprises other ingredients, marine oils are essential. If a more efficient utilization of such marine oils were found, this could cause prices to increase to a level the salmon farmers cannot pay, which eventually could drive them "out of business." Imagine that the "super profit" moved elsewhere in the value chain. This could be to those holding licenses to fish anchoveta – also an exclusive right to exploit natural resources. The exclusive use of a natural resource (our common coastline) is important for salmon farmers but not comparable to the falling water propelling the power plant.

A competitive advantage is required to achieve a super profit. The aquaculture industry must compete for the resources they purchase in the markets for labor, capital goods and feed. Furthermore, the price difference between protein sources, such as chicken or cod fillets, must not be greater than what the customers are willing to pay. Finally, they must refrain from competing at the expense of each other through overcapacity.

Strategically, salmon farming is what we might call a "cost-cutting game." All players face (approximately) the same price, and whoever has the lowest production cost "wins." Low costs can largely be linked to skill, the quality of the sites in the broadest sense, i.e., both biological and operational conditions, and to some extent, economies of scale. However, note that since all players meet the same price and all have capacity constraints, the most efficient player has no incentive to lower the price to outcompete less efficient players. However, the most efficient may have the incentive to acquire the less efficient if they are allowed to do so. The differences in profitability in the industry are considerable. Should land-based farming prove to be superior in terms of cost and sufficient land were available, it is conceivable that sea facilities would be outcompeted (and also that super profits throughout the industry were greatly reduced due to capacity increases, as land-based farming is not subject to the same licensing regime).

We will use the term "super profit" to refer to any return above the normal return on (cost of) capital on the industry or company level so that the term "economic rent" is reserved for where we are sure that the reason is the exploitation of a scarce natural resource. Economic rent is thus one of several sources of super profits. The normal return is the return on capital from alternative investments with the same risk. Super profit is commonly referred to as (positive) abnormal return in literature.

Is there a super profit available?

The Norwegian aquaculture industry has experienced significant growth since the crisis in 1991 (the bankruptcy of the Norwegian company selling salmon (Fiskeoppdretternes Salgslag (FOS)) and the salmon mountain) when world production was about 250,000 tonnes.

Super profit can be explained by a competitive advantage, which can be the exclusive exploitation of a resource, but there can also be other explanations. Measuring historical returns is susceptible to numerous measurement problems. Different evidence for the existence of super profits has been offered, including the historical return on salmon stocks, the willingness to pay for concessions and accounting information. None of these are without relevance, but they must be interpreted with some caution.

The salmon industry is one of many industries that have yielded good returns over the past 30 years. Even if an industry yield returns above the market average, adjusted for risk differences, an extraordinary return over a period of time may have other causes than economic rent (exclusive exploitation of natural resources). For example, that competition is less in an industry where demand growth is high, that a restructuring where economies of scale are extracted has occurred, the misfortune of competitors (the collapse in Chile), or due to the lack of negotiating power among suppliers. It is hardly any doubt that the salmon industry has achieved a super profit, but it may be attributable to being a competitive supplier of seafood in a market where demand growth has been high and supply scarce, partly as a result of the overfishing of wild populations. It will, however, probably be difficult to distinguish the effect of competitive advantages from more spurious or random effects, often called "windfall gains" (for example, currency fluctuations), and we have still not substantiated that there has been an economic rent (but not falsified it either).

Price fluctuations

The aquaculture industry has a very long lead time, from starting with fertilized roe to slaughtering the fish. Although most producers try to utilize capacity to the maximum, production fluctuates significantly, partly due to conditions that fish farmers do not control, such as growth rate, mortality, etc. The major producers are advanced "logistics machines" with limited opportunities to adapt production and slaughter to short-term fluctuations in demand, i.e., the supply side is very inflexible in the short term, and one must sell at the price that clears the market. The industry has been exposed to several demand

shocks, partly as a result of trade policy, and has therefore seen significant price fluctuations.

The industry sells a large portion of its total production in “Euroland,” and French households are concerned about the salmon price in euro, not production costs in Norwegian kroner. This means that fluctuations in exchange rates, which have been considerable, largely impact fish farmers’ profitability and, to a lesser extent, affect the Euro-denominated salmon prices in Euroland. purchasing power parity explains little of the changes observed.

Why does the salmon industry make money?

Many argue that it is because Norway has a long coastline of cold, clean water. This is not wrong, but many other countries also have that. Norway started building knowledge relatively early, and we also started regulating the industry at an early stage. The purpose of the regulation was to limit the adverse external effects, including “spillover” effects where the fish farmers destroy each other by operating so closely as to spread diseases. However, the regulations also served as a barrier to entry, resulting in lower competition and higher profits. Without regulation, the fish farming industry has all the characteristics of an industry susceptible to over-expansion.

It does not help with barriers to entry if other countries have a free establishment, unless the rules serve a purpose, i.e., that we are better off with the rules than without. The combination of weak regulation, an inefficient and perhaps corrupt bureaucracy and poor infrastructure has meant that only some countries have managed to take up the competition. There are multiple important factors for Norway’s position:

- ▶ A long coast with clean, cold water, but much more important is the fact that skilled people live there and have roads, bridges, ferries and airports. In addition, they have a local business community where one can buy support services
- ▶ Competent, efficient and uncorrupted bureaucracy and regulatory regime
- ▶ The existence of schools that educate fish farmers, veterinarians, biologists, fish health specialists, etc.
- ▶ Research environments with great expertise in fish health, ecology and water quality
- ▶ Reasonable proximity to important markets in Europe and free market access

This might be described as a “cluster effect” or knowledge accumulation in society and, of course, also in the fish farming companies. Economies of scale may also occur on an industry level. There is little to prevent fish farmers from bringing knowledge to other locations, but it is not as easy to move the whole cluster effect. The cluster effect probably contributes to a super profit, but many of these resources (infrastructure,

education, and bureaucracy) are made available to everyone. They have arisen from the investment of businesses and the investment of society (the tax money of the population). They are not the result of nature’s gifts, such as the water that falls down the mountainside, the cod that visits Lofoten to breed, or the oil pumped up from the seabed. However, it is not easy to distinguish economic rent from super profits in general.

Negative externalities

The salmon farms emit particles, nutrients and chemicals into the environment. They may spread diseases and parasites to populations of wild salmon, and escaped fish may hybridize with them. Salmon farms also compete for coastal areas with other use (rs). The large volumes of predatory fish (salmon is a predator) may also scare other species in the vicinity from their natural habitats and thereby affect local fisheries. In addition, there are spillover effects where one fish farm negatively impacts its neighbor’s fish farm. The negative externalities are not equal for all locations because the alternative use of the location is different and due to the fact, the locations are not equally vulnerable to emissions. For example, a location inside a narrow fjord with a salmon-bearing river nearby is probably more vulnerable than a location in deep water out in the coastal current.

Economic rent and negative externalities (and payment for ecosystem services)

Oil extraction may not necessarily have large negative externalities if you simply have to dig a hole in the desert to extract it, but the subsequent refining and consumption will certainly cause emissions. The economic rent from the extraction could be substantial. We observe that a tax on emissions will reduce the economic rent available, even if levied on the consumers.

Nature is not always a common good; that is, your use (consumption) may harm someone else’s ability to consume or reap other benefits from the same ecosystem. The falling water cannot be utilized twice, and the utilization of the falling water may negatively impact the alternative use of the river. The fish farming industry may have negative externalities, as described above.

How should we reconcile the constructs “negative externalities,” the more modern “payment for ecosystem services” and “economic rent”? Payment for ecosystem services may imply that the farmer pays for the emission of nutrients into the nearby river but also that the farmer is paid for maintaining a cultivated landscape which (surprisingly?) is defined as a good, even if it is a result of human reshaping of the landscape. Hence, the farmer is both a consumer and producer of ecosystem services. If the farmer also owns the hill and the river, the farmer will claim a

land rent that, under perfect competition, will deprive the owner of the power plant of any economic rent.

Conceptually, it is possible to pay for negative externalities and still reap an economic rent, but obviously, not if prices for ecosystem services are set by supply and demand. The owner of the power plant should first pay for negative externalities. The competitive rent then paid to the landowner is pure economic rent.

If the aquaculture industry lays claim to our common coastline or pollutes our fjords, they consume ecosystem services (or cause negative externalities) which they should pay for. But such a payment should not depend on them making a profit. On the contrary, if they destroy our coasts and fjords without making a profit, we should probably abandon the industry, and we should reallocate our resources, labor and capital to more productive industries. Hence, a payment for negative externalities should be imposed on all, regardless of size. Here, however, we are not talking about a tax on economic rent but about “polluter pays” or payment for consumption of ecosystem services. The emissions from a fish farm in a narrow fjord and out in the coastal current may be the same. However, the negative externalities are different because nature’s capacity to deliver ecosystem services is different. Intuitively this should lead to differentiated pricing.

On the other hand, it can be argued that the farmer does not pay for the nutrients released into a nearby river. Many companies within the tourism industry in Norway inflict considerable wear and tear on nature without having to pay the community for this. Gondolas are built up on our mountain tops, and cabin fields are developed in the calving areas of wild reindeer. There is no tradition of paying (the state) for consuming ecosystem services for commercial purposes in Norway. The practice has probably mainly been to limit the amount of use.

In conclusion, much of human activity consumes ecosystem services, also when the activity is sustainable. The activity may or may not be profitable from a financial viewpoint. We may prioritize the use of ecosystem services by pricing them. However, it is not obvious that payment for ecosystem services should be received by the state, which then may distribute the proceeds to those being negatively affected. The payment could alternatively go directly to those affected. That is relevant if a certain use affects private ownership or time-honored rights. Methods can also be found in some cases to internalize the effects. A simple example is forcing fish farmers to buy fishing licenses in the local river (and 20 rooms at the local guest house). The risk is that it works for the owner of the fishing rights (and the guest house) but not from a nature conservation standpoint if the fish farmer puts the fishing licenses in a drawer



and stops delousing the salmon. If the wild salmon has a value beyond the value of the fishing licenses (biodiversity), and it probably does, it is difficult to internalize the externalities. If we decide that it is unacceptable to exterminate the population of wild salmon in the nearby river, we should set an infinitely high value on it. Currently, no good tool is available for pricing the so-called ecosystem services.

How should we assess economic rent?

From the discussion above, we may infer that the consumption of ecosystem services does not necessarily result in economic rent. We have also advocated that there may be other sources of super profit in an industry that consume ecosystem services. We cannot automatically attribute any super profit to the (exclusive) use of ecosystem services.

In some cases, we do not need to distinguish economic rent from general super profit, i.e., we simply say that super profit equals economic rent. There are not so many ways to operate a run-of-river power plant. Most of the super profit in oil (extractive industries), hydropower and fishing concessions is probably economic rent, and we might not make a big mistake by excluding other sources of super profit.

We might ask whether it is interesting to try distinguishing economic rent from super profit in general. The answer is that there can be no basis for imposing a special tax just because an industry is particularly profitable. Therefore, it is important to identify whether and, if so, to what extent economic rent is reaped. If we say that the entire super profit is economic rent, we should be able to substantiate the claim.

If fish farming licenses were auctioned off, the auction price would probably reflect the profitability that can be achieved for a representative market participant. The auction price will

reflect all available super profits, not just the economic rent. In such a case, potentially 100% of the super profit is confiscated if there is sufficient competition, perhaps even more if we have a "winner's curse" problem. If we could "start it all over" and had not awarded concessions with indefinite (or infinite?) lives, this would obviously have been an option. If the winner of the auction has to "give away" their synergies, there is no reason to apologize. This is the price they would have to pay if they were to acquire a competitor as well.

Whether we tax (the auction price can be seen as a tax) the use of the cold, clean water or the competitive advantage inherent in using the infrastructure along the coast or an effective regulatory regime is not possible to distinguish. Politically, however, this is an interesting discussion for two reasons. If society builds a bridge out to an island, it may be appropriate to leave part of the benefit of using the bridge (consumer surplus), and thus the competitive advantage, with the users – at least if the purpose of the bridge is that it should still be attractive to live and do business on the island. Besides, the workshop on the island doesn't pay for the bridge (unless there are tolls), so why should the fish farmer do that? It is understandable that rural Norway rebels against taxation of economic rent even though much of the value creation ends up in few hands. Some of the benefits will always trickle down to the local community.

There are reasons other than district policy for not taxing the entire super profit. In a competitive economy, new entrants will establish themselves until super profits are gone. It is a gross simplification to say that everyone achieves a normal return (all the time). If someone, for various reasons, possesses a competitive advantage, such are usually temporary, they will be able to achieve a super profit. If some players have access to an exclusive resource, they can achieve a super profit (economic



rent) without otherwise having any competitive advantage. The super profit will persist as long as exclusivity persists.

It is likely that society will have to choose between taxing the entire super profit or limiting itself to taxing the obvious economic rent and thus accepting a certain leakage of economic rent. Society wants fish farmers to strive to maximize their returns, i.e., try to create a super profit – that is how we become more efficient and achieve economic growth. However, most investments in increased productivity are risky. Furthermore, both luck and skill determine the return on such investments. If we only allow the fish farmers to deduct the costs (capex) of their investments in increased efficiency and tax the return on capital, large or small, as economic rent, we obviously will increase the risk and lower the after-tax return of such investments (we will return to the subject of neutrality). Perhaps the optimal strategy, then, is to passively harvest economic rent in a market where everyone meets the same price without making risky investments in productivity improvements (why should the return on switching to LED bulbs be taxed at 62%?). Such problems are solved with an auction because the auction price is a “lump sum,” which will not influence subsequent behavior.

How can we possibly distinguish economic rent from other sources of super profit? Most company-specific sources of super profit decay fairly quickly due to innovation and competition. We may assume that if we auctioned out the right to operate from year six and onward, the auction price would mainly be the net present value of economic rent. On the contrary, the price for the right to farm in the first five years is likely to also include the effect of the individual player’s competitiveness as well as the impact of spurious short-term fluctuations in price (supply and demand). It is probably difficult to get the players to reveal what they would have been willing to pay from year six without

linking the auction to the right to operate for the first five years; that is, the method suggested is probably more theoretical than practical.

On top of the general problems that we have described, it is a fundamental problem in the aquaculture industry that the licenses are not homogenous. Instead, the value varies significantly with characteristics related to growth, disease risk, logistics and other factors that determine the production economy.

For the reasons mentioned above, a model for calculating economic rent is likely to be complicated and is unlikely to produce results with a high degree of precision. A model that seeks to calculate economic rent for taxation purposes must be relatively simple, difficult to “play against,” and cause as little loss of efficiency as possible. Although the willingness to accept loss of efficiency to achieve other political goals (redistribution of wealth) may vary with political stance.

Play against the model

When parts of a value chain are held outside the ambit of a taxation regime, transfer pricing issues are likely to arise, not only between the farming and marketing departments. If land-based fish farming is scoped out and sea-based fish farming continues to extend the land-based phase, interesting transfer pricing discussions are likely to arise. The model will certainly be played against (also if neutral), but it can be argued that a certain leakage must be accepted as counter measures easily will cause unacceptable efficiency losses.

Can taxation of economic rent possibly be neutral?

In theory, a taxation model where all cash flows are split between the enterprise and the government based on the tax rate will be



neutral. The assertion about neutrality is, however, based on the assumption that all projects with positive net present value will be realized. For example, let us assume that we invest 1,000 in Project A with a pre-tax present value (PV) of 1,200. Let us further assume that the government becomes a co-investor based on a tax rate of 62%. The project will still be carried out, but what if we can find a new Project B with a pre-tax PV of 1,150 with a tax rate of 22%? Most will clearly prefer Project B, and if the society is constrained by a lack of capital or human resources, Project B will be realized instead of Project A.

In microeconomic theory, the decision criterion is net present value (NPV) larger than zero. However, because all entrepreneurs are striving to realize a super profit and they need protection against their own misjudgment, they will not invest unless the NPV exceeds a threshold. Because entrepreneurs (and investors) should be more concerned about NPV than the internal rate of return (IRR), it hurts when the tax rate increases, even if the post-tax IRR is unchanged. Furthermore, if we cannot separate the effect of exclusive utilization of natural resources from other sources of super profit, the general attractiveness of the industry will be reduced. It is not attractive to remain in an industry where the best one can achieve is to “exchange money.”

Let us look at a project where we invest 100 at the start of year one and receive 27 at the end of the next five years. The investor’s required after-tax rate of return is 6% (alternative cost of capital), but investments with an expected return <8% will still be rejected. The IRR before tax is 10.9%. If we then assume straight-line depreciation over five years and 22% tax on profits, the IRR is 8.6% after corporate tax. Let us then assume that we introduce a 51.3% resource rent tax. We immediately get a deduction for the 100 in capex when calculating the economic

rent. If the government pays negative taxes, the IRR remains constant at 8.6%, but the NPV drops from 6.8 to 3.3. On the other hand, if we have to carry negative results forward, the after-tax IRR drops to 4.7%, and NPV becomes negative 3.1. See table 1.

A relevant objection to the calculations above is that an “up and running” business will benefit from a taxation model that allows deficits in one project to be deducted from profits from other projects. Clearly, this may bring the taxation model closer to being neutral. However, large projects may still be hit, particularly in periods with lower prices, and it may be difficult to enter into joint ventures. Furthermore, the argument suggests that tax planning is necessary to achieve the neutrality presupposed by the authorities, which seems odd.

Impact on risk

Let us assume an enterprise with an annual expected cash flow of 1,000 for a 10-year period. The enterprise is stable and will, in a normal year, be expected to make a cash flow of 1,222, but there is a 10% risk that the cash flow becomes -1,000. The standard deviation/expected value is 67% in a zero-tax scenario. Let us then introduce 20% and 60% tax and assume that losses are carried forward. The resulting cash flows for the three scenarios are illustrated in table 2.

The increase in relative risk is solely due to the fact that negative taxes are not paid out but carried forward. The negative outcome could be caused by a biological incident completely unrelated to general business risk, or it could be related to a geopolitical event. It is unlikely that the risk is 100% unsystematic and hence without any impact on the cost of capital. In any case, the increased tax rate is likely to reduce

Table 1

Scenario	IRR	NPV	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
CF (pre-tax)	10.90%	13.0	(100.0)	27.0	27.0	27.0	27.0	27.0
CF (22% tax)	8.60%	6.8	(100.0)	25.5	25.5	25.5	25.5	25.5
CF (22% + 51.3%) pay out	8.60%	3.3	(48.7)	12.4	12.4	12.4	12.4	12.4
CF (22% + 51.3%) carry forward	4.70%	(3.1)	(100.0)	25.5	25.5	25.5	24.5	12.4

Table 2

Scenario	Tax rate	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Expected value (EV)	Standard deviation (SD)	SD/EV
Senario 1	0%	1,222	1,222	1,222	1,222	(1,000)	1,222	1,222	1,222	1,222	1,222	1,000	667	67%
Senario 2	20%	978	978	978	978	(1,000)	1,178	978	978	978	978	800	603	75%
Senario 3	60%	489	489	489	489	(1,000)	1,089	489	489	489	489	400	500	125%



borrowing capacity (historically, the industry has not relied heavily on debt for financing).

Impact on the competitiveness

The owners of farming licenses cannot take these elsewhere. It is not easy to escape from the tax, but depending on how the model is set up, we can imagine different degrees of "play" against the model.

It is not an argument for not paying for negative local externalities that competitors in other countries do not have to pay, but there may be an argument for not paying for emissions that do not have a local effect.

Taxation of economic rent will likely weaken the aquaculture industry's competitiveness in relation to foreign players. It may also weaken the industry in competition for capital and labor in the local market. However, the industry will still be competitive, provided only economic rent is taxed. There is, however, a significant risk that also super profit stemming from other sources that the exclusive exploitation of natural resources is hit, which may reduce the attractiveness of the industry. Hence, we should probably be willing to tolerate a certain degree of leakage, i.e., the fish farmers are allowed to keep some of the possible economic rent. The alternative is easily that we

tax too hard, potentially with a significant efficiency loss as a consequence.

Some concluding remarks

It is likely that some excess return in the aquaculture industry, at least in recent years, is related to the exclusive exploitation of natural resources and the barriers to entry created by the regulatory regime. However, the players have strived to increase their knowledge, improve operational efficiency and build customer relations for decades. As a result, the players have, right or wrong, expected a net present value above nil on such investments. Furthermore, some of the super profit may result from the industry's superior ability to take advantage of a highly developed infrastructure along the coast.

The suggested tax will hit any profit indiscriminately. This may be partly a confiscation of prior investments in intangible assets, but it might also kill the incentives to make such investments in the future. Neutrality will not be achieved in an environment where projects compete for scarce resources and investors apply a hurdle rate decision criterion or discriminator even if negative taxes are paid out simply because it may be more attractive to allocate scarce resources to industries with a lower tax burden. There will be projects that are accepted outside the taxation regime now being rejected inside the regime.

A snapshot of the Norwegian aquaculture startup landscape



Introduction

The Norwegian aquaculture industry has experienced tremendous growth over the last 20 years, becoming a NOK 279b. industry in 2021 and reaching a production of 1,650,000 tonnes of salmon. This growth has been fueled by pioneering companies investing extensively in R&D and innovation, where Norway continues to uphold its position as the number one global producer and salmon aquaculture cluster.

However, as the industry has grown, so have the industry challenges and measured in volume. The Norwegian salmon industry has been stagnant for many years, with limited growth since 2012. This volume stagnation can largely be attributed to sea-lice problems and other environmental and fish health issues, resulting in a few “green lights” and mostly amber and red lights from the Norwegian production regulating traffic light system in recent years.

In this year’s Norwegian aquaculture analysis, EY has mapped the Norwegian aquaculture startup landscape to better understand the startup playing field, i.e., who are the companies, what industry challenges do they aim to address, and how are they funded? As part of this work, we have also talked with several industry experts from startups, venture capital companies, clusters and corporates to understand the opportunities and challenges they face. We will in this article provide you with some of our findings from this work.

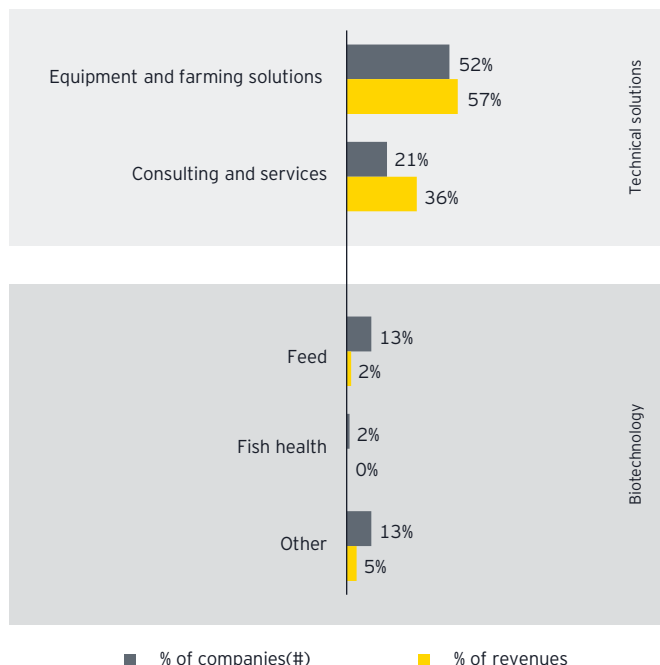
Limitations

For the purpose of this article, only Norwegian aquaculture entities fulfilling a set of criteria have been included:

- ▶ The startup must have been founded in 2015 or later.
- ▶ The startup should have some degree of innovation in its offering.
- ▶ The startup has average annual revenues lower than NOK50m over the last three years (2019-21).
- ▶ Land-based aquaculture is excluded as this is a separate article in the report.

Please note that not all Norwegian startups have been captured in our overview. However, we believe a large enough share to provide some generalizable insights.

Number of startups and share of revenues



Of the 65 companies included in our list, about three-quarters (72%) are found within the technical solutions segment, which is further divided into two subsegments, equipment and farming solutions and consulting and services. All three largest startup subsegments are made up of companies that mainly sell their products to the production segment (i.e., to the fish farmers). The strong reliance on the production segment as customers is one of the key challenges startups face. Several startups point to farming companies not welcoming their new and innovative products and services as a growth barrier, a topic which we will return to later in the article.

The second large segment is biotechnology (15% of the total), of which most startups are within the feed subsegment. Fewer companies have been identified within the fish health subsegment of biotechnology, which might be natural as the entrance barriers related to regulatory requirements are high.

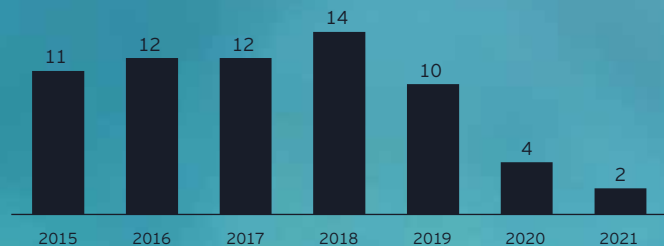
Only a handful of startups has been identified for the remaining segments (distribution and processing). Note that the production segment has not been assessed and new production projects have thus been scoped out in this analysis of startups. This includes the innovative area of land-based farming, which is a separate field of play. Furthermore, it includes farming of new seafood species, which deserves an article all on its own – perhaps in a future version of this analysis.

Norwegian startup landscape demographics



Startups by year founded

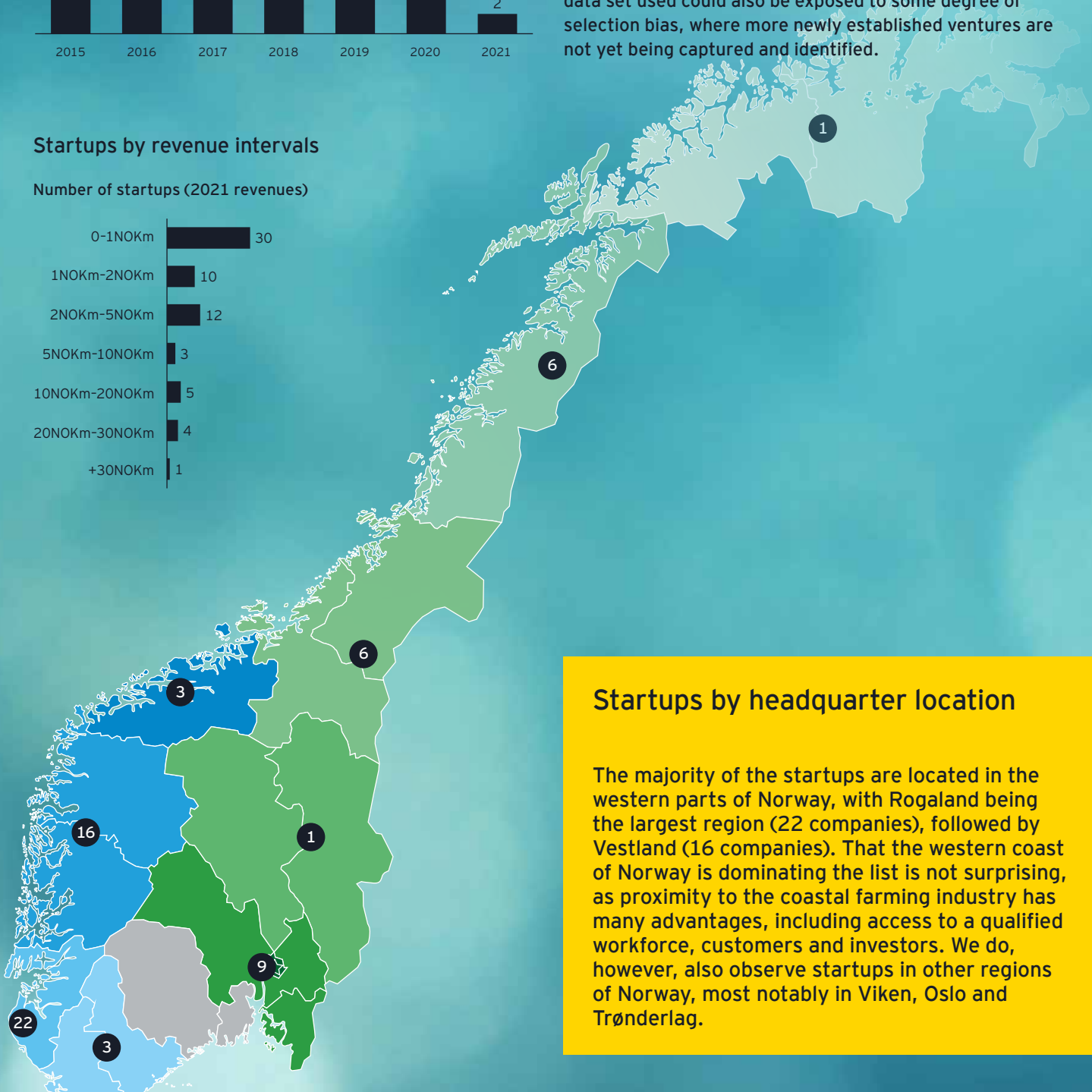
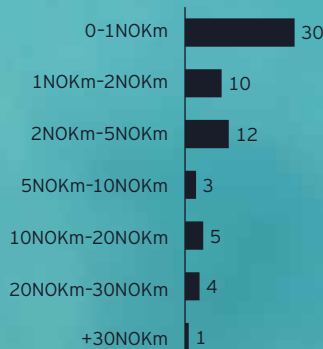
Number of companies



Our mapping suggests only two startups were founded in 2021, a decrease from four in 2020 and a significant decrease from the years before. This significant decrease could result from the economic uncertainty surrounding the COVID-19 pandemic, with a lower appetite for launching new and risky ventures. However, we should note that the data set used could also be exposed to some degree of selection bias, where more newly established ventures are not yet being captured and identified.

Startups by revenue intervals

Number of startups (2021 revenues)



Startups by headquarter location

The majority of the startups are located in the western parts of Norway, with Rogaland being the largest region (22 companies), followed by Vestland (16 companies). That the western coast of Norway is dominating the list is not surprising, as proximity to the coastal farming industry has many advantages, including access to a qualified workforce, customers and investors. We do, however, also observe startups in other regions of Norway, most notably in Viken, Oslo and Trøndelag.

What industry challenges are the startups addressing?

We have identified a set of key industry trends that the startups are addressing with their offerings. Almost 60% of the startups have offerings we have defined as being “digital native solutions,” meaning that the product or service are largely software with or without an associated hardware component. It is not surprising that many of the startups are software and hardware related, as digitalization has great untapped potential throughout the aquaculture value chain. Examples of such digital solutions include sensor and measurement technology (i.e., feed optimization, fish health insights, lice treatment, water quality measuring and biomass estimation), as well as management software (i.e., fish farming management solutions, supply chain traceability and other planning and monitoring software).

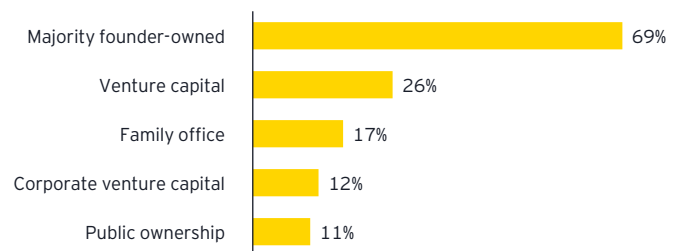
Several of the startups also engage in combating sea lice issues or otherwise improving fish health. Lower mortality and improved fish health will not only make the industry more sustainable but also significantly increase the sea farmers’ cost efficiency and value creation. Furthermore, through the traffic light system, it will also contribute toward increased biomass volume growth in the future.

Other key industry trends the startups are addressing include solutions contributing to reducing the industry’s carbon footprint and/or making the industry a more circular bio-economy, as well as the development of open ocean aquaculture technology and closed or semi-closed cages.

How are they funded?

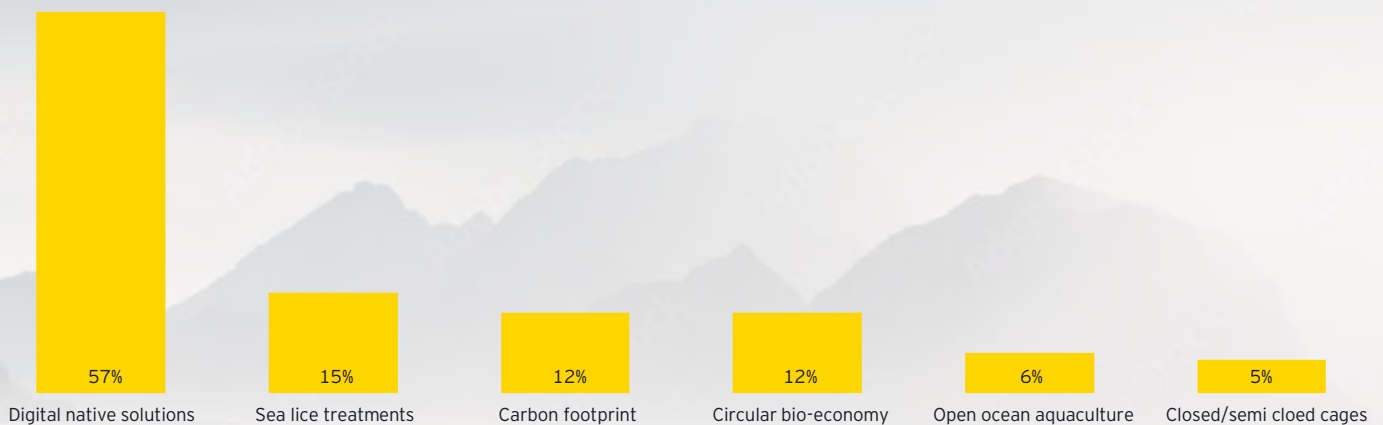
We have mapped the identified startups’ ownership structures to assess how they are funded. We find that almost 70% of the startups have majority ownership held by the founders themselves (and closely related parties, such as family members). In fact, 55% of startups do not have any equity financing from other professional investors than the founders.

Analysis of startups cap table % ownership per investor group



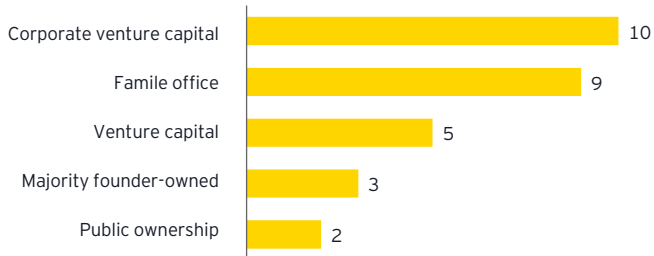
Twenty-six percent of the startups have backing from venture capital, 17% from family-owned investment companies (i.e., either through established family offices or otherwise known investment arms of wealthy families), 12% from corporate venture capital (strategic, large corporates and CVC, typically one of the larger farming corporates within the aquaculture industry) and 11% with ownership from public entities (i.e., a municipality-owned entity). Note that a startup can have ownership from multiple professional investors, and therefore, the total exceeds 100%. However, only ownership stakes above 5% have been considered for this analysis.

Startups tagged per industry-driven trend % share of companies addressing each trend*



*Note that the startups can address more than one industry trend, thus the graph sums to more than 100%

Average revenue (NOKm) per cap table structure

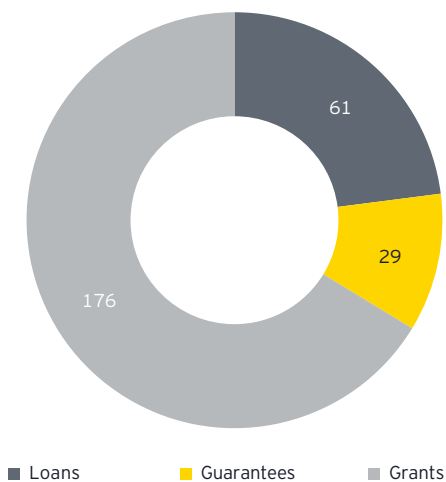


There is also a clear trend that the largest startups (as measured by revenues) have funding from corporate venture capital, family offices and venture capital, whereas the majority of founder-owned and startups with public ownership are relatively smaller. This at least suggests a healthy dynamic, where startups are able to attract more external funding as they grow their business and/or that startups with more external funding succeed better in growing their business.

Funding received from Innovation Norway

Among the startups considered in this analysis, 83% received funding from Innovation Norway over the period 2016-22. The average funding per company was NOK4.9m, and the distribution of the funding is illustrated in the chart below:

Total funding from Innovation Norway
Per funding type, NOKm

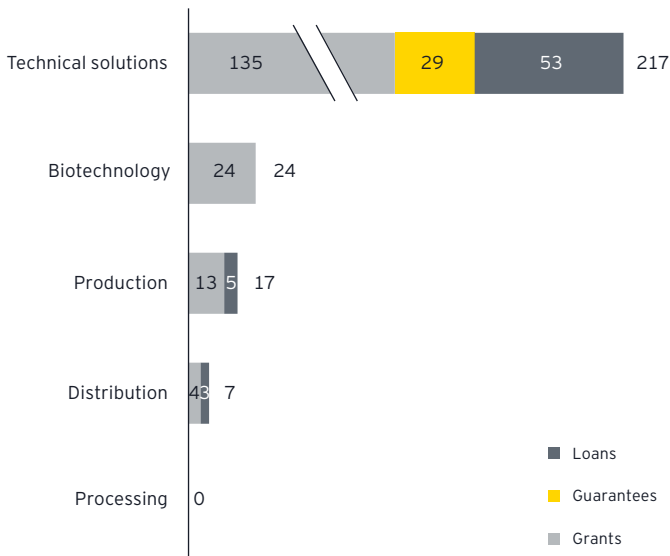


The total funding amount for the period was NOK266m, divided between NOK176m in grants, NOK61m in loans and NOK29m in guarantees.





Total funding from Innovation Norway
Per segment, NOKm



Naturally, the largest identified segment, “technical solutions,” has received most of the funding. With a total amount of NOK217m, divided between NOK135m in grants, NOK53m in loans, and NOK29m in guarantees. In addition, it is the only segment where banks have issued guarantees. Note that this overview only covers funding for startups considered in this analysis and thus can vary from how Innovation Norway (or others) would define the aquaculture startup landscape.

Which issues do the startups face, and how might the industry evolve?

Conceptually, EY professionals has discussed three main success factors in discussions with aquaculture startup market participants:

- ▶ Access to investor capital and funding
- ▶ Customers’ and stakeholders’ willingness to take on innovative products
- ▶ Access to qualified labor

In summary, conversations with industry experts and our industry mapping suggest that access to capital and funding is there to some extent, but some market participants point to

challenges in attracting risk capital, particularly for projects with longer horizons and higher capex needs. An example of this is within the development of closed and semi-closed cages, which is capital intensive, and where the large farming companies are also choosing to develop concepts of their own. Note again that the scope of this analysis is limited to companies with less than NOK50m in average revenues over the past three years. Thus, the access to capital for companies that have ventured further into the scale-up phase could be different, and this analysis limits itself to startups, which, hopefully, one day, will reach this threshold size.

Another issue pointed out as a challenge is succeeding in introducing innovative products to the market, particularly toward the production segment. With high profit margins in the industry, some experts point to a lower willingness to welcome innovation by the corporate farmers “in a segment, which is already performing so well.” This is a challenge for startups, as attracting investors and funding usually requires proof of concept. Further, many newly established companies must start from scratch as there are no technological standards, cloud solutions or similar that enable newly established companies to get up to speed. Participants do, however, observe a changing atmosphere and increasing interest in startups addressing key industry challenges within fish health and welfare and sustainability. Furthermore, the industry realizes the largely untapped potential of digitalizing the industry, both to solve industry challenges and to increase profitability. New farming technologies (i.e., closed and semi-closed cages, offshore and land-based) are also emerging, where startups will likely play a key role in driving innovation.

Access to qualified labor appears to be of lesser concern, where Norway has a highly developed aquaculture industry and access to qualified engineers and other core competencies in key regions.

In summary, it appears that the production segment’s willingness and incentives to take onboard and welcome new innovations will be a key success factor contributing to accelerating startup R&D and innovation. Further, there is additional potential for getting the industry’s stakeholders to work closely together to enable more innovation and increase the development of the aquaculture industry going forward.

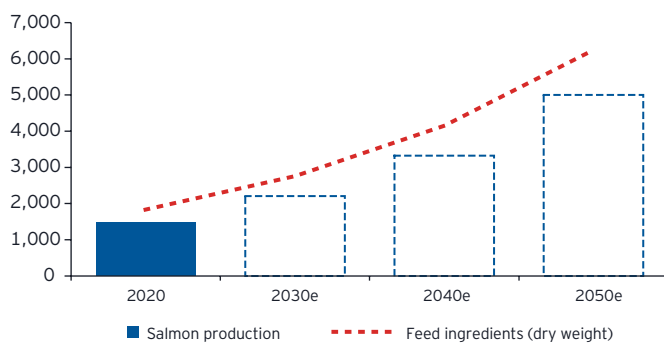
The path to industrialization of future ingredients for Norwegian salmon feed



Sustainable feed paramount for future growth

Norway has stated a national ambition of 5 million tonnes of salmon produced in 2050, which translates to 6.2 million tonnes of feed when measured in dry weight. To meet this ambitious goal, sustainable feed production is critical to ensure reduced emissions and costs.

Salmon and feed ingredients production by 2050 (tonnes)^{1,2,3}



Access to enough sustainable raw materials for feed is expected to become one of the greatest barriers to salmon aquaculture growth. Currently, feed is by far the largest contributor to both emissions and costs in the salmon industry, accounting for ~80% of the emissions per unit of salmon³ and ~46% of the production costs.⁴

The political platform for the current Norwegian government, Hurdalsplattformen, has stated that all salmon feed should come from sustainable resources by 2030, and more ingredients should come from Norway, as well as CCU inputs (e.g., CO₂).⁵ The message has further been reinforced by including sustainable feed as a mission in the latest long-term plan for research and education.⁶

It is not realistic, however, that the necessary feed volume growth of 920,000 tonnes by 2030 will be met by future ingredients from Norway. The report, Future ingredients for Norwegian Salmon Feed (2022), highlights the importance of both increasing national and industrial production of novel feed ingredients while, at the same time, improving sustainability along existing value chains.⁷ Setting industry standards, such as soy protein deforestation standards in Brazil, is a prime example of efforts contributing to more sustainable production in existing value chains.

Norwegian salmon production highly dependent on imported ingredients

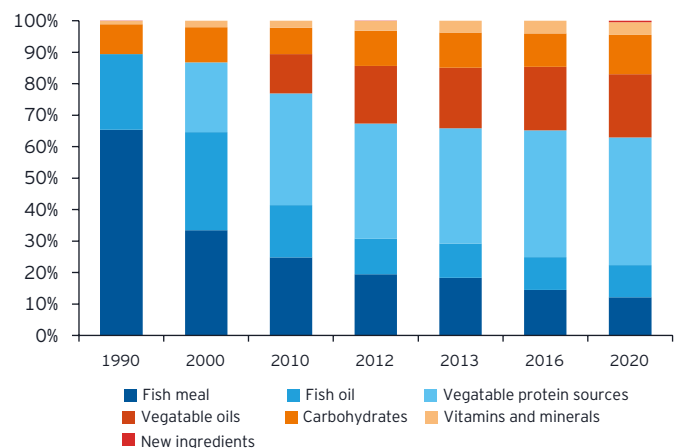
A total of 1.98 million tonnes of feed ingredients were used in Norwegian salmon feed in 2020, with only 8% coming from Norway (fish meal and oils).¹ The imported ingredients were mainly plant-based, with the largest volumes coming from Europe (~700,000 tonnes), Brazil (~370,000 tonnes), and Russia and Belarus (240,000 tonnes).¹ Marine ingredients came primarily from the Atlantic Northeast fishing area (FAO 27), with a total of ~295,000 tonnes.¹

Today's feed primarily consists of land-based resources with record low levels of marine ingredients

Marine ingredients were the dominant protein and oil source for fish feed in 1990 (90% share), but this has decreased significantly in recent years.¹ In 2020, marine ingredients accounted for only ~22% of Norwegian salmon feed. Plant-based ingredients are the dominant ingredient source in salmon feed, with a 60% share in 2020, where soy is the dominant protein source (~21%) while canola oil is the dominant oil source (~18%).¹

Micro ingredients, including vitamins and minerals, have been stable at ~4% in recent years, while carbohydrates accounted for ~12.5% in 2020.¹ New ingredients, such as insect meal, single-cell proteins, microalgae, etc., accounted for only 0.4% of total ingredients in 2020, and none were produced in Norway.¹

Ingredients used in Norwegian salmon feed in 2020 (% of total)¹



1 Utnyttelse av fôrressurser i norsk oppdrett av laks og regnbueørret i 2020. Faglig sluttrapport, *Nofima* 2022.

2 Resource utilization of Norwegian salmon farming in 2016– Professional final report, *Nofima* 2019.

3 Greenhouse gas emissions of Norwegian seafood products in 2017, *Sintef* 2019.

4 Lønnsomhetsundersøkelse for laks og regnbueørret: matfiskproduksjon (2021), *Fiskeridirektoratet*.

5 "Hurdalsplattformen– For en regjering utgått fra Arbeiderpartiet og Senterpartiet 2021–2025", *Regjeringen*, <https://www.regjeringen.no/contentassets/cb0adb6c6fee428caa81bd5b339501b0/no/pdfs/hurdalsplattformen.pdf>, accessed 8 November 2022.

6 "Langtidsplanen for forskning og høyere utdanning 2023–2032", *Regjeringen*, <https://www.regjeringen.no/no/tema/forskning/innsiktsartikler/langtidsplanen-for-forskning-og-hoyere-utdanning-2023-2032/id2929453/>, accessed 8 November 2022.

7 Future feed ingredients for Norwegian salmon feed, *NCE Seafood Innovation and EY* 2022.

Future Norwegian feed ingredients expected to account for 140 000 tonnes of salmon feed in 2030

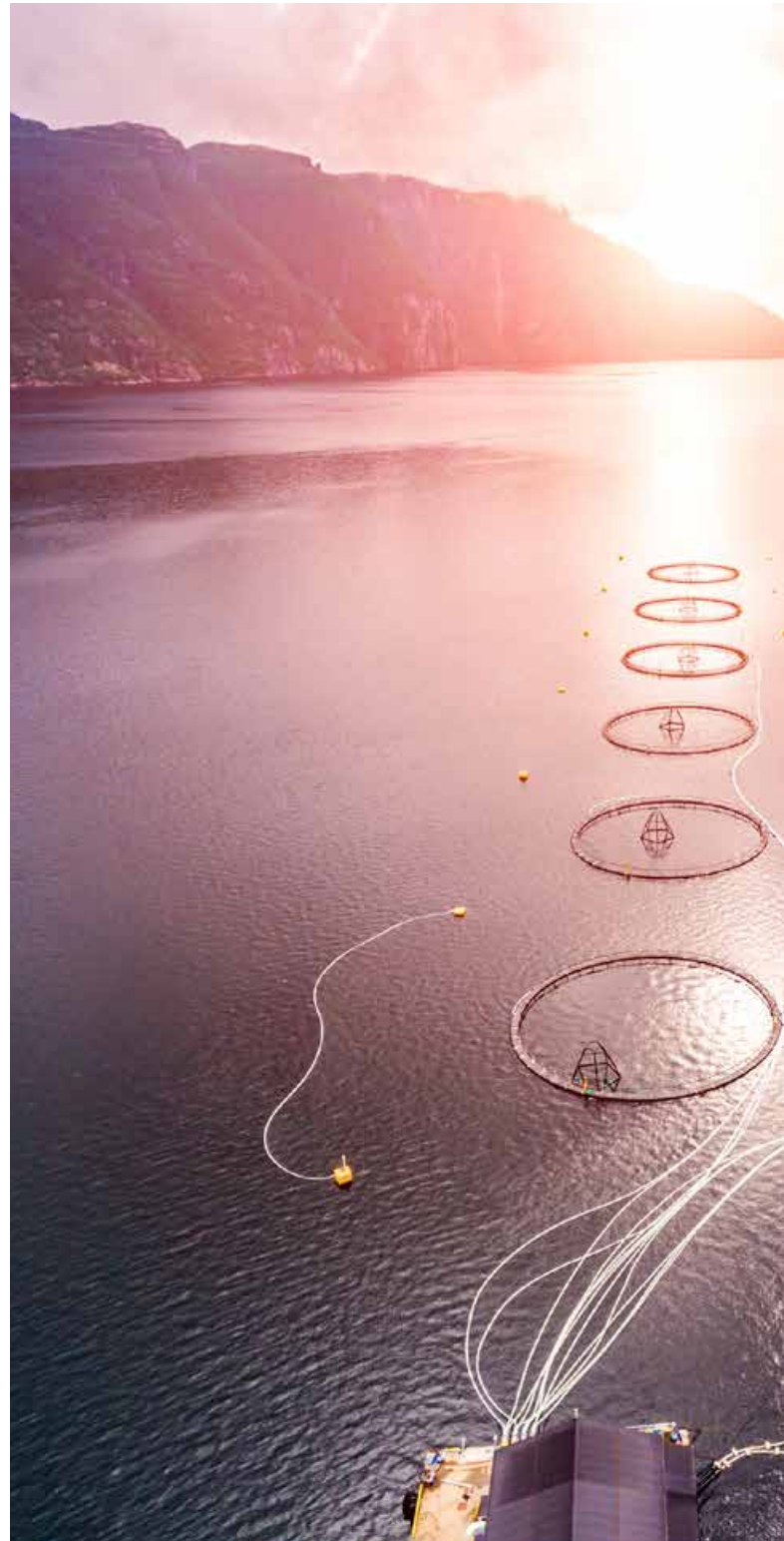
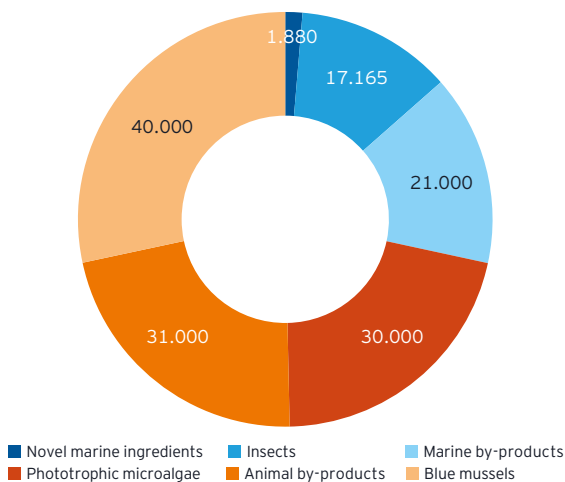
There are numerous early phase projects aiming to develop future feed ingredients from Norway, but few initiatives have reached industrialized production. Future ingredients for Norwegian Salmon Feed (2022) defines future ingredients as “harvested novel marine and plant-based ingredients, farmed organisms, and underutilized resources.” The latter includes land animal and marine by-products.

Blue mussels, land animal by-products and photoautotrophic microalgae are highlighted as ingredients with the largest short-term volume potential due to concrete investment plans and/or access to raw materials.¹ Although the resources have significant potential, a short-term acceptance of higher feed costs is likely to be necessary to scale up production. Likewise, customer acceptance is seen as the most critical barrier for land animal by-products to enter the feed ingredients portfolio.

Both microbial ingredients and other marine low-trophic species are likely to have significant scaling potential beyond 2030 but are not likely to be part of the national feed mix already in 2030. Insects also have the potential as an excellent protein source, but current regulations regarding the use of organic waste as feedstock limit future growth.

In total, 140,000 tonnes of salmon feed in 2030 are expected to come from future feed ingredients, far from the necessary growth requirements of 920,000 tonnes.¹

Future ingredients in 2030 (tonnes)¹



¹ Future feed ingredients for Norwegian salmon feed, NCE Seafood Innovation and EY 2022.



Realizing the potential of novel feed ingredients

To meet the national ambitions of sustainable feed ingredients, overcoming barriers from high cost, regulatory framework, customer acceptance and nutritional quality will be especially important.

Four critical success factors must be addressed to meet the national ambitions for feed and salmon production:

1 A portfolio of ingredients is essential to be able to meet the future feed demand

Future feed demand cannot be met by a single feed ingredient. Therefore, it is important to industrialize a range of new feed ingredients, as well as improve the existing value chains.

2 An overall strategy for bioresources should be developed

The reports suggest the need for a national “feed-food-fuel” strategy to map, prioritize and maximize the utilization of scarce resources. This includes, e.g., clarifying the need for imported vs. domestically produced ingredients and ensuring efficient use of by-products in feed production.

3 An overall strategy for sustainable feed ingredients

Science-based targets and taxonomy standards for aquaculture should be developed to prioritize ingredients with the highest degree of sustainability. To accelerate the production of low-trophic species, specific zoning and licenses should be developed. The industry highlights specific areas, not competing with traditional aquaculture, as particularly important to scale up production.

4 Implement financial incentives to industrialize the production of Norwegian feed ingredients

Currently, only blue mussels, land animal by-products and photoautotrophic microalgae are close to cost-competitiveness vs. existing, imported feed ingredients. To close the gap, financial incentives supporting sustainability will become critical, i.e., CO₂ fees and taxonomy incentives. Resource mapping and trial fishing support, resource waste restrictions, differential contracts, and development licenses are other suggestions to facilitate growth.

Finally, support schemes for upcycling of nutrients and CO₂ can become important for scaling up the production of low-trophic species. A similar scheme as Danish farmers, who are paid to utilize blue mussels to absorb nitrates and phosphorous spills from agriculture, could be effective also in Norway.

Potential production cost scenarios in 2030: Make it or break it



Looking 20 years back and 10 years forward

In the last 20 years, there has been tremendous development in the Norwegian aquaculture industry. The global production volume of Atlantic salmon totaled about 0.9 million tonnes in 2000, of which 0.44 million tonnes were produced in Norway.

Back then, conventional open sea net pens were the only production method, and processes, such as feeding, were mainly manual. The Norwegian salmon farmers sold the salmon for an average price of NOK25 but still achieved a profit as the production cost per kg was as low as NOK16.3, with a feed factor of 1.221.¹ The primary consumption markets at that time were Europe, Japan and the US.

The average production loss due to mortality and escapes in Norway was 6.1%. Sea lice were primarily treated with chemical water treatments, cleaner fish and through adding toxins in the feed. Development licenses, traffic light systems, automation and digitalization, post-smolt, sustainability and closed cages were not in the vocabulary yet. We have witnessed increasing industrialization, globalization and consolidation in several parts of the value chain and technological improvements in many areas. But biological conditions, technology, solutions and regulations still differ considerably between the salmon-producing countries. Biological challenges, such as sea lice, diseases and algae outbreaks, keep the industry alert and focused, helping the industry to continuously find ways to increase production efficiency and production volume in a sustainable way. The aquaculture industry is currently juggling operational challenges with a wider set of opportunities than ever before.

Growth seldom comes without struggle, and a broad range of industry challenges must be solved to reach this industry's enormous potential. The average production cost per kg (WFE) has risen from approximately NOK22 in 2011 to NOK41.7 in 2021.² That is an increase of 88% in 10 years, or roughly 8.8% average per year over the same period. Focusing on cost per kg (WFE) for 2021, you will find companies with an estimated cost per kg below NOK25 and companies with an estimated cost per kg over NOK60.²

EY teams have, together with industry experts, discussed the most important battles the industry needs to win to improve its operational abilities. In the desired scenario, the industry has control over its operational challenges and can scale its production to meet the increasing demand with a reasonable cost per kg. The question is how to get there. Over several years, corporates, startup companies and communities within the seafood sector have tried to solve some of the most pressing issues. Nevertheless, the production cost per kg has been steadily rising.

In the desirable scenario, we expect the industry to get control over its operational challenges and reduce its operational costs quite significantly. On the other hand, if the operational costs continue to increase at the same pace as the last 10 years, we can end up with a cost per kg (WFE) of NOK73 already in 2030.

As all the players are facing the same issues, with the solution yet to be found, now should be the time for the industry to think differently and approach the challenges in a new way.



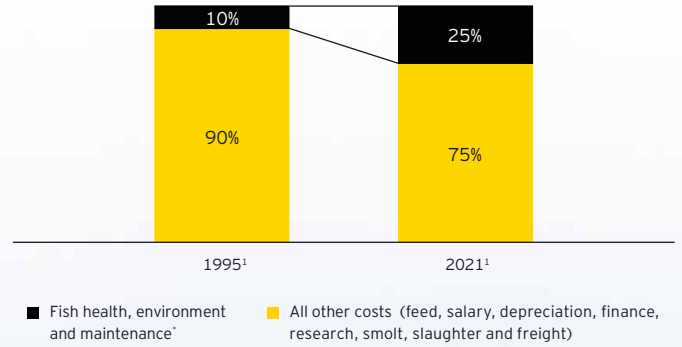
1 "Fiskeoppdrett 2000", Statistisk Sentralbyrå, www.ssb.no/a/publikasjoner/pdf/nos_c711/nos_c711.pdf, accessed 01 November 2022.
 2 "Lønnsomsundersøkelse for laks og regnbueørret", Fiskeridirektoratet, 2021.
 3 NOK30/kg is the 2011 cost level adjusted for inflation toward October 2022.

Introduction to the scenarios

Looking 10 years ahead, the industry can develop very differently, and our scenarios include two very different potential future situations. In the desirable scenario, the cost per kg is estimated at NOK30/kg (WFE). In the undesirable scenario, the industry has seen the costs continue the trend toward 2030 reaching a cost per kg at NOK73.

The purpose of the scenarios is not to create a binary suggested future for the industry but to illustrate that actions need to be taken and that there are huge unrealized operational possibilities if the industry takes the right actions. The scenarios are framed after a future-back-model, which tries to answer what actions the seafood industry needs to take today in order to push the industry toward the desirable scenario:

Relative cost development per kg



* In addition, any costs for other activities such as hatcheries, slaughtering and well-boat services are included in this cost item. In recent years, the focus on fish health and the environment has been an important factor that has contributed to increasing this cost's share of the total industry costs.



1 "Lønnsomsundersøkelse for laks og regnbueørret, Fiskeridirektoratet, 2021

Desirable scenario

- ▶ To receive a license to operate, salmon farmers are required to share data and analysis in a safe cloud solution with the rest of the industry. This enables sustainable solutions and increases the understanding of the differences between different sites and locations.
- ▶ Lice treatments are reduced substantially by using predictive data and by singling out the infected fish and neglecting the healthy ones.
- ▶ Post-smolt has become the new normal, and the fish is more robust when released to the pens leading to better fish health and better utilization of MAB.
- ▶ The shallow fjords (terskelfjord) are reserved for players with sustainable solutions without pollution, like closed pens. The industry has also increased the number of near-shore pens.
- ▶ Producers utilize the whole fish and have infrastructure that collects the sludge/waste and fish disposal to be used in upcycling and circular models.
- ▶ The mortality rate is reduced from 2021-levels¹ of 15.5% to ~5%, thereby reducing cost per kg significantly and increasing revenue growth in the whole industry.
- ▶ Feeding systems are optimized through new technology to ensure that all fish in the pens are fed optimally and thus increase the growth rate.
- ▶ The industry is a large exporter of technology and knowledge of farming solutions for farming in the open sea and on land.

Undesirable scenario

- ▶ Regulators continue to increase the tax burden on the sector instead of incentivizing sustainable solutions.
- ▶ The growth rate of salmon hasn't improved as feeding efficiency is still negatively impacted by lice treatments.
- ▶ Feeding, treatments and slaughtering are not data-driven decisions since the industry is not capable of utilizing the data. Machine learning is still only a buzzword, and the data remains in silos.
- ▶ Lacking technology improvements to strengthen the growth rate of the fish.
- ▶ The industry doesn't utilize the whole fish. Blood is spilled instead of creating new valuable biproducts.
- ▶ Key market players, the government and other industry enablers are still not working effectively together to solve key industry challenges.
- ▶ Norwegian subcontractors are not expanding internationally quickly enough, resulting in foreign subcontractors getting a technological advantage.



Battles to win toward the desirable scenario



Flat growth rate: The fish needs to eat more

The growth rate for salmon has almost been flat for the last 15 to 20 years. From one of our expert interviews, we got the bold statement as to why that is. “The salmon eats too little,” where they elaborated that during the peak lice periods, the salmon uses as much as 15% of the time either waiting for treatments or being treated.

Today, the industry doesn’t maximize its growth potential. Throwing more feed into the pen is definitely not the best solution to enhance growth. By instead focusing on eliminating the 15% waste time described above, the growth rate will increase more sustainably. Further, there is a great potential for growth by optimizing the conditions for the fish and feeding smarter to increase the feed factor.

Feed spreaders and camera surveillance have been present in the industry for several years, but further improvements are needed. In some instances, the feed spreader covers as little as 7% of the pen and cameras often only cover these areas. Often, feeding is thus stopped once the fish in the camera-covered areas stop eating, without knowing if all the fish is fully fed. The low coverage from the feed spreader also means that the fish will have to swim into the center of the pen to get enough food to reach the highest growth rate possible, which probably results in less than optimal feeding for the fish population that is less active.

Sustainable feed

The industry has a large carbon footprint driven mainly by feed and transport. Today 8% of the feed ingredients are from Norwegian resources, about 35% are from European resources, and at least 38% are from sources outside Europe.¹ In “Hurdalplattformen,” the Norwegian government set the ambition that all feed for the aquaculture industry must come from sustainable sources by 2030, showing that the industry has work to do considering that today only 0.4% of the current feed mix comes from what is regarded as sustainable novel ingredients.

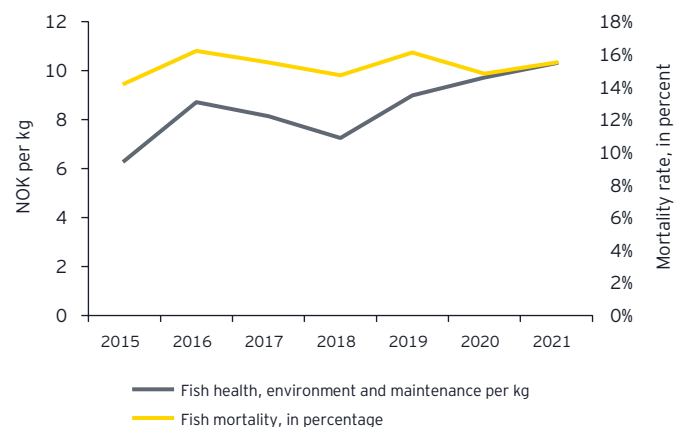
Feed is not only the largest sustainability challenge – it is also the salmon farmers’ largest profitability challenge, as it counts for approximately 50%² of the production cost per kg. Insects, marine by-products, photoautotrophic microalgae, land animal by-products and blue mussels are among the novel ingredients the salmon farmers need to explore further.

Fish health: wasted costs and lost revenue

As the graph below illustrates, the cost related to fish health has increased significantly in the last years, but the mortality rate in percentage has been at a steady state of around 14% to 16%. Fish death represents a huge loss in the industry and punishes the farmers twice. Firstly, since the dead fish already has incurred costs for the farmers, and secondly, through lost revenue. In 2021, a total of 54 million fish died.³ With an average (non-weighted) price in 2021 of ~NOK57,⁴ the fish could have been sold for NOK3.1b.

In the desirable scenario, the industry will have reduced deaths from 15% to 5% by 2030. This would reduce the cost per kg significantly and help the industry increase its volume sold.

Cost and mortality rate development



1 “Future ingredients for Norwegian salmon feed”, *NCE Seafood Innovation & EY*, 2022.
 2 Lønnsomhetsundersøkelse for laks og regnbueørret, *Fiskeridirektoratet*, 2021.
 3 “Fiskehelse rapporten 2021”, *Veterinærinstituttet*, 2022.
 4 “Slik endte laksprisen i 2021”, *Kyst*, 2022.

Technology and innovation

For the industry to take the correct operational actions, there is a demand for insight and a need to access operational data. Today, the industry is too dependent on manual processes and routines for fish health, ineffective feeding systems and a silo-based development of the industry where large market players, authorities, startup companies, clusters and communities do not collaborate to solve their common operational challenge. Further, using data can enable the biological potential of the salmon, which can grow up to 50% faster if the conditions are optimized.

The aquaculture industry needs to transform into being data-driven, where cloud-based data is shared between market players in order to enable large operational decisions. Key market players can't solve these industries' challenges alone. Data sharing and access to insights across all players in the industry will not only help solve the operational and biological challenges but also enable more disruptive technological development and faster development of startup and scale-up companies dependent on data to develop their solutions. This will also enable the industry to solve its sustainability challenges and help develop advanced solutions, e.g., circular operational models for sludge and waste and fish disposal.

Utilization of whole fish: the missing 6%

The salmon farming industry is proud of the way they utilize the whole fish; almost nothing is disposed of. In 2021, as much as 94% of the residual value of the salmon was used.¹ Of the missing 6%, it is mainly the fish blood that isn't being utilized.

In 2021, blood from the salmon was estimated to be 34,600 tonnes. This number highlights that there still is a way to go, and the industry should not be satisfied before they reach 100%. In the desirable scenario, producers utilize the whole fish. For instance, fish blood is rich in protein and iron, which could be

used for nutritional and iron supplements in tablet form and food fortification.

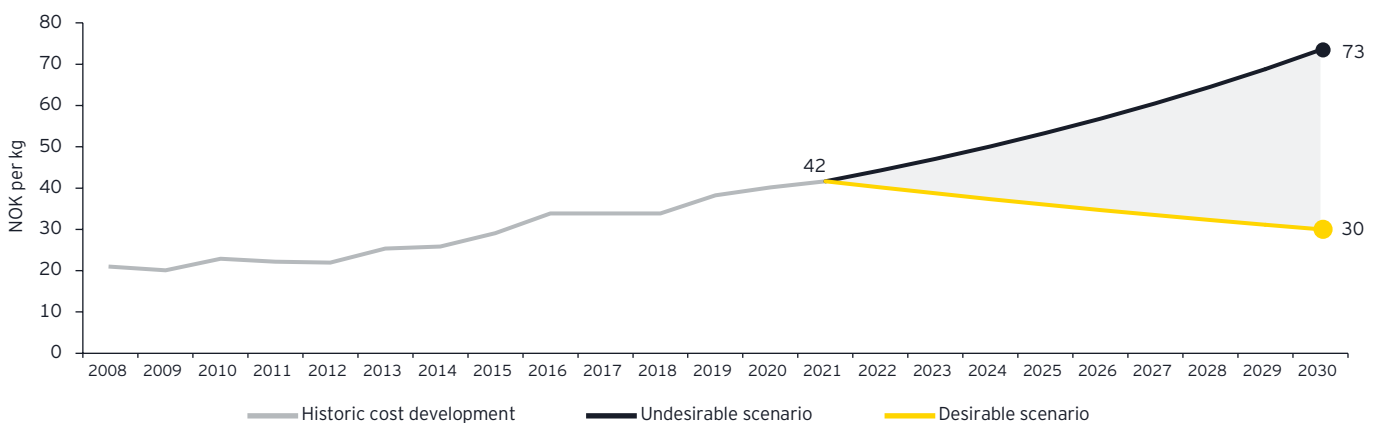
Governmental collaboration and sustainable incentives

To accelerate a more sustainable development of the Norwegian aquaculture industry and enable a more operational and effective industry, there is a need for collaboration between the market players and the government. Further, there is a need for standards, regulations and agreements that forces farmers toward more sustainable solutions. Thus, to create these standards and incentive plans which will push the industry in a more sustainable direction, there is a need for a better understanding of the industry both for the government and the industry players themselves. It means that there is a need for insights and data.

The way the recent governmental proposal on resource rent tax was introduced serves as an example of how a lack of dialogue with and understanding of the industry can result in adverse and potentially unintentional impacts. Such sudden regulatory changes reduce the predictability in the industry and, with it, potentially also investments and innovation. Such regulatory changes can push the industry over to the path of the undesirable scenario and the road toward a cost per kg of NOK73 in 2030.

A higher production cost will naturally lead to lower profitability and thereby diminish the Norwegian industry's competitiveness vis-à-vis foreign fish farmers, other farming technologies and other resources for protein.

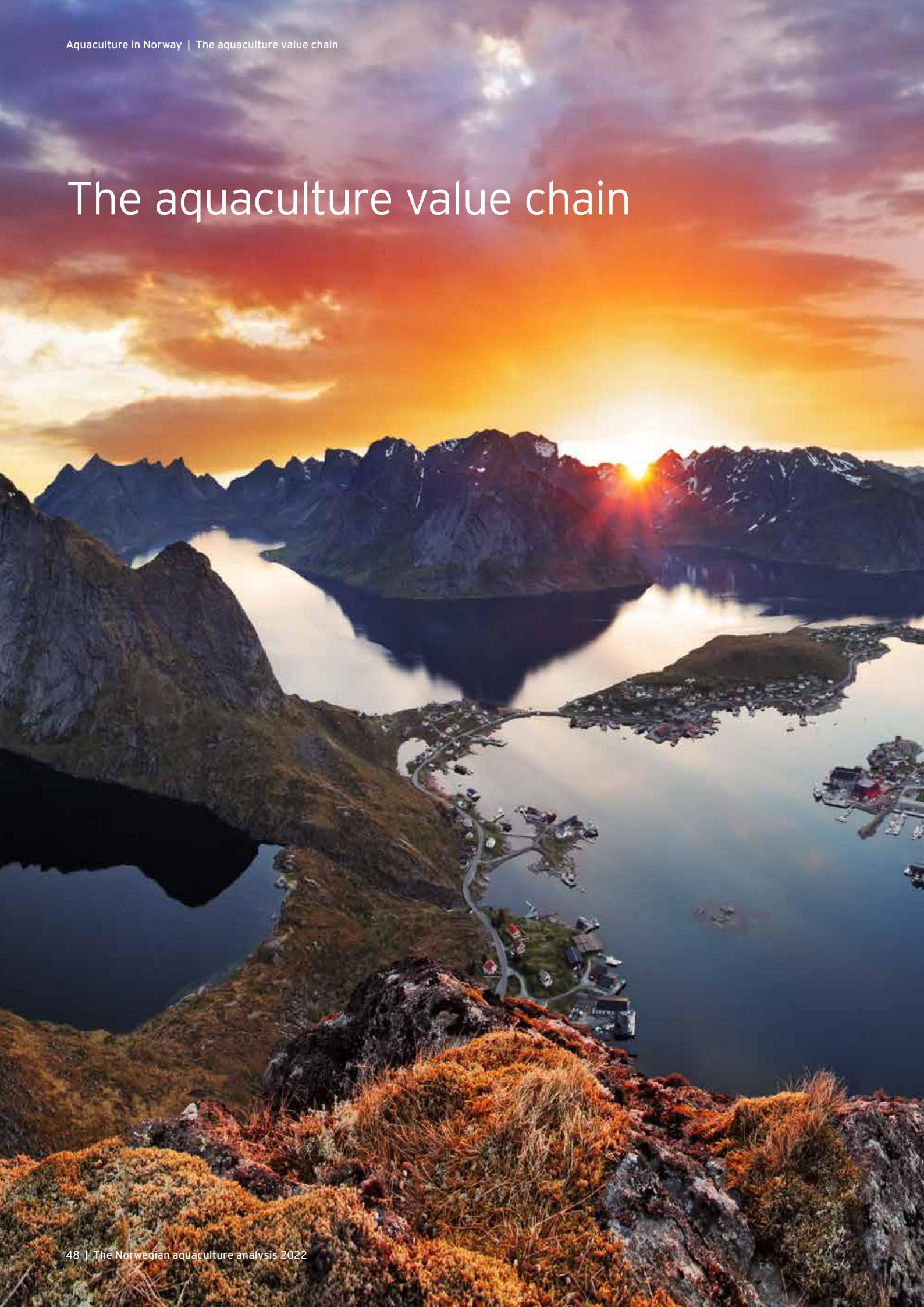
In order for the Norwegian aquaculture industry to reach its full potential, all stakeholders need to join forces and collaborate with the industry's best interest at heart.



1 "Analyse marint restråstoff 2021", SINTEF & Kontali Analyse, 2021.



The aquaculture 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 value creation can be presented in different ways.

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

Technical solutions suppliers are needed at every stage of the value chain. Hence, presenting them as just one segment can be misleading.

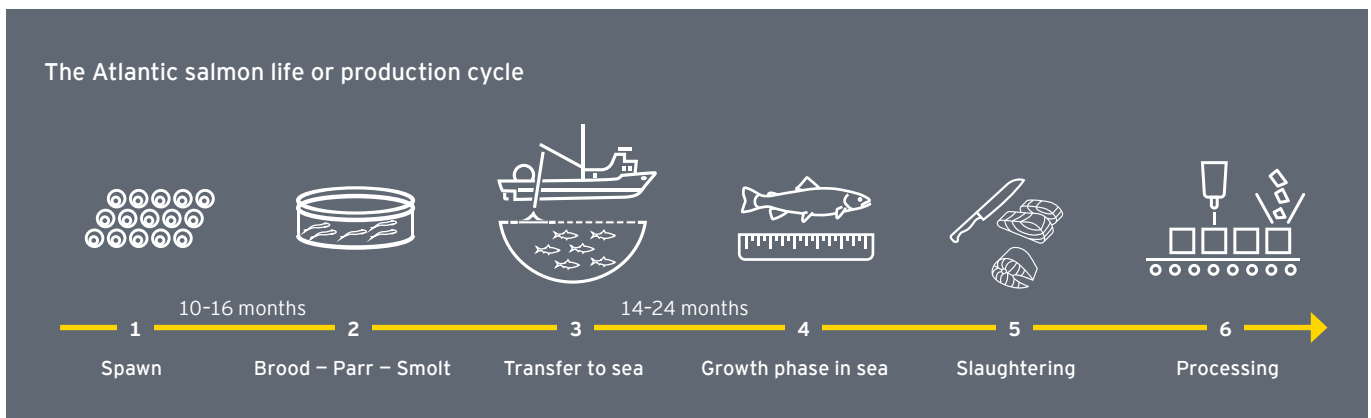
The above-mentioned challenge is almost the same for biotechnology suppliers, who deliver a wide range of products including feed, vaccines, medicines and cleaner fish. The common denominator for these products is the biological or

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 net pens 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 extends over three years. During the first year, eggs are fertilized and the fish are grown to 100g-250g in weight in controlled freshwater environments. Subsequently, the fish are transported into seawater cages where they are grown to about 4kg-5kg. This growing process takes 14 to 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.





Technical solutions



About the segment

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

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

We have divided the segment into three subsegments:

- ▶ Consulting and services
- ▶ Equipment and farming solutions
- ▶ Yards

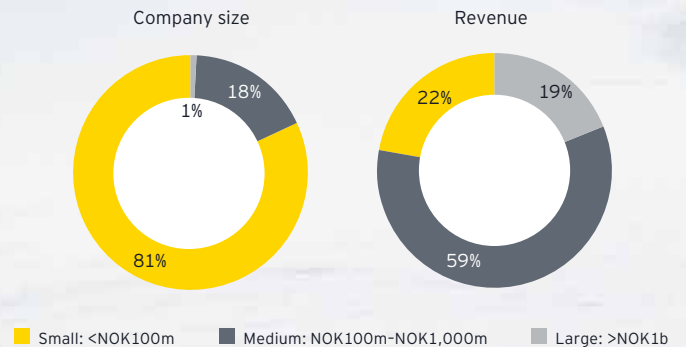
Segment highlights

While the segment has experienced continuous revenue growth, margins have been under pressure since 2016, reaching a low in 2018. This is in part due to increased competition in the segment. However, in 2021, the margins have improved and are now back at the historical average. Increased focus on farmers' environmental footprint and sustainability, as well as digitalization, has a positive spillover effect on this segment as it incentivizes farmers to invest in new technology. Although the M&A activity has been high in the last few years, the segment is still rather fragmented and predominantly made up of small-sized companies, of which nearly 70% had revenues below NOK50m in 2021. However, there has been an increase in large companies with revenues above NOK1b, which is a result of both M&A and revenue growth in the segment.

Key financials



Segment composition (2021)



From 2021 to 2022, 35 deals involving companies in the segment were announced. These companies were the target in 26 of the transactions, with a relatively even distribution between industrial and financial buyers. This indicates a continuing trend of companies using M&A as a way of expanding their product offering and market position. It also highlights an increasingly strong interest from financial investors.

Consulting and services

Equipment and farming solutions

Yards

Consulting and services

The companies in this subsegment offer competency on various specializations across the whole value chain (asset-light) and ongoing maintenance and services on production facilities with vessels and machinery.

The subsegment is comprised of mid- and small-sized companies. The latter accounts for 85% of the companies, indicating a fragmented competitive landscape. In the period from 2020 to 2021, we observed a total of 12 M&A transactions in this subsegment. Targets were both companies in the development and commercial phase, with buyers being primarily industrial companies, whereas the financial buyers typically participated in minority private placement transactions.

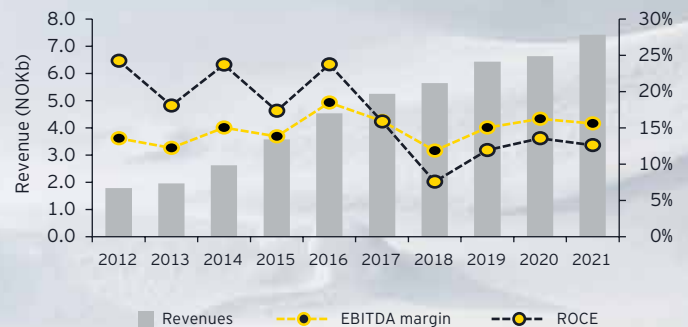
Revenues have increased significantly over the past decade, with a compound annual growth rate of 17%. The year 2021 was a strong year with a revenue growth of 12%, a great improvement from 2020, which was negatively affected by the pandemic. Consulting and services show attractive double-digit margins throughout the period and seem to have recovered well from the lower EBITDA levels witnessed in 2018. In 2021, the EBITDA margin decreased slightly from 16.3% in 2020 to 15.6%, mainly due to lower gross margins, partly offset by a decrease in personnel expenses and other operating costs. Margins are primarily driven by mid-sized companies, indicating favorable effects from economies of scale and showing that many small-sized companies are in a pre-commercial phase.

Part of this subsegment is capital-intensive, and CAPEM has increased significantly over the last five years, primarily driven by vessel purchases for some of the service providers. In 2021, CAPEM continued to grow as companies ramped up investments after a restrained 2020. However, because of the large investments, ROCE had a minor decrease in 2021, indicating a lagged effect of the investment's ability to generate returns.

Top five companies (2021 revenues)

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

Key financials



Consulting and services **Equipment and farming solutions** Yards

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 providing more specialized equipment.

EBITDA margins fell to an all-time low in 2018 (4.3%), driven by a fall in gross margins and increased personnel expenses. These developments were likely the result of a change in product mix and increased competition. Since then, margins have recouped, coinciding with general growth across companies of all sizes. In 2021, the subsegment experienced high activity with revenue growth of 9.1%. This is still lower than the double-digit CAGR experienced in the last decade but with an improvement from the weak growth in 2020. The subsegment is characterized by a competitive nature, and although the EBITDA margin increased to 6% in 2021 (from 4.6% in 2020), it is still below the historical average from the last decade.

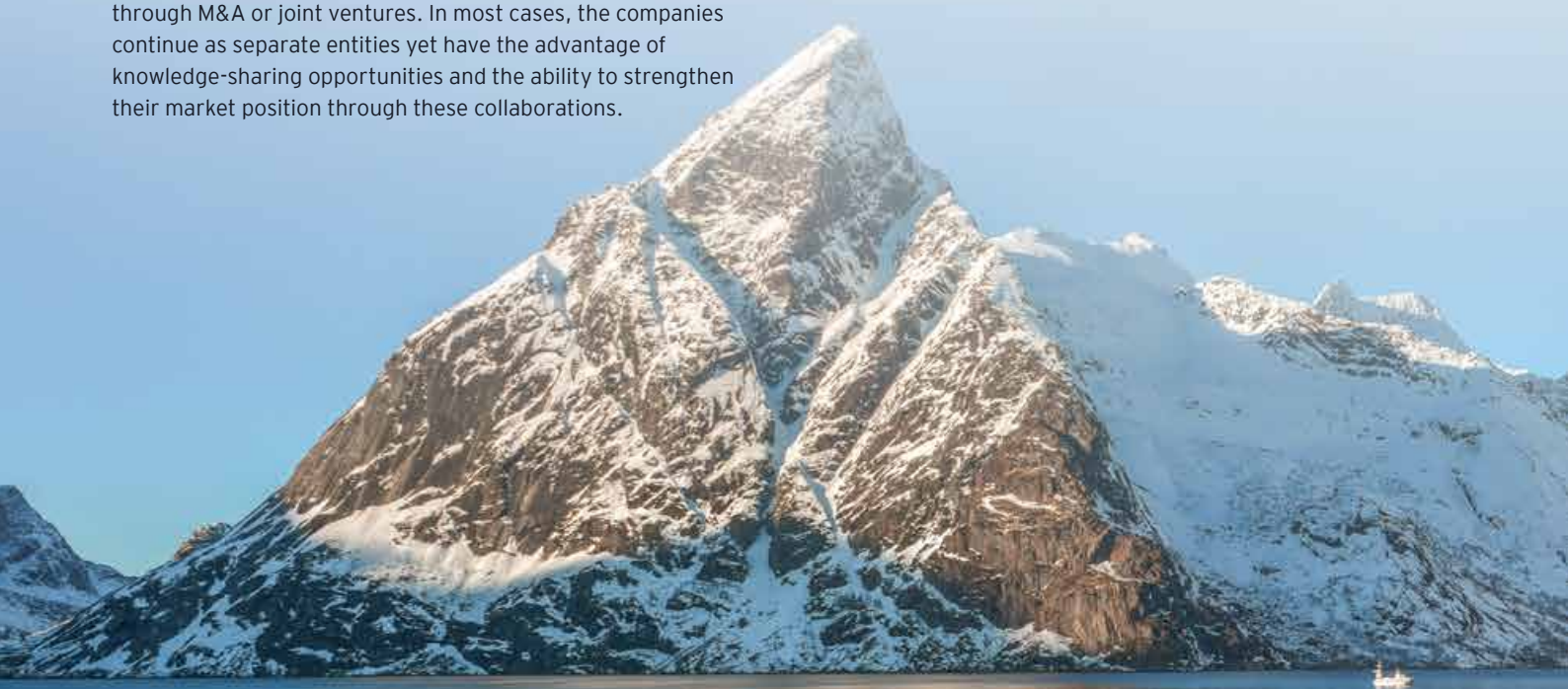
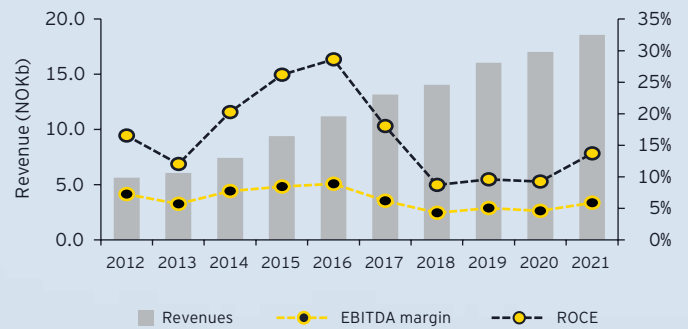
After limited growth in 2020, capital employed grew by 12.2% in 2021, as companies have increased their investments following the pandemic. Combined with strong EBIT levels, the ROCE came in at 13.7%, up from 9.2% in 2020, continuing the positive trend from the low levels in 2018.

We observe trends where companies in the subsegment partner 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 their market position through these collaborations.

Top five companies (2021 revenues)

1. Scale Aquaculture AS
2. AKVA Group ASA
3. Artec Aqua AS
4. MMC First Process AS
5. Optimar AS

Key financials



Consulting and services

Equipment and farming solutions

Yards

Yards

Yards included in this subsegment primarily construct or retrofit well-boats, processing vessels and feed freight vessels.

The yards can only build a limited number of vessels at a time, and the construction period may be longer than a year. This can lead to fluctuations in revenues, as observed in the chart. The well-boat industry continues to expand, resulting in many well-boat orders in 2021 and 2022, with several yards reporting high order backlogs. The number of newbuilds is driven not only by increased market demand for well-boat services but also by replacing older well-boats as newer and more sustainable technologies are introduced.

The yard subsegment experienced revenue growth of 5.4% in 2021, reaching an all-time high revenue in 2021. The growth is driven by a continued strong demand for newbuilds and high activity. On the other hand, margins have been under pressure, with an EBITDA margin of 2.4% in 2021, down from 4.7% in 2020. One of the top players was the largest contributor to both the revenue increase and the EBITDA decrease, reporting that despite the high activity, the market for newbuilds has been challenging due to the pandemic, with delays and pressure on margins.

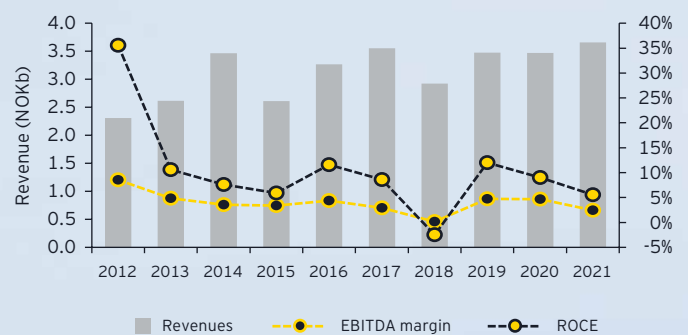
The top five players accounted for approximately 83% of revenues in the subsegment in 2020.

Although the yard market is considered quite concentrated in Norway, companies experience significant international competition, especially from low-cost countries.

Top five companies (2021 revenues)

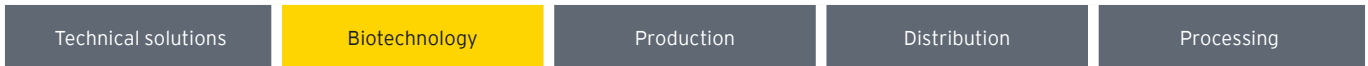
1. Aas Mek Verksted AS
2. Myklebust Verft AS
3. Fitjar Mekaniske Verksted AS
4. Sletta Verft AS
5. Salthammer Båtbyggeri AS

Key financials



Biotechnology





About the segment

Biotechnology refers to the application of biological technologies in product research and development. Modern biotechnology has been used in aquaculture with regard 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

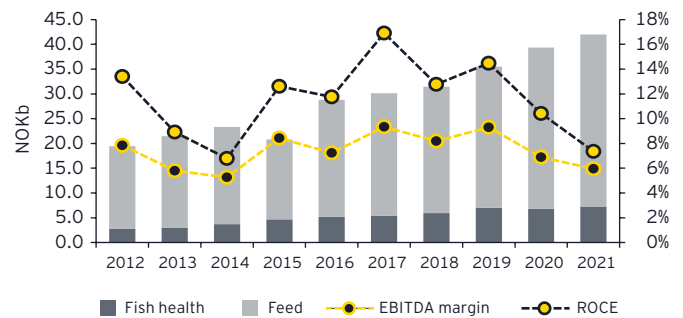
Segment highlights

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

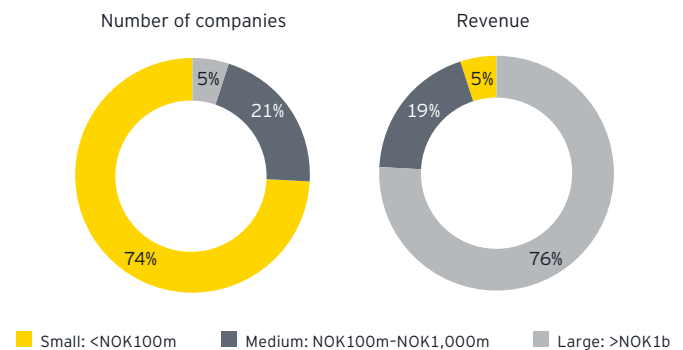
The biotechnology segment has seen substantial growth in the past decade, with a compound annual revenue growth rate of 8.9% from 2012 to 2021. The growth has been positively influenced by high salmon prices and stagnating volume due to biological issues, resulting in higher demand for healthy and efficient fish feed, fish medicines, vaccines, etc., to increase production.

While the revenue growth rate subsided, the EBITDA margin increased steadily from 2016 to 2019. The segment experienced double-digit revenue growth from 2018 to 2019 and 2019 to 2020. At the same time, the segment experienced a record-high EBITDA margin in 2019 (9.4%), with a significant drop in margins in 2020 (6.9%) and 2021 (5.9%). Significant revenue growth and positive margin development were observed in both the high-volume and low-margin feed subsegment, as well as in the high-margin fish-health subsegment from 2018 to 2019. From 2019 to 2021, the feed segment experienced lower margins despite continued revenue growth, primarily driven by higher raw material prices and competition. The fish health segment saw its margins drop from 17.7% to 15.5% despite revenue growth from 2020 to 2021. We observe some companies reporting higher electricity costs as an explanatory factor for decreased margins in 2021.

Key financials



Segment composition (2021)



Fish health

Feed

Fish health

The financial results in the fish farming industry depend on healthy and high-quality fish. Entities within the fish health subsegment provide products, services, research and development projects that are crucial for maintaining and improving fish health in the global aquaculture industry. The subsegment also includes the breeding and genetics companies that supply genetic material (i.e., fish eggs or fry) to the fish farmers. 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 challenges

Biological issues remain a significant challenge for Norwegian salmon farmers. Sea lice still represent 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 and mechanical and biological

methods for lice removals. Several companies within the fish health subsegment have provided medicinal treatments for combating sea lice, and they are continuously developing new and improved pharmaceuticals.

Entities within the fish health subsegment invest heavily in research for finding new, sustainable and efficient solutions for battling sea lice and other aquaculture-related biological issues. However, despite the effort, the Norwegian Veterinary Institute concludes in its 2022 edition of the Fish Health Report that more salmon than ever died of a too early death in 2021. They note that the situation is marked by various diseases and lice treatment, putting a strain on the fish.

Revenue and margin change driven by selected industries

The focus on fish health and biology in the aquaculture industry has been the driver behind the revenue and margin growth in the fish health subsegment over the last decade. In 2020, both revenue and margins decreased, with revenues bouncing back with a 6.2% growth in 2021. The EBITDA margin dropped from 17.7% to 15.5% despite higher revenues. Margins are under pressure, and we observe that, among others, increased electricity cost has negatively impacted margins. We also note



that pandemic restrictions have limited the operational activity for some players, limiting their ability to go through with site visits, etc.

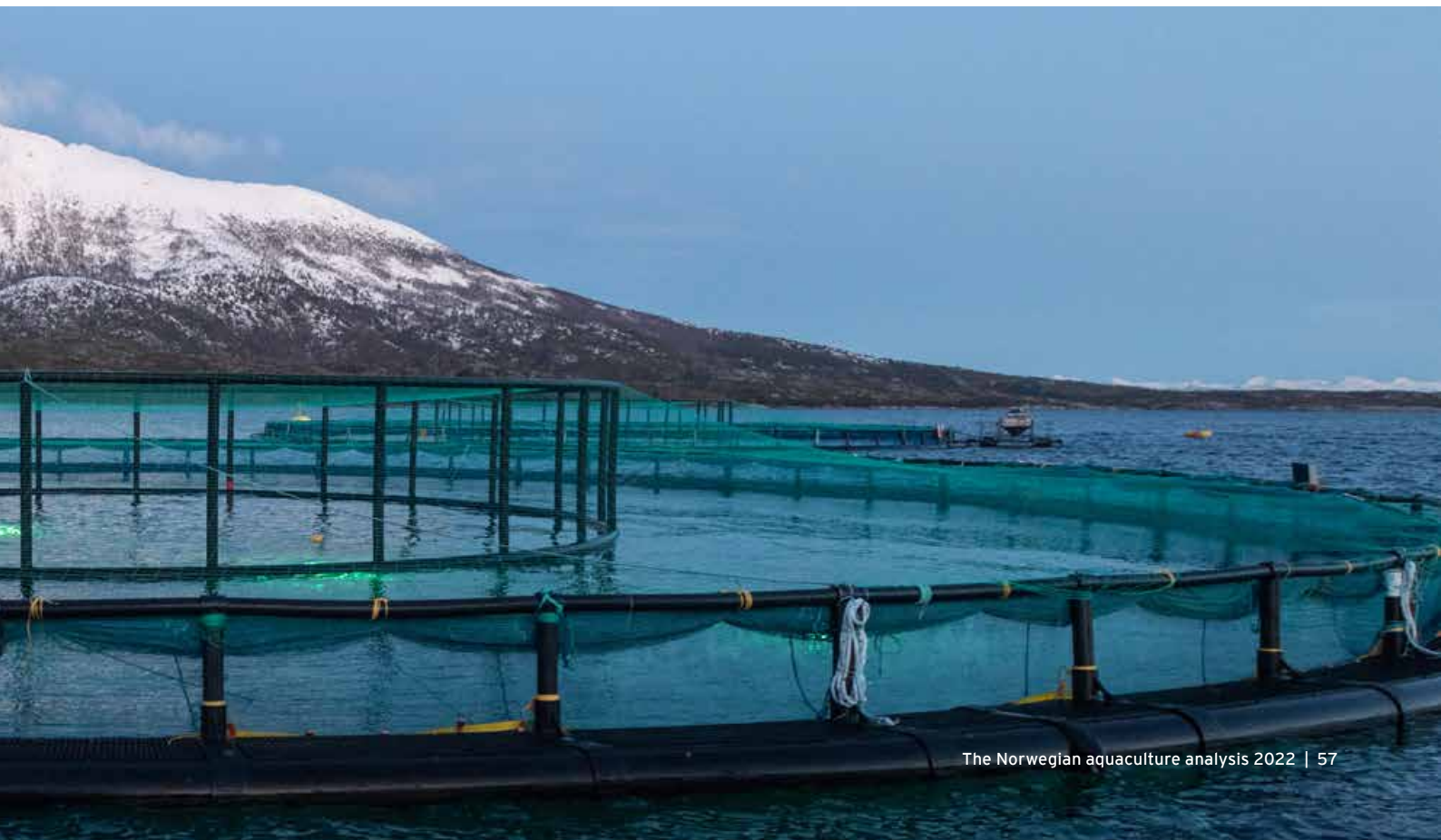
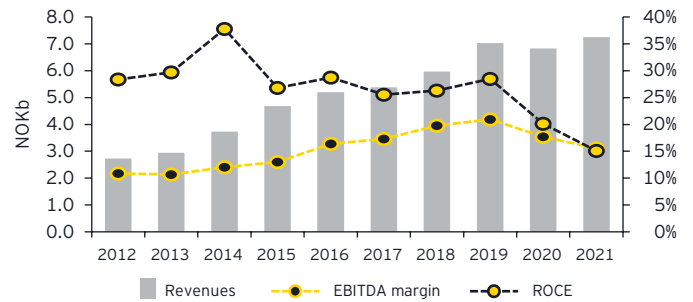
The 2020 reduction was driven by two groups of companies. The cleaner fish companies saw a significant drop in both revenues and margins from 2019 to 2020, and the trend continued in 2021. The volume of cleaner fish sold in 2021 has not been lower since 2016.

In 2020, the breeding and genetics industry was impacted by the pandemic, specifically the export of their goods. This resulted in the production of genetic material that they were unable to sell. These companies saw both revenue and margins increase in 2021, with revenues reaching an all-time high.

Top five companies (2021 revenues)

1. PHARMAQ AS
2. STIM AS
3. Veterinærmedisinsk Oppdragssenter AS
4. Nofima AS
5. Aquagen AS

Key financials



Fish health

Feed

Feed

The feed subsegment includes feed producers and companies producing and supplying input factors to feed production. Feed represents about half of the total production cost for salmonids and contributes to approximately 95% of the carbon footprint in conventional salmon farming. 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 economic, environmental and biological point of view. While the feed producers included in the feed subsegment produce feed and products for other species as well, salmonid feed makes up a significant amount of the total feed produced.

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 '90s, today, conventional marine materials only constitute between 25%-30% of the average Norwegian fish feed. Therefore, the long-chain omega-3 fatty acid content in farmed salmon has declined. However, the feed procurers are investing heavily in finding alternative sources of omega-3, including by-products 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.

Continued revenue growth

The subsegment had a steady but diminishing revenue growth from 2011 to 2018, and the EBITDA margin was virtually unchanged from 2015 to 2018. This is largely explained by increased competition in the feed subsegment following Mowi's entrance to the market in 2014.

In both 2019 and 2020, the subsegment experienced double-digit revenue growth (not seen since 2015), and the EBITDA margin increased to 6.4% in 2019 but decreased to 4.6% in 2020. The massive revenue growth in the subsegment was driven by higher sold volumes of feed because of the observed growth in biomass and harvest volume.

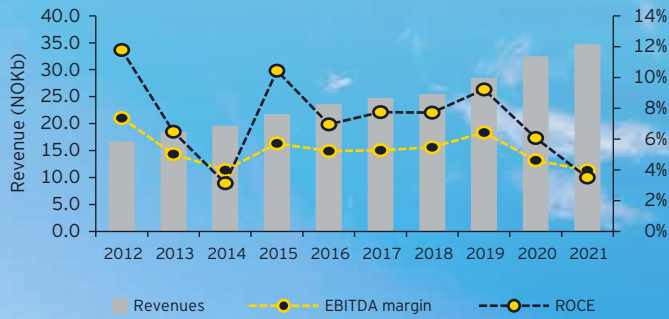
In 2021, revenues increased by 6.8% because of larger production volumes, but the EBITDA margin dropped further to 4.0%, the lowest level seen since 2014. Higher raw material costs have resulted in increased pressure on margins. The lower margins combined with higher capital employed also explain the drop in ROCE from 9.2% in 2019 to 3.5% in 2021.

Isolating the largest feed producers, we observe steady margins of around 3.5% in the 2020 to 2021 period and a double-digit revenue growth of 12.2%. Feed producers report increasing costs of raw materials and continued high competition in 2021, and we note that this will continue in 2022 with rising inflation. We expect the increasing cost of raw materials to materialize as a higher cost of goods sold for the salmon producers going forward.

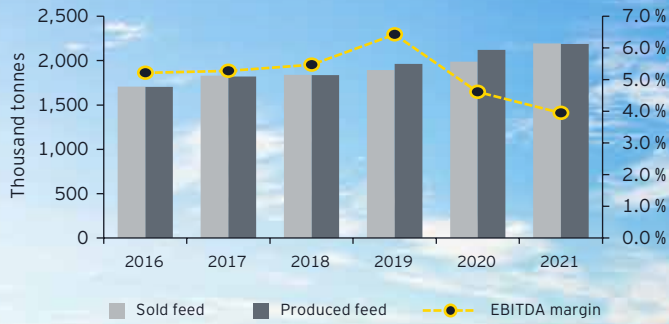
Top five companies (2021 revenues)

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

Key financials



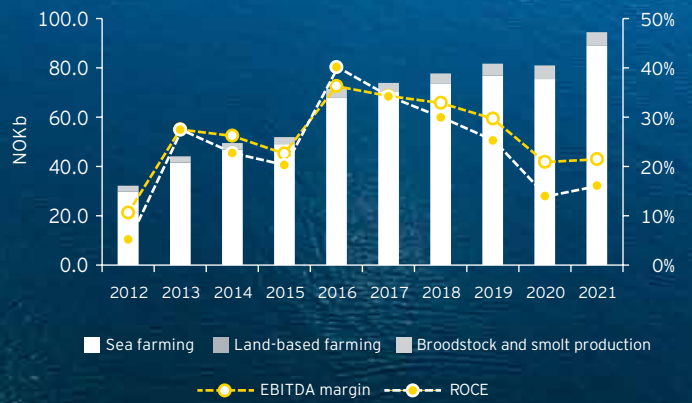
Feed EBITDA margin and volume development



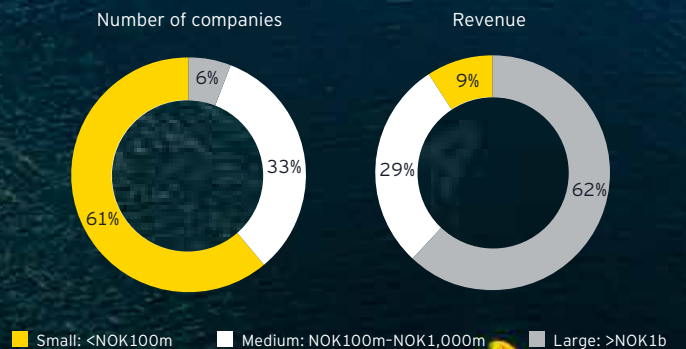
Production



Key financials



Segment composition (2021)



Technical solutions

Biotechnology

Production

Distribution

Processing

About the segment

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

We have included land-based farming as a separate subsegment. The current production volume in this subsegment is very limited but given the current number of identified land-based projects, it may potentially become an important complementary production method in Norway. However, how many of these projects will materialize remains to be seen.

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

- ▶ Broodstock and smolt production
- ▶ Sea farming
- ▶ Land-based farming

As ensuring 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 for the broodstock or eggs and in handling and vaccination of fry during the freshwater stage.

The segment consists of more than 200 companies.* However, a relatively small number of companies account for most of the value creation. In 2021, the 10 largest companies had a market share of about 54%, measured by revenue.

Segment highlights

The production segment has experienced substantial growth from 2012 to 2021, with a notable acceleration from 2016, driven by a significant increase in prices and favorable currency exchange rates for exports.

As a result of the increased profitability and higher 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 biological and environmental issues. These challenges materialize in higher costs and are, together with changes in the salmon price, a key reason for the decline in the EBITDA margins in the 2016 to 2020 period (from 36% to 21%). In 2021, EBITDA margins increased to 22%, primarily driven by a higher salmon price.

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 sustainable growth in volume. Biological challenges and diseases are two of the major concerns the industry faces going forward.

There has been a significant increase in research and development (R&D) over the last few years to tackle the challenges facing the industry today. 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.

A new tax regime awaits from 1 January 2023

On 28 September 2022, the Norwegian government introduced an additional resource rent tax of 40% for the sea farming segment, which will be applicable from 1 January 2023. There was no prior notice, and it came as a surprise for the industry and its investors. While the industry awaits how the actual new tax regime will come into play, the temporary consequences have been significant, with large drops in market caps of listed sea farming entities, postponed investments (in particular in smolt and processing facilities), temporary layoffs in the processing industry and 30% lower auction prices for licenses in October 2022 compared with August 2020. It is yet highly uncertain how the resource rent tax will impact the industry going forward. Please refer to separate articles in this report for more details.

Broodstock and smolt production Sea farming Land-based

Broodstock and smolt production

The companies in this subsegment are specialized in broodstock and smolt production. Some of the companies operate on a stand-alone basis, while others are owned fully or partially by sea farmers or other industry players.

As the industry faces increasing production challenges related to sea lice and diseases, the broodstock producers put a lot of effort into 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 the growth rate.

Smoltification is the biological process that makes young fish ready for the transition from freshwater to seawater. Fish that has undergone this process is called a smolt. This is the middle stage of the production cycle and is operated by the smolt producers. In specialized fish farms where conditions are optimized, the smoltification process takes 10 to 16 months.

Stable growth

In the last decade, these companies have experienced continuous revenue growth, with increasing EBITDA margins in the period after 2018. This trend shifted in 2021, with both a revenue decline and a drop in margins. However, this is somewhat misleading, at least in terms of revenue development, as the primary reason for the decrease is mergers, where companies previously vertically intergraded through separate entities are now merged.

The margin drop is driven by a few entities. A combination of maintenance and upgrades resulted in one player having significantly fewer smolt generations in 2021. Furthermore, there was fear of illness, resulting in the destruction of fish.

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 smolt (250 g+) has been introduced in the market. The larger smolt is typically

referred to as post-smolt. Today, there are smolt producers producing smolts of up to 1 kg. The reason for using larger post-smolt is to reduce the time in the 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. While the post-smolt initiatives are still in their initial phase, preliminary reports from farmers indicate a reduced need for delousing and reduced occurrences of PD.

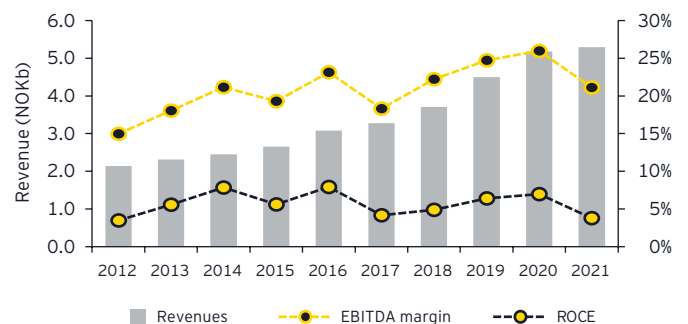
Recirculatory aquaculture system (RAS) technology

As RAS technology becomes more developed, we see an increase in land-based smolt facilities based on this technology. RAS is a way of recirculating water in fish tanks, enabling companies to produce large quanta of fish with 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.

Top five companies (2021 revenues)

1. SalMar Settefisk AS
2. Nordlaks Smolt AS
3. Helgeland Smolt AS
4. Osland Stamfisk AS
5. Tytlandsvik Aqua AS

Key financials



Impact of the suggested resource rent tax

The suggested resource rent tax regime is supposed to be cash-flow-based, and capex can be subtracted in full the year it is incurred. However, based on the proposal, it appears that this is applicable only to capex related to the sea phase and not investments in smolt facilities on land, which represent large investments for the vertically integrated sea farming companies. This has led to an investment halt in Q4 2022. Billions of NOK in planned investments have been put on hold until the new tax regime workings are clearer.



Broodstock and smolt production

Sea farming

Land-based

Sea farming

The final step in the production process is sea farming, which is by far the largest subsegment in the Norwegian aquaculture industry when measured by EBITDA contribution. This is where the fish are put into seawater and grown until harvest size (about 4kg–5kg). This process takes about 10 to 24 months, depending on smolt size and other growth factors.

High salmon prices since 2016

Over the last few years, the sea farming segment has experienced record-high profitability as a consequence of all-time-high salmon prices. This resulted in EBITDA margins above 30% in the 2016 to 2019 period.

While demand has increased in recent years, sea farmers have struggled to increase supply correspondingly due to production constraints, sea lice and diseases. Consequently, the average salmon price for farmed Atlantic salmon more than doubled from 2012 to 2016 (to above NOK60) and has remained fairly stable at NOK60 until 2020, when it dropped to NOK55, with an increase in 2021 to NOK58.

Volume growth in 2019–21 after several years of stagnating production volumes

In 2019, the segment observed a notable increase in harvest volume for the first time in several years, with approximately 7% volume growth compared with 2018. In comparison, the compound annual volume growth rate from 2014 to 2018 was merely 0.4%. The volume growth is predominantly explained by an increase in the number of grow-out seawater licenses for salmon and trout in Norway over the last five years (from 990 in 2016 to 1,098 in 2021) and an increase in the number of development and R&D licenses from 98 in 2016 to 153 in 2021. The volume growth continued in 2020, albeit with only 2.6% compared with the record high volumes in 2019. In 2021, record-high volumes were once again harvested and sold, and for the first time since 2012, double-digit growth was achieved at 11.6%.

Stable cost per kg from 2020 to 2021

Over the last few years, disease, sea lice, extreme weather and other operational and biological challenges have led to a significant increase in production cost per kg. According to our analysis, cost per kg has spiked by almost 25% since 2016.

Please note that our analysis is simplified as we look at the aggregated figures, i.e., annual accounts for each company. Thus, we are not able to differentiate between production costs and other costs, meaning that our numbers will deviate from the pure-play numbers reported by the Directorate of Fisheries.

The negative cost trend subsided in 2021, and cost per kg was, somewhat surprising, almost equal to that of 2020. However, we note that according to the statistics from the Directorate of Fisheries, they found the 2021 cost per kg to be NOK41.7, up by NOK1.5 from 2020. The cost per kg observed in our figures might be explained by higher farming volumes, resulting in the fixed cost base being distributed on a higher volume.

In 2020, we saw that higher cost per kg combined with a lower revenue/kg resulted in the lowest EBITDA margin (20.7%) for the segment since we started working on the Norwegian Aquaculture Analysis. The 2021 figures tell much the same story in terms of margins, although we see a slight increase to 22.7% on account of somewhat higher prices and stable cost per kg.

The 2021 EBITDA margins align with the 2015 margins, even though the 2021 salmon price is more than 35% higher than in 2015.

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 drive operating costs. Delayed growth, starvation and forced early harvest curtail harvest volumes and represents less visible costs that are also present due to sea lice. The current high inflation regime is expected to increase the cost to stock, resulting in an increased cost of harvested fish going forward.

High investment levels

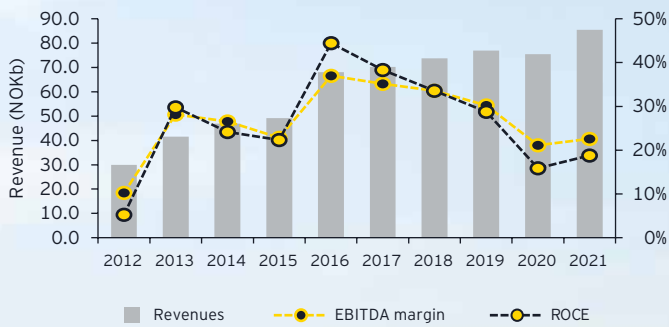
Over the last couple of years, there has been a significant increase in capital expenditure and R&D investments, with an increase in CAPEM of approximately 40% from 2017 to 2021. R&D investments are especially related to alternative sea farming solutions, like closed and semi-closed facilities at sea and offshore farming solutions, which can potentially increase supply in the long run.

Top five companies (2021 revenues)

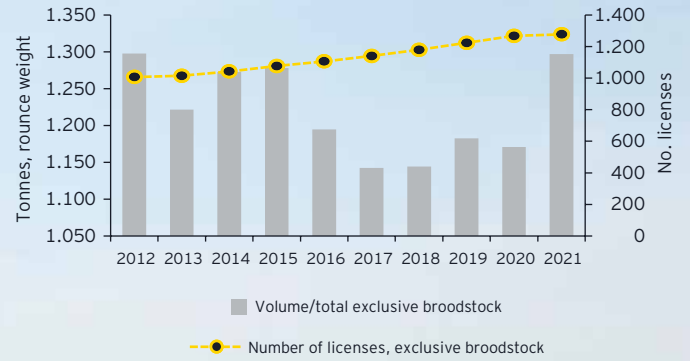
1. Mowi ASA
2. SalMar Farming AS
3. Cermaq Norway AS
4. Lerøy Midt AS
5. Nordlaks Oppdrett AS



Key financials

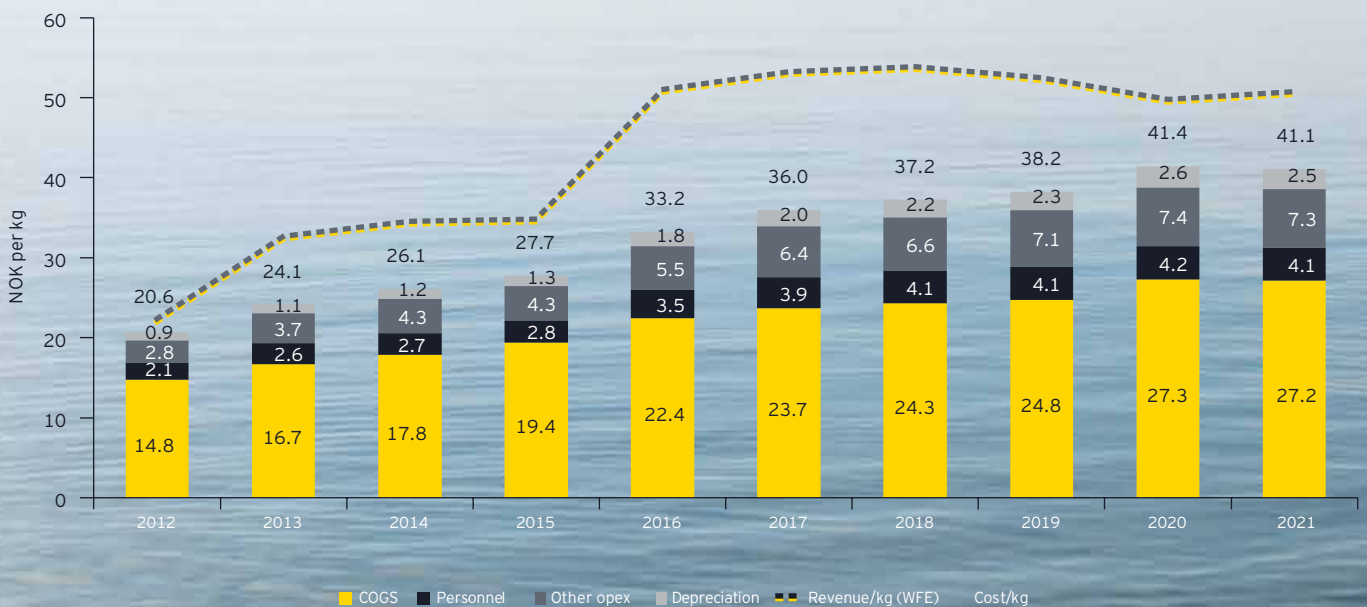


Development in number of licenses and harvest volume per license



Source: Directorate of Fisheries

Cost per kg (WFE)



Broodstock and smolt production

Sea farming

Land-based

Land-based farming

The stagnating volumes in the sea farming segment (traditional net pen production) combined with increased demand over the last years have been the driving forces behind the emergence of land-based farming. Over the last years, we have seen tremendous growth in planned land-based production projects as presented in previous versions of this report (although how many will materialize is yet to be seen), with several of these projects planned in Norway. Land-based production can potentially be an important complementary production method to supply the market with the much sought-after product.

There is a large number of land-based farming projects in Norway. Even though we still have quite some time until several of these start with full-scale production, we have included them in this year's analysis as a separate part of the production value chain.

However, since only Nordic Aquafarms AS had revenues from salmon production in Norway in 2021, we have presented the top five companies based on planned capacity in Norway instead of basing the list on revenue. In 2022, Salmon Evolution started harvesting its first generation of salmon, whereas Andfjord Salmon is growing its first batch of fish which is planned to be harvested halfway into 2023.

Several of the Norwegian projects are based on flow-through technology rather than RAS. This is possible through a combination of sea temperatures and locating the facilities close to the ocean.

Globally, we have identified around 10,000 tons of harvested volumes in land-based salmon facilities in 2021, with slightly higher estimated volumes for 2022 as we approach the end of the year. Please note that our mapping may not provide a 100%



complete picture. Atlantic Sapphire is heading up the game with a harvest of 2,734 tonnes in 2021 (HOG).

It is evident from the actual harvest numbers that the ramp-up of production is going significantly more slowly than anticipated a few years back. An increasing number of large-scale land-based projects have managed to raise sufficient capital and start the construction phase, and several companies put fish in their tanks for the first time in 2022.

However, we have seen several facilities experiencing considerable technical challenges, which have led to fish mortality incidents. It is not always straightforward to assess from the outside whether these are ad hoc incidents or if they represent more permanent technological challenges. From failure comes learning that may gradually reduce the risk for some of these types of incidents going forward.

Despite this, a few players are working hard to steadily increase their harvest volumes, and multiple other companies have reached the stage where they have placed smolt in their facilities in 2022, which will be harvested in 2023. Examples include, but are not limited to, Salmon Evolution, Andfjord Salmon, Proximar and Nordic Aqua Partners.

Top five companies (based on planned capacity)

1. Salmon Evolution (100,000 tonnes)
2. Andfjord Salmon AS (70,000 tonnes)
3. Helgeland Miljøfisk AS (50,000 tonnes)
4. Ecofisk AS (40,000 tonnes)
5. Salfjord AS (36,500 tonnes)



Distribution





About the segment

The distribution segment includes companies offering services within the subsegments:

- ▶ Trading
- ▶ Slaughtering
- ▶ Transportation on sea

Total revenue and margin development for the distribution segment is heavily influenced by the fact that the trading subsegment makes up 90%-95% of revenues. Trading is driven by the 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 demerged their trading business into a separate legal entity this year.

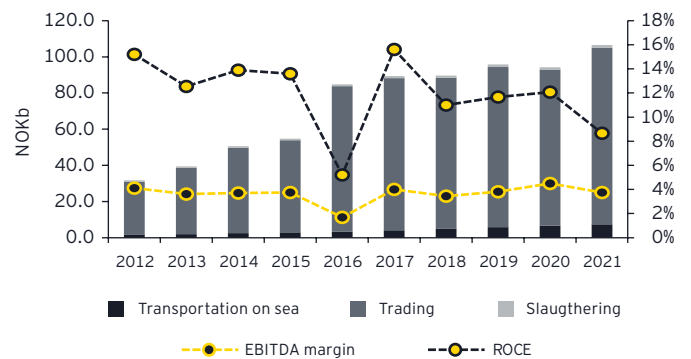
In 2016, there was a significant increase in the salmon price, resulting in a jump in revenues for the traders compared with 2015. Export increased year-on-year in the 2016 to 2019 period, with a small decrease in 2020 driven by a lower sales price.

The export of Norwegian salmonids has steadily increased, reaching new heights every year with the exception of the COVID-19 pandemic year, 2020, which was down 3% from 2019. The HoReCa market was particularly challenging in 2020 due to the pandemic. In 2021, the total export value of Norwegian Salmonids amounted to NOK85b, representing a 15% increase from 2020. The increase is primarily driven by increased export volumes to European markets but also due to increasing prices. Furthermore, a weak NOK as compared with EUR has also been favorable for the exporters. Demand growth has been supported by the gradual reopening of the HoReCa; however, a challenging logistics and freight situation has affected the industry negatively.

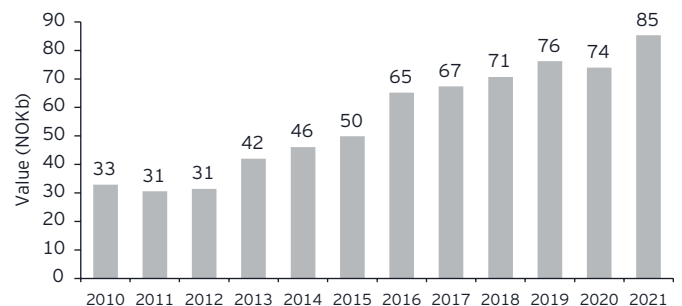
The overall export development confirms the continued high demand for Norwegian salmon. Thus, an increase in salmon supply through more farmed fish will be welcomed in the market.

Transportation on sea continues its impressive revenue growth also in 2021, and we also observe a margin increase. As such, this subsegment continues to perform well at the back of increased harvest volumes and the continued biological challenges in the sea farming subsegment.

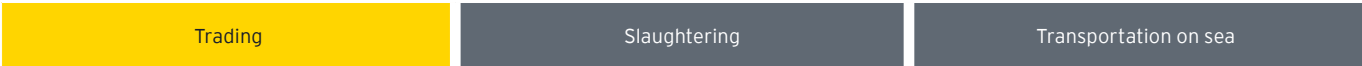
Key financials



Norwegian salmon and trout exports



Source: Directorate of Fisheries



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 subsegment.

Volume growth

Revenue in the trading segment is closely related to the volume of fish sold and the price achieved. In 2020, the increase in harvested volumes was not sufficient to make up for the price decrease following the COVID-19 pandemic, resulting in a revenue decrease for the subsegment. With both an increase in sold volumes and price achievement in 2021, we observe an impressive 11% year-on-year growth.

Please note that the large increase in revenue from 2015 to 2016 was driven by both a surge in the price of salmon and the fact that Mowi separated their trading business into a separate company (previously integrated with the production company).

The trading subsegment is a low-margin business. The companies typically sell fish both in the spot market and on fixed-price contracts. Historically, we have observed companies experiencing both favorable and unfavorable fixed contracts, impacting the achieved margins.

Norwegian exports

The vast majority of Norwegian-produced salmonids are being exported, and Europe is by far the most important export market. Approximately 75% of the 2021 export volume went to Europe, compared with 79% in 2020. Increased farmed volume led to a record-high export volume of Norwegian salmonids in 2021.

According to the Directorate of Fisheries,¹ the total export value of Norwegian Salmonids was NOK85b in 2021, an increase from NOK74b in 2020. The increase was predominantly driven by volume growth, but increased prices also contributed. Since most of the volume is sold in EUR, the weakening of NOK vs. EUR positively impacted the export value. The gradual reopening of the HoReCa industry supported the demand growth; however, supply chain disruptions and a strained freight situation remained challenging for the salmon export market.

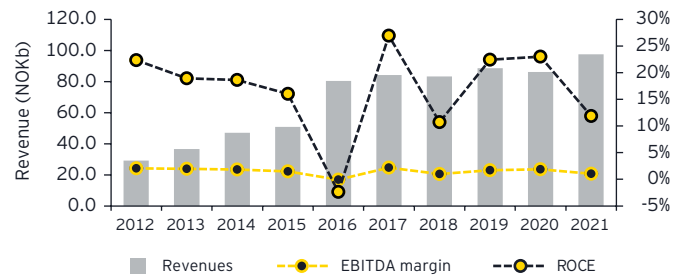
The export of salmonids reached a new all-time high in 2021 with a total export volume of 1,487k tonnes (13% increase vs. 2020).

Export volumes have remained strong in 2022,² with year-to-date export volumes as of mid-December 2022 amounting to 1,389k, slightly behind the same time last year's volumes of 1,426k.

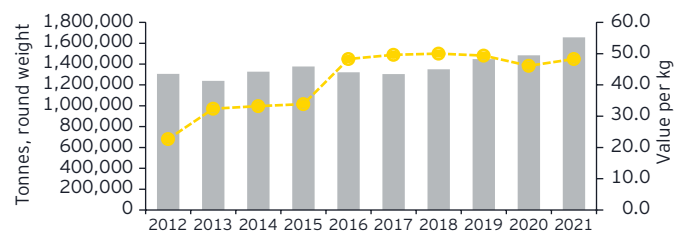
Top five companies (2021 revenues)

1. Lerøy Seafood AS
2. Mowi Markets Norway AS
3. SalMar AS
4. Seaborn AS
5. Norway Royal Salmon AS

Key financials

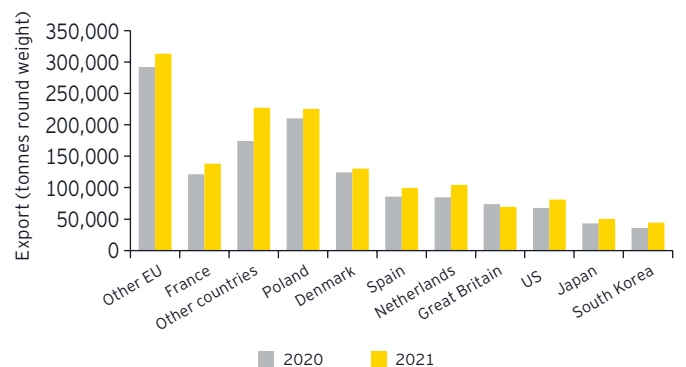


Sold volumes of slaughtered fish (round weight)



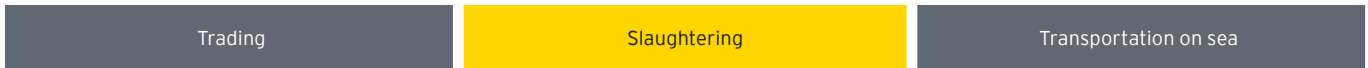
Source: Directorate of Fisheries

Export markets for salmon (volume)



Source: Directorate of Fisheries

1 "Nøkkeltall fra norsk havbruksnæring 2021," Directorate of Fisheries.
 2 "Akvafakta uke 51", Akvafakta.no, 11.11.22.



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.

Considerable drop in margins in 2021

A larger harvest volume will naturally give the slaughtering subsegment more work, and as such, an increase in revenue is expected when harvested volumes increase. The negative EBITDA trend seen from 2016 to 2019 appeared to be broken in 2020, but the decline continued in 2021. The EBITDA margin for the segment was 5.8%, representing the lowest point observed over the last decade.

We note that as the subsegment is relatively small, the financial performance of a few companies can have a high impact on the total subsegment's performance.

This is evident when analyzing 2019. One of the larger entities accounted for approximately 80% of the year-on-year revenue growth for the subsegment but was not able to make this growth profitable and reported an EBITDA level more or less in line with 2018. It is interesting to note that in 2020, the same company maintained a record-high revenue but was able to be more profitable than in 2019. Adjusting for this entity, the remainder of the subsegment performed in line with the previous years, with a slight revenue increase and an EBITDA margin of approximately 11% in 2019 and 13% in 2020.

The low EBITDA margin in 2021 was largely influenced by a 72% revenue decrease for one of the companies as a result of challenges in connection with the startup of a new harvesting plant, resulting in limited production capacity this year, combined with a relatively fixed cost base.

Investing in new technology

The segment is investing in larger slaughtering facilities with more modern technology, such as automation and robots, in order to improve capacity, efficiency and profitability. Through optimization of every step – from the pump systems that transport the fish into the slaughtering facility to electric stunning and efficient chilling technology – new state-of-the-art slaughtering facilities are being invested along the Norwegian coastline, often with a price tag in the NOK0.5b-NOK1.0b range. Capital employed increased by more than 50% in 2021, which is quite substantial, a growth driven by high investment in tangible assets, i.e., new harvesting plant and equipment. This increase,

combined with lower margins, resulted in a ROCE of only 2.8%, down from 10.9% in 2020.

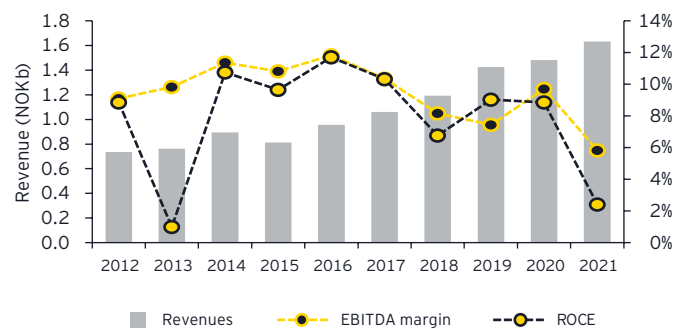
It remains to be seen if the new resource rent tax regime will impact the incentives and ability to continue these investments going forward.

In 2018, Hav Line introduced a vessel with slaughtering facilities onboard with a plan to sail directly to Denmark. This brought on some political turmoil and led to the introduction of a regulatory requirement to sort farmed fish in Norway before export. Hav Line has since received a 10-year dispensation from this requirement. Given the current political sentiment and the goal to secure workplaces along the Norwegian coastline, it seems unlikely that such a dispensation will be given to others soon, i.e., this option is limited by Hav Line's current capacity.

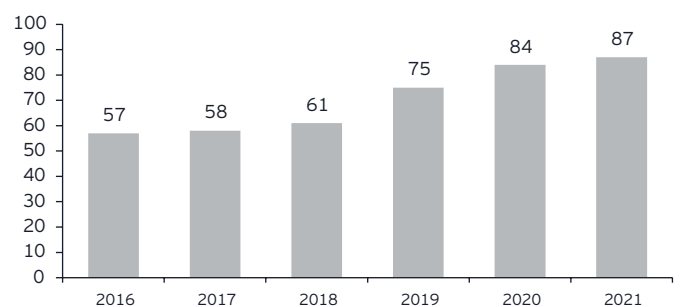
Top five companies (2021 revenues)

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

Key financials



Number of approved harvesting plants in Norway



Source: Directorate of Fisheries

Trading

Slaughtering

Transportation on sea

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/or processing plants. The segment also includes companies that focus on the 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 fish.

As barriers to entry are high in terms of required capital expenditure, the segment remains dominated by a few players. The five large companies make up approximately 47% of the revenue and approximately 53% of the EBITDA in the subsegment in 2021 (numbers are higher if you include all the legal entities in the same groups as the top five).

Continued revenue growth

Transportation by sea has experienced tremendous growth over the last decade. This subsegment has thrived on the biological issues in the production segment, as a large share of the revenue growth has come from the increased treatment of AGD, sea lice and such.

This has also contributed to high EBITDA margins in this subsegment, especially in the period from 2015 to 2018. The substantial drop in EBITDA margins from 2018 to 2019 is misleading due to vessel sales in several entities in 2018 significantly impacting the EBITDA margin that year. If we adjust for various vessel sales, we still observe margin variations and find that margins have decreased from above 40% in 2015-17 to around 38% in 2021.

Isolating the well-boats, we observe relatively stable margins in the 2015 to 2021 period, ranging from ~41% to 46%. Adjusted for vessel sales, the well-boat segment achieved an EBITDA margin of 45% in 2021, a slight increase from 2020.

The feed transportation entities report lower margins in 2019-21 compared with the previous periods, with a significant drop from 30% in 2018 to 23-24% margins in the 2019 to 2021 period.

Processing vessels represent a growing venture area within aquaculture. We have identified multiple entities that are dedicated to processing vessels. The growth in this subsegment is predominantly attained through the addition of more vessels, and in 2021 we observe an EBITDA margin of 54%, an 8 pp increase from 2020.

Continued investment willingness

High margins fuel willingness to invest. Several of the larger players are announcing that they are continuing the already ongoing expansion of the well-boat fleet. Many new vessels have entered the market, as illustrated in the adjacent graphics, and multiple newbuild projects are still under construction. We have noted a current pipeline constituting 20 vessels for delivery in 2022-24; however, limited capacity is contracted from 2025 and onward.

Whether the new vessels will replace existing vessels or they will increase the active Norwegian fleet, it could have different effects on the margins for this subsegment. Some existing vessels are likely to be sold or moved to other markets (such as Chile, Scotland and Canada). How the supply dynamics will play out in the years to come will depend on the net capacity added to the Norwegian market.

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.

Continued consolidation

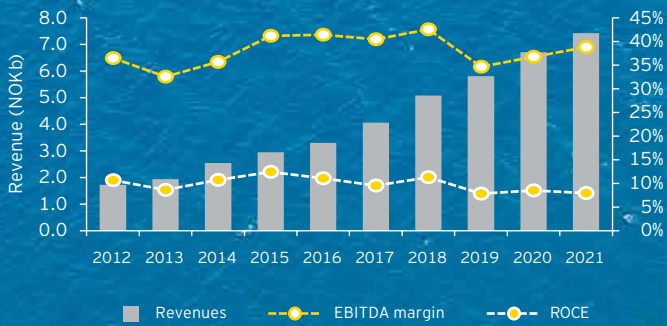
The subsegment has seen multiple transactions over the last couple of years, and we expect this trend to continue as we note a continued strong M&A appetite for these types of companies. We expect both further industry consolidation as well as acquisitions by financial investors.

We also observe that the trend, whereby SMBs and family-owned businesses combine forces to invest in well-boats for joint use, continues. These entities are motivated by the high market rates as well as higher operational flexibility.

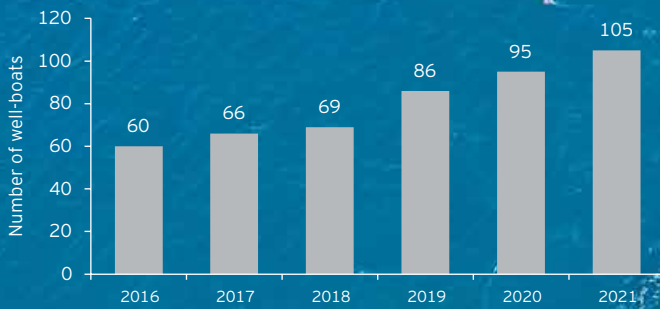
Top five companies (2021 revenues)

1. Rostein AS
2. Sølvtrans Rederi AS
3. Eidsvaag AS
4. Sølvtrans Rederi III AS
5. Norsk Fisketransport AS

Key financials



Number of well-boats



Source: Directorate of Fisheries, Kystrederiene

Processing



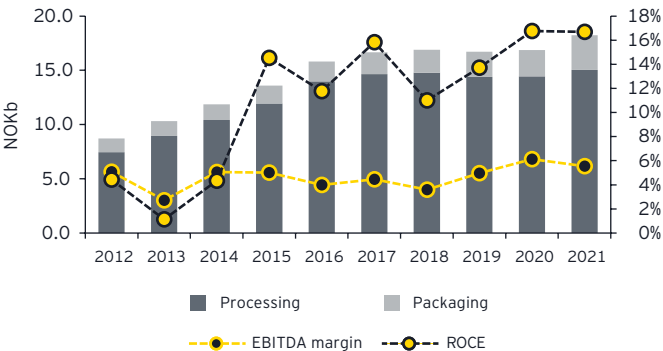


About the segment

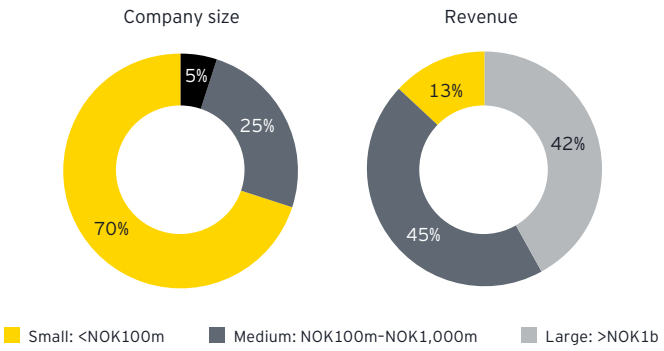
The processing segment includes companies offering services primarily related to secondary processing and companies producing different types of packaging.

We have divided the segment into two subsegments:
 1. Processing
 2. Packaging

Key financials



Segment composition (2021)



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 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 therefore underestimates the total size of the subsegment. Another factor is that the majority (approximately 80%) of Norwegian salmon is exported for further processing.

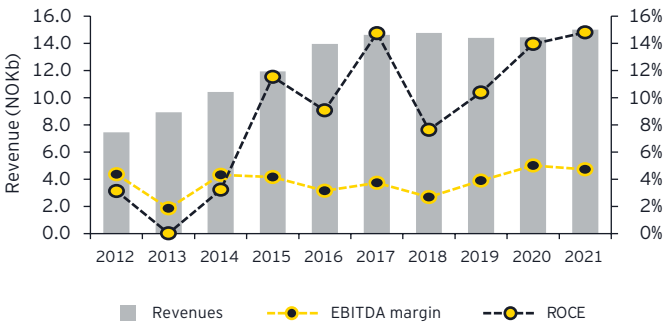
Stable revenue and margin levels

While margin levels have been fairly stable over the last decade, the subsegment has experienced high revenue growth until 2016, when the revenue plateaued. This must be seen in the context of the harvested volumes of salmonoids in Norway.

Top five companies (2021 revenues)

1. Sekkingstad AS
2. Hofseth AS
3. Hofseth Aalesund AS
4. Norsk Sjømat Stranda AS
5. Nordlaks Produkter AS

Key financials



Processing

Packaging

High-cost segment

As evidenced by the EBITDA margin, secondary processing is still demanding and costly in Norway due to labor-intense production and the cost of raw materials influenced by high salmon prices.

There have been discussions on whether more secondary processing, i.e., 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 (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 main countries that receive round-weight fish and process these prior to redistribution.

It's worth mentioning that the export share of processed salmon has increased over the last couple of years. As of mid-December 2022, fresh and frozen salmon fillets accounted for 16% of the total exported volumes.

The resource rent tax proposal has suggested that a norm price based on NASDAQ spot prices will be applied to determine the taxable income for sea farming companies and not the actual prices achieved in order to avoid transfer pricing issues in vertically integrated groups. The final arrangement is yet to be determined, but due to the high uncertainty, the market for fixed price contracts from the sea farming segment to the processing segment has been nonexistent since 28 September 2022, resulting in less processing in Norway and more export of round fish. The sea farming companies do not want to risk being taxed based on a norm price that differs (is higher) than what they agree in fixed price contracts. The norm price can also be lower than the actual contract price achieved; however, it is not unusual that fixed-price contracts, on average, have lower prices than spot prices.

Whether or not the suggested norm price will come into effect, and in what way, may impact the processing segment in Norway going forward.

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. In addition, several companies deliver products to the aquaculture industry, but where the share of revenues from the aquaculture industry may not be high enough to be included in this analysis. Due to this, revenue for this subsegment may be somewhat misrepresented.

The products of the packaging subsegment are vital in keeping fish and fish products fresh during transportation and storage. Such products enable longer shelf life 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 comes up with new solutions.

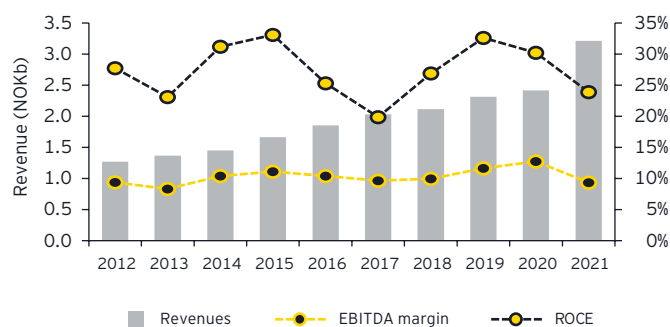
The subsegment has experienced steady growth, with a revenue CAGR of 7.7% from 2015 to 2020, with a significant revenue increase in 2021. This is not a pure-play segment, and some of the companies also deliver various solutions to non-fish farming-related industries. As such, the growth is not only driven by increased demand in the aquaculture industry.

Margins have remained relatively stable at around 10%, with an uptick in 2019 (11.7%) and 2020 (12.8%), followed by a reduction to 9.4% in 2021.

Top five companies (2021 revenues)

1. Vartdal Plastindustri AS
2. Bewi Eps Norway AS
3. Bewi Food AS
4. A/S Nesseplast
5. Accon AS

Key financials





Methodology and definitions

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 is 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

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.

Calculations

EBIT: earnings before interest and taxes

EBITDA: earnings before interest, taxes, depreciation and amortization

Capital employed: fixed assets + immaterial assets (ex. licenses) + net working capital

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

CAGR: compound annual growth rate

WFE: whole fish equivalent

HOG: head on gutted

IFRS: International Financial Reporting Standards

R&D: research & development

CCU: carbon capture and utilization

MAB: maximum allowed biomass

pp: percentage points

SMBs: Small medium business

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