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The greening of Norwegian salmon production

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Abstract

The Norwegian salmon industry has, in terms of production and economic results, been a great success. However, due to environmental problems such as sea lice and escapes, the industry encounters increasing resistance from many quarters, headed by the wild salmon sport fishers. In order to improve the image of the industry, the fisheries authorities have suggested four new reforms that all contribute to the greening of the industry. At present, the outcome of these reforms is uncertain. The article discusses the pros and cons of these reforms. It sees them as an introduction to the next large battle for space, which is due to take place if the salmon industry is going to expand as projected.

Keywords: Salmon production; «Greening»; Management measures; Institutional reform; Environmental indicators

The Norwegian aquaculture industry is at the crossroads. In the last 45 years, the production of salmon has increased from less than 1,000 tons to 1.2 million tons in 2014. The industry has, over the years, become a financial success with significant repercussions in many coastal communities. It is frequently referred to as “a Norwegian answer to IKEA”¹ and is seen as one (of a few) promising sectors in terms of growth when the petroleum industry gradually has to be reduced. The future prospects are enormous, but the industry is also facing increasing opposition from many different quarters in Norwegian society. Currently, the main focus is on salmon escapes and the incidence of sea lice, which are believed to have significant negative effects on wild salmon and trout. Sport fishers, professional fishers, conservationists and recreational groups have demanded full stop and no further increase in production, and they have been heard. Both the current and the former Ministers of Fisheries have publicly declared that further growth is impossible until the problems of sea lice and escapes have been solved or, at least, considerably reduced. Meanwhile, the fish farming companies have shown that they have the capacity and market access for an increase of production. In this situation, both fish farmers and authorities have been searching high and low for acceptable new solutions. Is it possible to increase production while at the same time reducing the ecological footprint of the industry? In this article I shall describe four such initiatives, assess their possible effects and discuss whether these instruments may contribute to a more sustainable aquaculture industry, not only in Norway but also in other salmon producing countries where Norwegian interests are involved. The article is based on several previous projects (Hersoug and Johnsen 2012, Johnsen et al. 2014, Andreassen et al. 2014, Hovland et al.

2014), interviews with key stakeholders, a review of public documents and, not least, 40 years of contact with the aquaculture industry.

Theoretical perspectives on aquaculture regulations

Natural resource governance is based on interventions that regulate human behaviour (Berkes 2008). These interventions are defined on the basis of assumptions about how human actions affect nature (Pálsson 2006). Because nature is not directly accessible, it has to be represented through specific governable objects, which in turn become the foundation for defining interventions (Johnsen et al. 2009, Johnsen 2013). Governable objects are constituted when the components and processes in an ecosystem are represented symbolically. Specific techniques are used to translate and assemble the components and processes into bounded, homogenous objects that can be measured, quantified, or modelled in ways that make it possible to create specific intervention mechanisms for governance, as is done with a fish stock or with the maximum allowable biomass (MTB) in aquaculture.²

Aquaculture regulations, much like fisheries regulations, are public regulations. That is, they are a distinct type of public regulation. From the early 1970s, there were two main reasons for regulating access to this industry. The first applied to how much should be produced and by whom. Salmon farming was a risky business and overproduction could create bankruptcies and loss of private and public capital. Hence, volume had to be controlled. The authorities also had a plan of using aquaculture as a means to increase employment in rural coastal areas, facing severe problems as the fisheries and processing industry were contracting. Therefore, the right to do fish farming was directed to certain groups or persons. The measure to be used was licensing, combined with limited production volume. The second reason applies to the environment. Fish farming is regulated because it takes place in what is defined as *common property* (coastal sea areas) and because fish farming involves important *externalities*. What one fish farmer is doing may influence not only other farmers in the same area but also other stakeholders in other sectors and industries. Consequently, regulating aquaculture is done for different reasons, but they all depend on having legitimacy—that is, by being accepted as valid by most stakeholders (Jentoft 2004).

Licenses or concessions have been used in Norway for more than 100 years to regulate, among other sectors, hydroelectric power. They were used in regulating access to the fisheries, and were quite familiar when the Ministry of Fisheries was going to limit the number of fish farmers in the 1970s. As pointed out by Mikalsen (1983), the administrative allocation of rights to participation in aquaculture does not imply the elimination of competition, but that access to competition is regulated and normally limited. Licensing certain operators means that these fish farmers are allowed to enter an exclusive market, a market with limited participation. According to Hernes (1978), such licensing may be seen as foreclosing the decisions of the market. Without intervention, the market would have eliminated many operators and, in the next round, probably opened the arena for *other* operators. Hence, the judgment of the market is not effectuated because the effects may be deemed too costly or unwanted in political terms. What is worth noting is that this transfer of responsibility for access from the market to a public hierarchy makes public authorities responsible for the results of the allocation, while the fish farmers acquire status as clients. Hence, the critical issue is how the aquaculture authorities organize the allocation in terms of goals, criteria, and administrative processes (Hersoug 2005).

The environmental aspects of aquaculture had to be regulated by another management measure, namely the allocation of space, or *locality*. Deciding where to place the aquaculture activities thus became part of marine spatial planning. Marine planning is a process whereby coastal space becomes framed as a governable object (Johnsen et al. 2014). Coastal space as a governable object is not equal to the undefined natural space, but a translation of an ungovernable complexity into a defined, governable object that can serve as a foundation for governance interventions. In a marine setting, this takes place when a variety of biotic and abiotic components in a specific location are translated into specific spatial properties that can be defined on a map representing the space.

When aquaculture licenses became freely transferable from 1991 onwards, this was a step in the direction of using the market to a larger degree than before. The authorities were less interested in *who* did the farming than in *how* they farmed. It was not a question of substituting one system for the other (from plan to market), but how to change the mix of the two steering systems. However, such changes do not happen haphazardly. They are mediated through *institutions*. Here we are not going into detail about the many definitions of institutions, but suffice to say that many theories are based on rational choice theory, where institutions are seen as sets of positive (inducements) and negative (constraints) motivations for individuals, in which the individual utility maximization is acting as the dynamic element in the institutional set-up. Against this instrumental perception of institutions, it is possible to supply a more sociological concept, where management institutions are *embedded* in a larger social structure (Polanyi 1944, Granovetter 1985). These authors argue that markets and other coordinating mechanisms are shaped and are shapers of social systems of production (Hollingworth and Boyer 1997). The interconnectedness of social and economic systems works both ways. The crucial point of this theoretical understanding is that politics is not an exogenous variable that can easily be eliminated. Politics is the very essence of resource management, i.e. of allocating scarce resources (Easton 1953).

As pointed out by Holm (2001), modern fisheries management builds on science and, if we are to understand fisheries management, we need to understand the role of science. The same applies to aquaculture management. Science and scientific knowledge have to be seen as institutions. In this respect, I have found it fruitful to introduce a *social constructivism perspective*. A central element of this perspective is *framing*, which may explain why certain solutions have been chosen while others have been neglected or refuted. According to Holm and Nielsen (2007), a frame is a boundary, and framing is the process of producing this boundary. In our case, framing can be used on two levels: first on how problems are perceived and then on how they can be solved. Framing is central in most science and technology studies (STS), but this is not the place to explicate the various positions (see Barnes 1982, Bloor 1991, Collins 1992). Actor-network theory, as developed by Latour (1987, 1993) and other writers in the same tradition, has proved very useful when considering various elements of resource management (Holm and Nielsen 2007, Johnsen 2013).

In our case, the regulation of aquaculture implies the use of two very different sets of management measures; the license regime, which in effect limits the number of competitors, and the locality regulation, which is part of a larger system regulating the use of coastal space. Both systems can be seen as social constructs, but as soon as they are established and fortified by institutions, laws, science, stakeholders and lobby groups

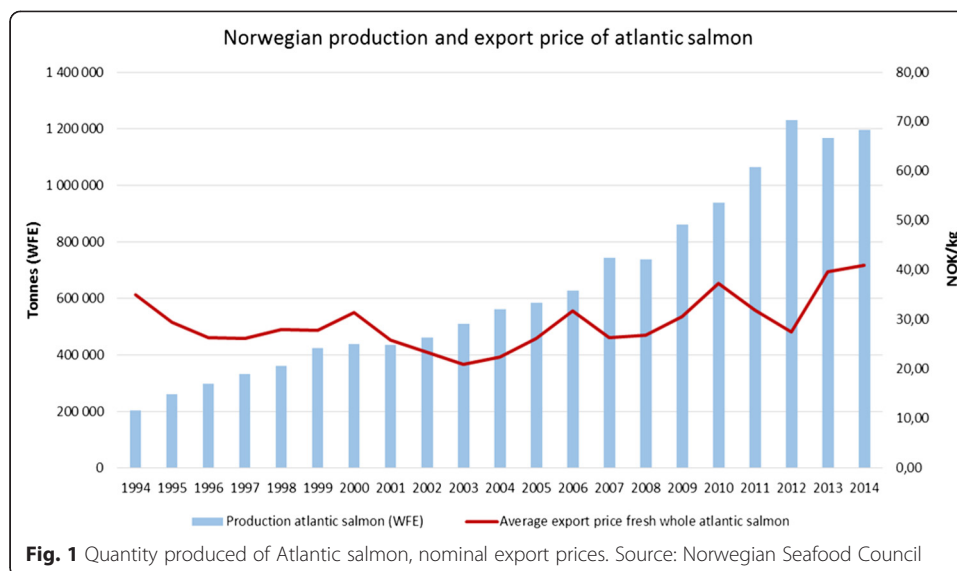
they may be difficult to change. The network created by various types of actors seems stabilized and may be taken as a fact, or as the (only) solution. Consequently, establishing a new regulatory system implies the creation of new institutions (or the modification of old), laws, networks of stakeholders and material artefacts. In our case, a new regulatory regime is critically dependent on the production of knowledge—that is, on science—which in turn can be made operational for management interventions.

Aquaculture—a success or a horror story?

According to the fisheries authorities and the industry Norwegian salmon farming is, per 2015, a great success story. During the last 45 years, the industry has grown from under 1,000 tons to 1250,000 tons (salmon and trout). The average annual growth has been around ten percent, and aquaculture is the most rapidly increasing sector in the entire Norwegian economy. Norway is the world's largest producer of Atlantic salmon (*salmo salar*). Chile is in second place, with about half of Norway's production. Salmon and trout amounted in 2014 to 70 percent of the total value of seafood exports, and salmon farming has thus in a few years taken over the hegemony within Norwegian seafood production. The industry employs approximately 10,000 persons directly, i.e. in producing brood stock, juveniles, on-growth farms, slaughterhouses and directly value-added processing, while derivative effects in terms of production of intermediate goods and services employ around 14,000 persons. Many of these jobs are located in marginal coastal municipalities, which in the same period have experienced a sharp decline in terms of fishing and fish processing. The seafood industry is currently the third largest export industry, after petroleum and petroleum related input factors, and is considered one of the industries that can take over when petroleum activities have to scale down over the next 30–40 years.

The ambitions for further growth are formidable. The previous government stated in its report to Parliament that Norway would be “the world's leading seafood nation” by inter alia, providing a regulatory framework that increases further growth, based on biological sustainability (Meld. St. 22 (2012–2013)). The current government is even more specific: “The Government will follow up the vision of a quadrupling of GDP in the industry over the next decades ...” (Andreassen et al. 2014). Both governments have largely relied on expert reports from the Royal Norwegian Academy of Sciences (DKNVS) and the Norwegian Technical Academy (NTVA), which in their report outlined a future scenario with a tripling of salmon production in 2030 and increasing five-fold in 2050 (DKNVS/NTVA 2012). Shortly summarized, “The sky is the limit!” Fig. 1.

This view is by no means shared by the critics. The most eager critics are the sport fishermen and their organizations, *Norges Jeger-og Fiskerforbund*³ (organizing the users) and *Norske lakseelver* (organizing the river owners).⁴ They frequently accuse the fisheries authorities of managing the salmon industry in an unsustainable manner, to the detriment of the wild stocks. The representatives of the river owners are even more outspoken, demanding that there be no further increase before a new management regime has been established.⁵ But opposition is not limited to the recreational sport fishers and river owners. The conservation interest groups have followed suit, with traditional groups like *Norges Naturvernforbund* and *Natur og ungdom*, as well as the newer NGOs like World Wide Fund for Nature (WWF), Bellona and Greenpeace, supporting the recreational fishers.



The professional fishers, organized through *Norges Fiskarlag* and *Norges Kystfiskarlag*, have for years been rather accommodating vis-à-vis the new industry. They recognize that many former fishers are now fish farmers and that the industry creates employment and secures settlements all along the coast. But, with concentration of ownership and a complete reorganization of the salmon industry during the 1990s, the critics became more predominant. The salmon farming companies, especially in the north, were soon owned by large national or multinational companies with limited local connections. Fishers felt that traditional breeding grounds and fishing grounds were threatened, and they often opposed plans suggesting new and expanded areas for the aquaculture industry. One particular issue caught their attention: the claim that spawning cod would not return to traditional fjords in the north due to aquaculture farms located in these fjords. A more recent concern is the massive use of *flubenzuroner* in the delousing of infected salmon, which in the next round affects all bottom-dwelling creatures, including snails, shrimp, crabs and lobster. In sum, fishers are no longer welcoming the unconditional growth of the salmon industry.

Finally, we have the general public, represented by their local councillors all along the coast, which is organized into 275 coastal municipalities. As long as the industry offered new jobs, they welcomed the new salmon industry but, with the more recent developments, many turned to scepticism and, quite often, straightforward resistance against any further expansion. This can be explained by the fact that coastal plans, normally worked out as part of the municipality plan, which is to be revised each fourth year, are costly and cumbersome to make. One issue is that most small, coastal municipalities lack capacity and competence to do planning at sea, and therefore need to hire external consultants or enter into some type of inter-municipality cooperation (Hersoug 2013). The other issue relates to the political costs of manoeuvring a coastal plan with generous allocation to aquaculture, which quite often has to be adopted against the interests of fishers, both professional and recreational, recreational dwellers, conservationists and tourist interests. By 2014, many municipalities said no to further expansion until they are offered a better economic deal.

A complex management regime

While the traditional fisheries are subject to one ministry, aquaculture depends on at least four ministries and their subordinate directorates and supervision. Here we will briefly look at the two basic elements of the system: the use of *licenses* (permits) and the regulation of *localities* (sea space or sites).

The use of licenses has a long tradition in Norwegian fisheries. The Lysø Committee, which had been tasked to investigate how the new fish farming industry should be regulated, also suggested the use of licenses (NOU 1977:39). At the outset, all existing farms were recorded and, from then on, all new facilities were required to apply for a license. Each owner could only have one license and, through irregular allocation rounds, the fisheries authorities could regulate both *where* (geographically) and *who* should be prioritized. Licensing rounds were arranged in 1981, 1984, 1985, 1989, 2002, 2003, 2006 and 2009. In 1991, the ownership restrictions were lifted. It had already been under pressure for years, since large owners operated with minority interests and “straw men”, which ensured effective control of several farms (Hovland et al. 2014). With the bankruptcy of the salmon farmers’ mandatory sales union (*Fiskeoppdretternes Salgslag*) in 1991, many salmon farmers went bankrupt, which in turn paved the way for a large-scale reorganization of the industry (ibid).

From the start, the licenses were regulated according to net pen volume, originally 8000 m³, then 3000 m³, 5000 m³, 8000 m³ and, finally, 12,000 m³. It proved to be a highly approximate production limitation, because the volume was just measured down to five meters depth, and many farmers had already acquired nets that were both 20 and 30 meters deep. Later, the volume restriction was combined with feed quotas as a result of the production limitations following the EU’s threats of trade restrictions due to accusations of Norwegian dumping and use of irregular subsidies. Thus, throughout the 1990s, licenses and quotas acted as production control measures, through which the fisheries authorities tried, to the best of their abilities, to limit growth, so that the industry would not be affected by further trade restrictions. In 2005, feed quotas were replaced by a system based on maximum allowable biomass (*MTB*), a system that still persists, despite criticism from those farmers who carry out extensive processing in Norway. MTB for a standard license is 780 tons from Nordland County and southwards, while farmers in Troms and Finnmark have 945 tons as the upper limit. This is to accommodate the northern locations’ shorter growing seasons, due to lower seawater temperatures.

The present government has decided that the licensing system should remain unchanged. There are, however, challenges from several quarters, not least by the conservatives who, in opposition, advocated that the system should be discontinued in favour of a system based on technical approval, i.e. on the basis of environmental considerations only. The Senior Think Tank, a grouping of established fish farmers and people with solid experience in all aspects of farming operations, has advocated that the state’s role as “production manager” should be abolished (Seniortanken 2014). Their main objection is that the aquaculture industry should be treated like any other industry, where it is up to the actors themselves to determine production volume, within applicable technical and environmental regulations. Another type of criticism has been that licensing rounds act as “beauty contests”, with applicants promising gold and green forests, such as further processing, local employment, etc. These promises are seldom checked and tested, and many of the lucky license winners are selling shortly afterwards,

normally with windfall gains (Andreassen and Robertsen 2014). Nevertheless, licensing regulation is no longer regarded as a production control tool, but as a necessity in terms of “distribution and scarcity considerations”, which refers to the environment and optimum use of the coastal zone (NFD 2014).

But a license is not enough. The farmer must also have a site (locality), and in Norway it is the coastal municipalities that reign over sea space. Planning at sea has, until now, been a voluntary task, but such plans were earlier on regarded as a precondition to be awarded farming licenses. In 1985 coastal municipalities got the opportunity to plan their sea areas to the baselines, i.e. the straight lines connecting the outermost reefs and islands. In 1989, the area was extended by one nautical mile (1852 m). Thus, the planning responsibility should coincide with EU’s Water Directive, which Norway has also acceded. In practice, this means that the municipalities now reign over an area of about 100,000 km². Here, municipalities allocate space for aquaculture (A-sites) or create multipurpose areas where aquaculture is included as one of several possible activities (FFFNA-areas). But the process toward an approved locality is long and difficult, as many considerations and agencies are involved. Proceedings are outlined in Fig. 2, which states that the Norwegian Food Safety Authority plays a central role as manager

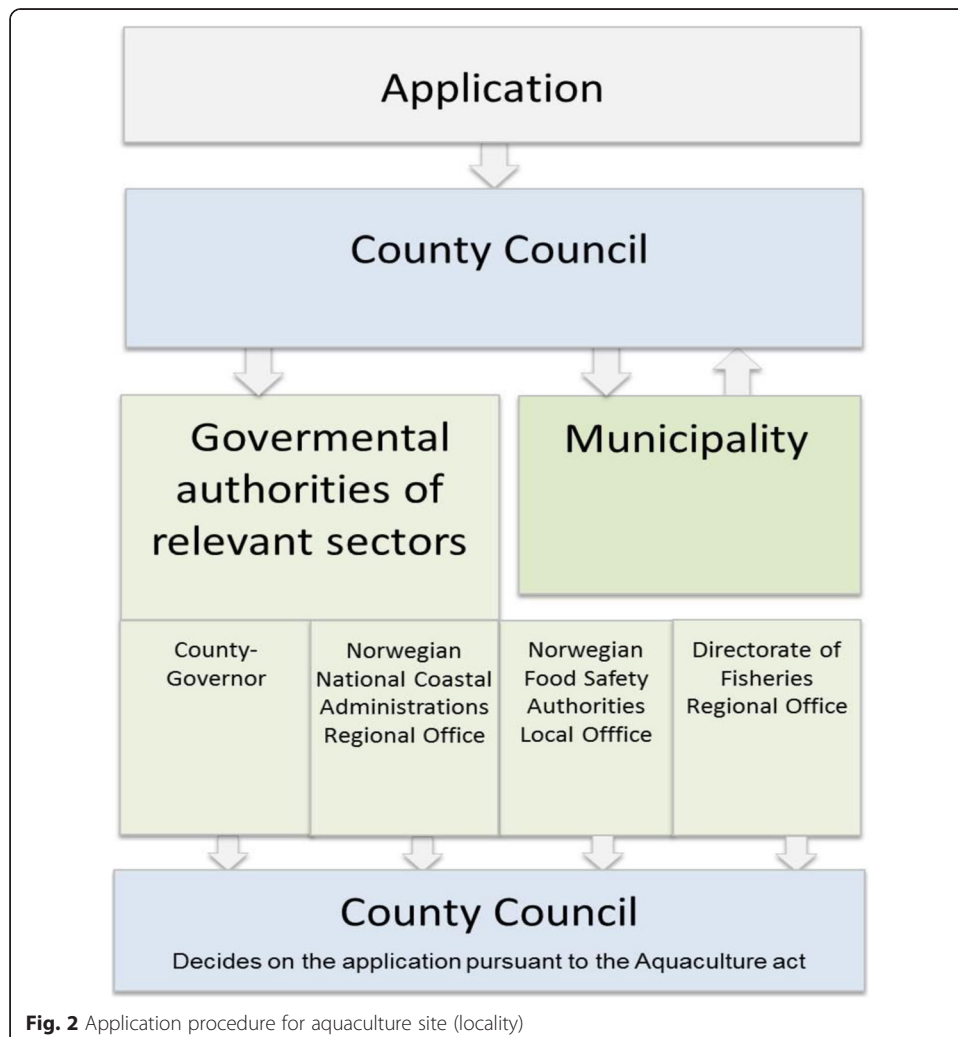


Fig. 2 Application procedure for aquaculture site (locality)

of the Animal Welfare Act and Food Act; the Coast Directorate manages the Harbour Act; the county governors act as managers of a number of laws, primarily the Biological Diversity Act, the Pollution Control Act and the Open Air Act; while the Directorate of Fisheries manages the Aquaculture Act and the Marine Resources Act. The county is responsible for coordinating the proceedings, ensuring the quality assurance of the applications, and assigning the localities. Each of the afore-mentioned agencies have, in principle, a veto opportunity in relation to proposals for new farm localities, while the Ministry of Local Government and Modernisation is called on to mediate if the agencies do not reach agreement with the municipality plan.

No further growth, except

In 2013, the Minister of Fisheries and Coastal Affairs was hard pressed. The salmon farmers had the capacity to produce more, the markets were favourable and profits were excellent. On the other hand, an increasingly sceptical opinion demanded a full stop until the two major threats had been solved, or at least significantly reduced. The Ministry of Fisheries and Coastal Affairs then came up with a new idea: to introduce a new type of license, under much stricter conditions than the present ones (which have a fixed critical limit of a maximum of 0.5 sea lice per fish), and to allocate licenses only to those able to implement new solutions regarding escapes and sea lice. With an open competition, a number of promising new solutions could be tested out on an industrial scale and, within a few years, it was hoped that the industry would be able to cope with both sea lice and escapes. In sum, it was a large-scale industrial experiment that had the support of most salmon farmers and did not encounter much resistance from the traditional opposition groups described above.

One year later, a new conservative/right government had taken over, and it decided to finalize the allocation of green licenses. In addition, the minister wanted to open for immediate growth, partly in order to compensate for the shelving of another growth proposal to use an *average* MTB over the year. She therefore proposed that each existing farmer should be able to increase its MTB volume by five percent under new and very strict regulations regarding sea lice. The minister also wished to initiate a more predictable, long-term growth, under which the growth parameters were fixed and transparent. A new proposal was therefore presented for public hearing during the fall of 2014 (NFD 2014) and as a White Paper in the spring of 2015 (Meld. St. nr. 16 (2014–2015)).

Finally, a new green management policy was developed, largely under the radar of most public debate. The Norwegian Food Safety Authority (*Mattilsynet*) has the task of controlling fish farms and checking not only public health concerns, but also animal welfare, according to the mandate granted in the Animal Welfare Act. Based on a system of counting sea lice in all sea pens at all farms every week, the Norwegian Food Safety Authority is able to keep track of the offenders and perform risk based surveillance. In the more serious instances, the Norwegian Food Safety Authority demanded the slaughter of all or some of the salmon at the farm. By January 2015, the Norwegian Food Safety Authority made public its list of worst offenders, based on counting sea lice in 2013 and 2014. In the next round, these companies will be required to halve their maximum allowable biomass (MTB) on specified locations.⁶

All four measures can be seen as part of the actual effort of *greening the Norwegian salmon industry*, i.e. making the industry more acceptable to the Norwegian public, to

the central and local politicians and, not least, to the foreign consumers buying 95 percent of the salmon produced in Norway. In the following we shall have a closer look at these four elements.

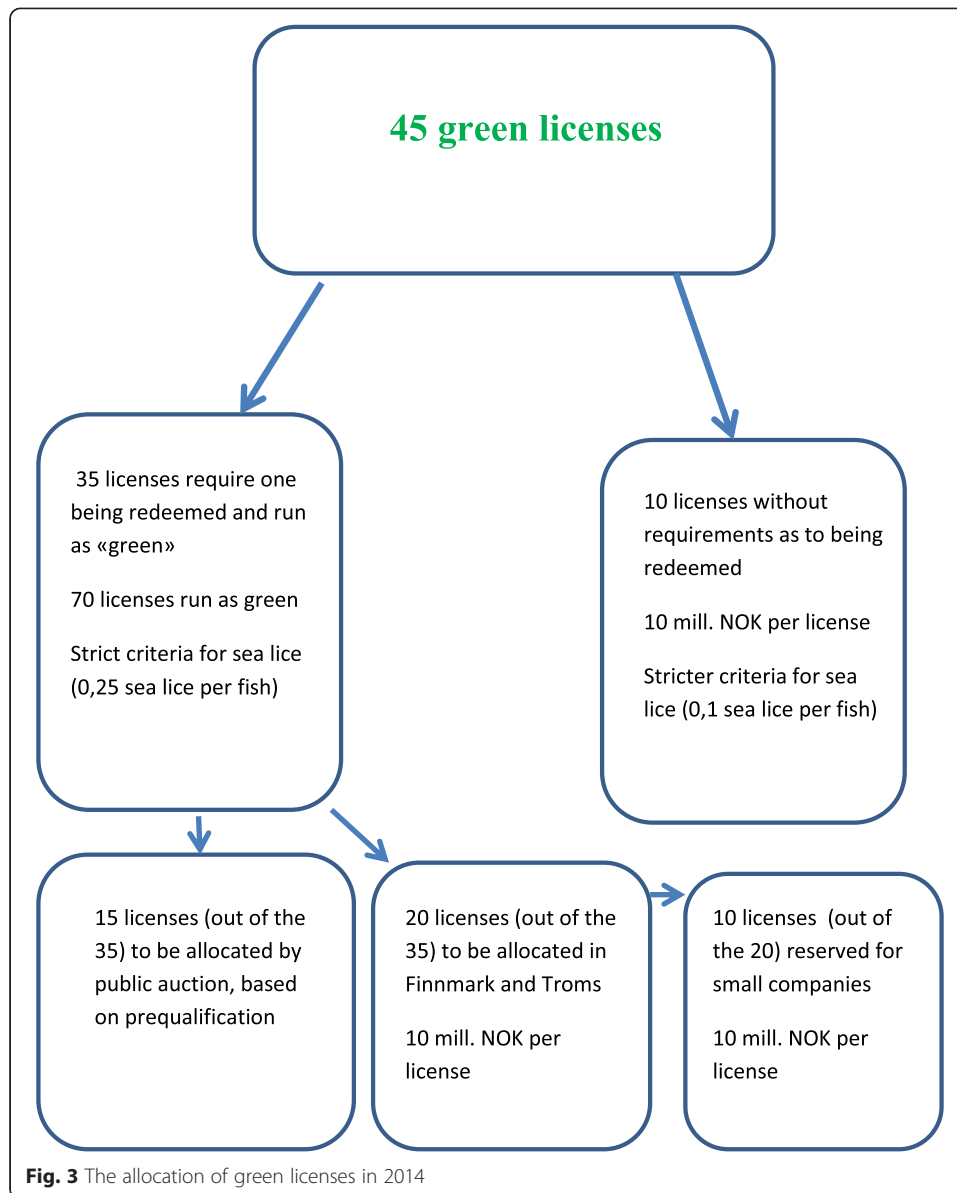
Green and super-green licenses

In 2011–2012, it was obvious that a further expansion of aquaculture was not on the agenda. The Ministry of Fisheries and Coastal Affairs had received strong criticism from the National Audit Office (*Riksrevisjonen* 2012) regarding the management of the Norwegian aquaculture industry, and the planned expansion of five percent of MTB across the country had to be cancelled. Only farmers in Troms and Finnmark (where the sea lice problem was relatively small) got the opportunity to increase production. Meanwhile, there was a strong desire to increase production by the farmers; they had the capacity and skills, while there were few problems on the market, with some exceptions for restrictions in China, and prices were high. The solution was the introduction of so-called *green licenses*, with which farmers were given the opportunity to expand production if they adopted new solutions that could lead to a reduction of sea lice and escapes. The scheme was eventually relatively complicated, in that the Ministry simultaneously wanted to embed both regional priorities and maintain a diverse farming structure in terms of company size. Furthermore, the Ministry would want to use both public auction and allocation by fixed price. Finally, the environmental criteria were differentiated, as 35 of the allocated licenses should have an upper limit of 0.25 adult female sea lice per salmon, while ten licenses had to commit themselves to maximum of 0.10 sea lice per salmon. The distribution of the different groups and conditions is illustrated in Fig. 3.

The assignment process was organized so that a small group of professionals, headed by a lawyer, accounted for the selection, based on criteria that were prepared in advance. They chose to concentrate on measures that would reduce the incidence of sea lice and the risk of escapes. In practice, this implied a variety of louse defeating devices, which ranged from the use of skirts (outside the net pens) to the use of laser cannons to shoot sea lice. Furthermore, the use of large smolt (up to one kilo, produced on land-based facilities) and triploid salmon was prioritized. Interest was great and 255 applications were received in all. Groups A and B are now finally awarded, while in Group C there are still legal complaints, and final allocation is not expected until the appeals procedure is completed, which will probably occur in the summer of 2015. It is also important to note that, in Groups A and B, companies must commit themselves to redeem an existing license per awarded license, which will also run on green terms. This means that, when the scheme is implemented, there will be 80 licenses that will be run on green terms, of which ten will be run on stringent or *super-green* conditions (0.1 sea lice).

An incremental step: five percent increase on strict conditions

For a long time, the present MTB-regime regulating production has been heatedly debated. An expert committee, looking into the pros and cons, concluded in 2013 by recommending the use of an average MTB (over the year) instead of the present system of using the given MTB as an absolute ceiling at any time (Guttormsen et al. 2013). However, the farmers were split; while some of the large companies preferred this more



flexible approach, others, headed by Marine Harvest, were dead against it. In the end, the Minister of Fisheries decided to drop the proposal and instead introduced a new offer to the fish farmers: the possibility of buying a five percent increase, provided that they were able to keep the sea lice level down to 0.1 during a production cycle with a maximum of two delousing treatments. The offer was presented in the summer of 2014 and could be effective a year later, depending on the reactions of the fish farmers and other stakeholders.

The fish farmers, represented by their generic organization FHL, were in principle in favour of the opportunity to increase production. They also found the price acceptable (1.5 million NOK for a five percent increase), but they found the suggested regime untenable. The suggested level of 0.1 sea lice per license was found unrealistic and the sanctions were seen as risky (economic fines and, ultimately, withdrawal of the increase without compensation). In addition, the farmers found it difficult that the fisheries

authorities should operate with three different sea lice regimes, one with 0.1, one with 0.25 and one with 0.5 sea lice. In the spring of 2015, the offer was repeated, in a slightly modified version (a lower price and an extended deadline). The actual number of farmers responding positively to this offer will first be known in 2016. At the outset, it is expected that farmers with small sea lice problems will probably be interested, while others are sceptical and will wait and see, their final decision depending, among other factors, on the possibility of transferring licenses across administrative regions.⁷ Among the sceptics, the attitude is fairly uniform; there should be no increase whatsoever until the problems of sea lice and escapes have been solved.

A new allocation regime

While the outgoing Labour/centre/left government tried to get around the political limitations on further growth by introducing green licenses, the new conservative/right government proposed a completely new policy regulating growth. The proposal, introduced in 2014, was sent out for public hearing with a view to be presented for the Norwegian Parliament by late spring 2015. The proposal is concerned with the lack of clarity regarding future growth in the salmon sector, and tries to suggest a predictable growth path, thus reducing the uncertainty for salmon farmers. Right from the beginning, the authorities stressed that the future growth of the sector has to take place within a sustainable framework. This means that further growth will be determined by biological sustainability, as defined by various possible parameters. The proposal, which was later developed into a White Paper, contained three alternatives for further growth:

1. The first implies “business as usual”, i.e. to continue the present practice of allocating new licenses through license rounds, when the government sees fit. However, the new government is adamant that licenses from now on shall be allocated on “objective criteria”, not on shifting political likes and dislikes.
2. The second suggests that growth shall be determined by a fixed annual growth rate, leaving the environmental concerns to other regulatory measures.
3. The third is to make growth dependent on an operational management rule (similar to the Operational Management Procedures we find in fisheries management). Predictability is here secured by a set of environmental indicators that are decisive for growth (or reduction) of production.

The Ministry made no attempt to hide that the third alternative was its preferred solution, and used most of the 60-page document to spell out how such a system could be set up and how it would operate in practice. We do not have the space to elaborate the proposal in detail, but suffice it to say that a number of questions are left open, with the request that stakeholders comment and, if they disagree, to come up with better solutions. The groundwork for the proposal was made by an expert group, the Area Committee, which delivered its report in 2010. The main idea of this report was to divide the coast into different production areas and manage growth according to fish mortality as the central indicator. While the idea of using production areas and put-out zones received wide acclaim, the use of fish mortality as the main indicator met with stern resistance. So when the idea was taken up again in 2014, the main indicator was changed to the frequency of sea lice in a particular area. For the sake of illustration, the

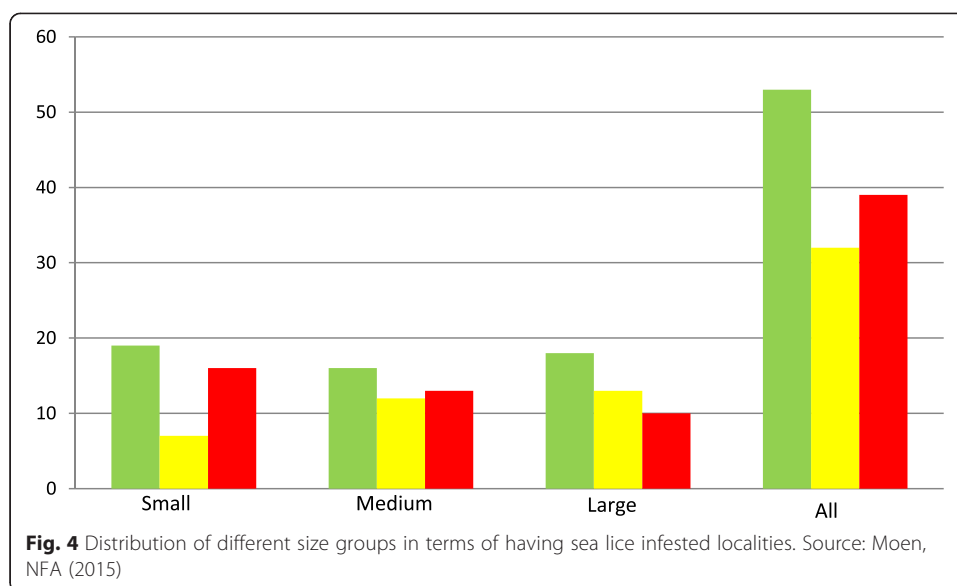
coast was divided in 11–13 production areas, where all licenses are connected to a particular area (different from the present seven management areas). Critical values have been suggested, similar to what we find in the fisheries management system, where traffic lights (green, yellow and red) indicate where growth can take place, what areas are under observation, and what areas require reduction in terms of annual production, as measured by allowable biomass (MTB). Other indicators can be connected to the system, such as local and regional pollution, but at this stage, only the frequency of sea lice has been developed to the necessary sophisticated level to be used as an indicator.

The idea behind the proposal is not only to regulate growth, but to make the salmon farmers collectively more responsible for the environmental standard in their production areas. For obvious reasons, the presence of sea lice will vary from one put-out zone to another, thus paving the way for different grading within a production area. But in the end, the different grades will be weighted and the area will be assigned a value or traffic light colour. On the issue of how production capacity shall be allocated, the proposal suggests a Solomonic solution that partly increases capacity via annual or semi-annual license rounds and allows existing farmers to expand by a certain percentage. In terms of payment, the Ministry prefers the public auction of new licenses, while also allowing the use of fixed prices and lottery. For fear of subsidy or dumping allegations (primarily from the EU), the Ministry will not prioritize any particular group in terms of size (small-scale versus large-scale) or in terms of preferred technical solutions. “The Ministry considers biological sustainability the most important requirement for future growth, while the market seems not to be a reason why the authorities shall regulate the production capacity” (NFD 2014: 22). Nevertheless, the Ministry insists on maintaining the license system untouched, although the actual production connected to each license will vary depending on where it is located and how well the farmers in the area are able to reduce the sea lice level.

At this stage, it is important to stress that the new regulatory regime is still on the drawing table and many details are to be decided at a later stage, not least influenced by a rather diversified response from the various stakeholders, who often combine elements from all three solutions to create their preferred options.

A new regime of sanctions

While green licenses and any new farming regime will produce results sometime in the future, it is already one regime that is operational. The sanctions’ regime builds on the simple logic of reducing the MTB at farm level, based on long time violation of given louse limits (0.5 adult female sea lice per salmon). The Norwegian Food Safety Authority (*Mattilsynet*), which is responsible for the organization of the system, has for a long time had the authority to impose restrictions on farmers and, at worst, require the slaughtering of fish. The Norwegian Food Safety Authority has systematized sea lice data for 2013 and 2014 based on weekly reported counts, which makes it possible to pick out the worst offenders in the first place, i.e. localities that, over a long time, have had sea lice over the allowed limit. In January 2015 these farms have received a warning letter stating that stocking up on these sites must be halved in the next round (production cycle). This does not mean that the company must halve its MTB, but that the company in this case must find other localities where the company’s given license MTB can be placed. What is interesting to note, is that company size does not seem to have



any significant impact on the frequency of its sea lice-infested localities. As can be seen from Fig. 4, all size categories have red localities (ranging from 21 to 40 percent).

The measure has, as expected, triggered strong reactions. The publication of the companies included on the list and the use of data are highly controversial issues, but the Norwegian Food Safety Authority seems to have strong support in the Ministry of Industry and Fisheries that the measures will be implemented as planned, and that the authorities will take complaints and possible litigations as they come.

Discussion

In the proposal for a new growth regime, it is clearly stated that the industry does not need the state to regulate production according to market needs. Nevertheless, it is equally clear that the government has no intention of changing the existing license regime. This may at the outset seem somewhat paradoxical, but makes sense when one considers the values involved. At the last auction of salmon licenses (in 2014), prices were in the range of 55 to 66 million NOK. If we make a calculation based on the more modest average of 40 million NOK per license, the value of the 1,000 licenses allocated so far will be in the order of 40 billion NOK. No owner would like to see these values scrapped overnight, not least because many have bank loans where the license values are used as collateral.

However, the present license regime has many drawbacks. The most important is that it is very hard for newcomers to enter the industry. They can, of course, buy a license on the open market, but an entry ticket of 40 million NOK is too much for most prospective entrants. This means that the industry is nearly closed to newcomers, which creates the risk of blocking new ideas. In recent years ownership has been heavily concentrated. Although there are still 130 companies involved, with 89 owners, the ten largest are actually producing 80 percent of the quantity (NFD 2014).⁸ Over time, the ownership concentration has seemed to increase even further, not necessarily due to economies of scale in the actual production, but due to the advantages of handling all

the other operations, including the access to sea space. So far, the ESA (the controlling organ of the European Economic Space agreement) has overruled the previous Norwegian ownership regulation of a maximum of 25 percent of the total number of licenses, and instead set maximum ownership at 40 percent. This has, somewhat hesitantly, been accepted by the previous government, so long as certain requirements regarding further processing, research and the use of labour are fulfilled.⁹

The four management measures described above have one feature in common: they are all based on one simple indicator, namely the frequency of sea lice (adult, female sea lice) as reported by the farmers themselves and controlled by the Norwegian Food Safety Authority. This implies that the question of sustainability has been framed as a question of biological sustainability, i.e. of not affecting the wild salmon and trout negatively. The indicator and critical threshold values have been defined, which in turn have been transformed to a simple system of traffic lights (red, yellow and green). The success of such a regime will therefore depend on whether the authorities are able to *stabilize* the regime, i.e. to get the system accepted and institutionalized. Along this route, there are several challenges. The first relates to the connection between the frequency of sea lice and the status of the wild salmon and trout stocks. While the Institute of Marine Research is proclaiming a definite and clear connection, other researchers and the farmers themselves point to other factors explaining the poor conditions for out-migrating wild salmon and trout (FHL 2015, Bellona 2015). Basing the environmental state on one indicator only may also seem like a risky strategy, although the Ministry is open to adding more indicators (such as pollution) at a later stage.

Secondly, the critical values are still being debated, and while 0.5 sea lice per salmon seems to be accepted as a common denominator, the new limits introduced by the green licenses (0.25 and 0.1) are by many experts considered unrealistic. Many farmers still demand a more scientific explanation for the fixed critical values, although most seem to accept that keeping down the level of sea lice, will, in general, reduce the impact on wild salmon and trout. Even better (for the farmers), this will, if successful, reduce the costs of delousing, which already constitute more than 3 billion NOK per year.

Thirdly, many stakeholders, both inside and outside the industry, doubt the counting regime that has been established, and accuse some farmers of under-reporting. The authorized count by the Norwegian Food Safety Authority is accepted, but the NFA will, in any case, only be able to control a few farms every week. Fourthly, the public sanctions are heatedly debated. Slaughtering part of or an entire batch of salmon will of course have dramatic economic consequences, as will the requirement of halving the put-out for the next production cycle on specific locations, as is now being implemented by the NFA's sanctions' regime. Many farmers and their organizations have already warned that they find the collective punishment inherent in the new growth regime unfair and illegal. All farmers in an area could be forced to reduce their put-out due to the practice of one bad farmer. Fig. 5.

Last but not least, the new proposed growth regime (measure no. 3) seems to confound two different but closely related systems: the license system, which gives a person or a company the right to farm, and the locality (site) system, which allocates space where one might farm. So far, these two systems have been kept isolated, as the right to farm is a prerequisite to apply for a site, but not the other way around. The right to farm has been decided by the state (the Ministry), while the site allocation is, in

<i>License</i> MTB (780 or 945)	45 Green licenses (1) 5% MTB increase (2)	Increased or reduced <i>license</i> MTB for a period ↑
<i>Locality</i> (site) MTB From 780 to 10 000	Sanctions' regime(4)	New growth regime (3), based on environmental standard in 11-13 new production areas based on sea lice as indicator

Fig. 5 New management measures according to license MTB and locality MTB

principle, up to the municipalities, although the county authorities are responsible for the process and the final distribution. By suggesting, as in the new proposal, that companies risk their *license MTB* if they do not comply with the environmental requirements as measured by the sea lice indicator, the authorities mix the two systems, which may not be the most convenient way of obtaining the goal that all partners share (a sustainable salmon industry).

In that respect, the “new” sanctions regime is built upon a different logic, under which specific *sites* are monitored and required to reduce MTB for the next production cycle. Sites are here the central theme, not the licenses and their accompanying MTB. It should also be mentioned that the responsible authority (the Norwegian Food Safety Authority) already has the mandate to reduce production in entire *areas* with a bad environmental standard. The Norwegian Food Safety Authority may reduce the MTB on such localities and also refuse to grant permission to new localities. The possibility that companies’ license MTB can be reduced may open a host of legal claims as to the legality of this measure. The comments from the Directorate of Fisheries (2015) to the proposed new growth regime speak for themselves:

“The consultation paper envisages a radical change of management regime for Norwegian aquaculture. This will partly require a significant research work, extensive rulemaking, significant changes in management, restructuring of registers besides changes and strengthening of audit. The production areas must be created in separate regulations, which also contain the necessary procedural rules for changes. The operation of a system of production areas is difficult to realize widath the current fragmented management system. A system of production areas involves a more complicated administration itself, and will be very demanding with the current roles and responsibilities.” (Author’s transl.).

Hence, the administrative organ most closely involved with the present regime considers the new management regime “a radical change” and “very demanding”. While green licenses may be seen as a front-runner of a new regime, the actual proposal of the traffic light system is the full implementation of a more environmentally oriented production system. Whether this system will be viable (fully institutionalized) depends not only on governmental will (political support in the Norwegian parliament) and the acceptance of and cooperation with the major stakeholders (farmers as well as environmental NGOs), but also on scientific backing (solid science to support the indicators,

the threshold values and, ultimately, the results in terms of improved survival of wild salmon). Shortly summarized; the green licenses, the five percent increase and the current sanctions' regime operated by the Norwegian Food Safety Authority can all be seen as *modifications* of the existing management regime, although they contain a number of new elements and principles. The suggested new management regime (based on increasing or reducing the *license MTB*) is an entirely new approach, which may require dramatic changes in the institutional set-up of the sector administration. All four initiatives depend critically on the quality of the science involved to prove sustainability, i.e. whether the scientific results are being accepted by the stakeholders and the larger public (including foreign consumers).

The discussion so far has been limited to Norwegian salmon farming, but the reforms under way may also have repercussions for other salmon producing countries. While it may be argued that the policy of diversification into other countries (Chile, Canada, Ireland, and Scotland) by Norwegian salmon producers originally may have postponed stronger regulations at home, the management logic also works the other way around. Stronger demands on safety for escapes and improved treatment of sea lice in Norway will, within relatively short time, be transferred to other countries where the multi-national companies are involved (Perkins 2010). Over time, these demands will be incorporated into "best practices" and may also be included in international standards, such as the Aquaculture Stewardship Council's Salmon Standard.

Conclusion

Through the new initiative of providing "green growth", the past and present governments have tried to circumvent the impasse created by massive problems connected to sea lice and escapes. We have earlier claimed that Norwegian salmon production is not limited by lack of space or by exceeding ecological limits (Hersoug and Johnsen 2012). The main issue is what is *acceptable* in terms of ecological footprints to Norwegian politicians (acting on behalf of the Norwegian people) and, in a similar manner, what is acceptable to foreign consumers, who are increasingly occupied with sustainability concerns. At present (spring 2015), the government is hard pressed between an industry that would like to expand further, having both the capacity and the markets, and an increasingly sceptical public opinion, which clamours for no further expansion until the main challenges have been solved. In this situation, at least three other public debates are interfering to complicate a political solution. The first is a technical, scientific debate: how can sustainability be measured, monitored and used as the main mechanism for regulating growth? The second applies to how the proceeds from the very profitable salmon sector should be divided, i.e. to what extent should the municipalities managing the near shore sea areas on behalf of the Norwegian people receive an area fee (in addition to a share of the license fees).¹⁰ The third relates to the sale of Norwegian companies, which offers Norwegian sea territories to foreign companies free of charge.¹¹ This presentation of the greening of the Norwegian salmon industry has not suggested any easy way out of these conflicts. Whether the green licenses are successful in producing the results promised in terms of reduced sea lice and escapes remains to be seen. The large number of technical solutions now being implemented is by all means promising, but the jury is still out as to tangible results. The promise of a five percent increase in production volume (MTB) in return for much stricter limits

regarding sea lice has not met with enthusiasm and implementation is pending. How the new proposed growth regime will be implemented is even more uncertain; it depends not only on the technical feasibility but also on gaining the political support and cooperation of salmon farmers. The new sanctions regime has already been introduced, but we have still not seen the results and definitely not the legal reactions of those who are affected (having to reduce their MTB to half on certain “red” localities).

According to a former prime minister (Mrs. Gro Harlem Brundtland), “Everything is dependent on everything”.¹² This seems to be an apt description of the current situation in the aquaculture industry. Further growth cannot be obtained before the industry has succeeded in reducing its ecological footprints as measured in terms of frequency of sea lice and escapes. Whether the new management measures (the green licenses, the five percent increase, the growth regime and the sanctions regime) will produce the expected results remains to be seen. Using the Actor Network Theory terminology, it depends on whether all the necessary steps toward a new regime can be stabilized, accepted as legitimate and supported by science. This is by no means secure. The different debates related to the use of sea lice as the main indicator in all the suggested management reforms indicate that the new framework is far from taken for granted. Regarding the question of institutional reform, the crucial question is how to institute a new management regime where future production is dependent on environmental considerations while at the same time presenting predictable growth opportunities to the salmon farmers. In many ways, it is a question of “squaring the circle”. Predictable, actual growth cannot possibly be guaranteed if it is dependent on changing environmental conditions. Increased license MTB may be granted, but whether the growth will be realized depends on the environmental conditions on the site or area level, which at present depends on the farmers’ ability to reduce sea lice and escapes. Based on risk analysis, we may say that the political risk of operating in Norway will increase. However, if the regime turns out to be successful, the biological risk will be considerably reduced, thus improving not only legitimacy but also profits.

In the short run, the main challenges are connected to reducing sea lice and escapes. In this context, four new initiatives have been presented, all with good intentions but variable degrees of probability that the problems they address will be solved. As soon as these problems have been solved or considerably reduced, the area issue is going to resurface. Larger and better areas are definitely needed if the industry is going to expand as planned (Arealutvalget 2010, Hersoug and Johnsen 2012). The willingness to grant new areas to the aquaculture industry depends in the last instance on legitimacy—on whether the demands of the industry are seen as legitimate and valid. The attempts of greening the industry may, from this perspective, be seen as a preparation for the larger battle—the battle for space, which is bound to be the central issue if the Norwegian industry is going to increase its production five-fold by 2050. It is still an open question whether a greening of the existing management institutions is sufficient or if this dramatic increase would require a wholesale institutional reform. A third possibility is that the present conflicts will be reduced as a result of new technological solutions, such as transferring the production onshore or further offshore. While the first option certainly will reduce the comparative advantage of Norwegian producers, who have access to large areas of sheltered sea waters, the second will require large investments in new technology, and thus drive the industry

toward further concentration. In this respect, the greening initiatives may be seen as a compromise that allows for the continuation of the present success of open or semi-open salmon farming in net pens in the fjords while, at the same time, reducing the environmental problems.

Endnotes

¹<http://www.ilaks.no/solberg-laks-er-det-norske-ikea/>.

²Maximum allowable biomass is here indicated by the Norwegian acronym MTB (Maksimalt Tillatt Biomasse).

³All Norwegian organizations are presented by their Norwegian names, in italics.

⁴The organization represents rights holders and river associations in 70 salmon rivers. Members are spread across the entire country. Through local chapters Norwegian Salmon Rivers represents approximately 7000 rights holders. It constitutes about 70 percent of all licensees to salmon rivers in Norway.

⁵<http://www.lakseelver.no/Nyheter/2015/januar/Pressemelding%20vekst.pdf>.

⁶It should be noted that the MTB should be halved on specific locations, not affecting the MTB guaranteed by the license. In principle the affected companies will then have to find other (and better) localities for the production being reduced. If small companies have only few localities that are all being restricted, this will, other factors equal, reduce the company's total production. This will in the end, be left to the discretion of the Food Authority.

⁷At present licenses are geographically bound to the seven administrative regions of the Fisheries Directorate.

⁸In Chile there are 24 companies controlling 80 percent of the total production.

⁹The present government has suggested that these requirements should be scrapped in 2015, thus leaving the salmon sector on an equal footing with most other industries.

¹⁰The main income of the municipalities is income tax and economic transfers from the state. Until 1999 part of the company tax was allocated to the municipalities. Today the tax goes directly to the state and is then redistributed through the economic transfer to the municipalities (Isaksen and Mikkelsen 2012).

¹¹The former state owned company, Cermaq was recently sold to the Japanese multinational Mitsubishi.

¹²<http://www.ordtak.no/index.php?fn=Gro%20Harlem&en=Brundtland>.

Competing interest

The author's declare that he has no competing interests.

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