Area fee in the Norwegian salmon farming industry

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Abstract

A discussion on a new tax, an area fee, for the Norwegian salmon industry has been on-going for several years. This thesis examines which tax benefits the industry and the host municipalities the most. To investigate this, three taxes are compared by a set of evaluation criteria. The three chosen taxes are: tax on quantity, tax on revenue and tax on area used.

To conduct the thesis, existing reports and papers are used extensively in addition to economic theory and an industry specific knowledge. The industry is highly regulated with restricted production sites and limited production licenses.

Tax on revenue is preferred among producers as it varies with production and market trends, while municipalities prefer a stable tax income as from tax on area used. Taking every evaluation criteria into account, we find tax on individual revenue to be the most suitable of the analysed taxes.

The thesis gives the reader a brief introduction of the industry and relevant regulations for the analysis. Thereafter, the analysis begins by introducing seven defined evaluation criteria and a stylized model. All three taxes are analysed in compliance with the model and the set criteria. At the end of the thesis we briefly discuss how to implement a tax before presenting our conclusion.

Acknowledgements

Table of Contents

Figures

Tables

v

1   Introduction

In this thesis, we look at the implementation of an area fee[1] for the Norwegian aquaculture industry. The industry is earning economic rent from natural resources and a limited production in a market where Norway has market power. Limited production is caused by regulations on production licenses and numbers of production sites. To increase the available production areas, a greater share of the economic rent can be paid in taxes to increase municipalities' incentive to facilitate for production. The research question we analyse is:

Which tax will benefit the salmon farming industry and host municipalities the most?

We acknowledge the difficulty in determining which tax is most beneficial for both the municipalities and the salmon farming industry. In order to answer the question we analyse a tax on quantity, a tax on area use and a tax on revenue, to see how different taxes have different outcomes and benefits. Tax on quantity and tax on area has been up for public discussion several times and we therefore find them highly relevant for our analysis. We also analyse a tax on revenue to better illustrate differences among taxes, and particularly, how some taxes can be more beneficial for producers and municipalities than others.

The discussion of a new tax has been on-going for several years and the government investigated the question in 2008. This resulted in a change in the already existing property tax as of 2009 (Ministy of Finance, 2009). Municipalities can demand tax revenues from the value of installations and equipment used for salmon production. The discussed area fee was not imposed because of difficulties in designing a tax based on use of area.

An additional tax will increase producers' costs and can therefore reduce their international competitiveness. Nonetheless, both firms, such as Grieg Seafood, and the Norwegian Seafood Federation (FHL) (the industry organization) are in favour of an industry specific tax paid to the host municipalities (Skeie, 2011). However, the industry has a preference of redistributing already introduced taxes rather than increasing the total tax payments (Fish.no, 2011). A direct tax payment to the municipality is expected to increase municipalities' incentives to

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[1] The term area fee and the corresponding Norwegian term *arealavgift* have been used extensively in the public discussion. Area fee as a term combines every tax that can give municipalities more revenues from the salmon farming industry by taxing anything related to production. Area fee must not be mistaken with area tax, a tax on square meters used for production.

provide new production sites and facilitate for increased production. Our interest in this topic arose as the tax is not implemented while both municipalities and firms favour a new tax.

The possible tax is discussed in several newspaper articles and blog posts. The topic of providing more revenues to municipalities hosting aquaculture is also up for discussion in the new Norwegian government (Solberg I). The government has stated that they will look into alternatives for providing host municipalities with more revenues from the industry (Office of the Prime Minister, 2013).

1.1   Why is a tax requested?

Ever since the beginning of the salmon industry, production volumes have grown and the development is not expected to slow down in the years to come. Globally there are several conditions favouring growth in the aquaculture industry. The world's population is growing and results in an increasing demand for food and protein sources. Catches of wild fish are stagnating and increased consumption of seafood must come from aquaculture. This creates opportunities for the Norwegian salmon industry in the global market.

Increased production requires more area and suitable production sites. Given today's situation, municipalities need further incentive to facilitate for increased production in their zoning plans.

Municipalities hosting aquaculture production have several arguments for a tax implementation. They mainly base their arguments on the fact that production is occupying area and earning high profits without giving back to the host municipalities. Traditionally, the government and the county have received the majority of both the distribution fee for MAB-licenses and the corporate tax. Higher tax revenues are preferable to increase the municipalities' revenues in order to improve inhabitants' services and facilities. Municipalities also face several costs related to coastal planning and production sites, and want these costs covered by a new tax.

The recent focus on area use and municipalities' earnings from the salmon industry has resulted in a number of reports and a book by Hersoug and Johnsen (2012) on the topic. The book illustrates the difficult question of coastal planning and cooperation between different coastal users. For our thesis, reports by Kontali Analyse AS (Liabø, Nystøyl, Lassen, &

Kjønhaug, 2011) and Nofima (Isaksen, Andreassen, & Robertsen, 2012) have been highly relevant, as they are written specifically on the topic of an industry specific area fee.

Nofima was engaged by the Ministry of Fisheries and Coastal Affairs, the Research Council of Norway and The Norwegian Seafood Research Fund (FHF) to investigate municipalities' attitude towards aquaculture in 2012. Nofima found a common wish among the municipalities to be compensated for their effort on preparing for aquaculture and the lack of local value creation. The report did not find a general reluctance for the industry based on interviews with mayors in the municipalities.

Gullestad et al (2011) investigated the need for production area and how to develop area use in a best possible way. The report is perceived as critical towards a property tax on the salmon industry while being more positive towards an area fee, but neither has been given much focus in the report.

Kontali Analyse AS and a law proposal from Lund & Co (Lund & Jensen, 2013) are both made on order from the municipalities' interest group Network Fjord and Coastal Municipalities (Nettverk fjord- og kystkommuner), and focuses on the importance of taking the municipalities preferences into account. Both papers state that the recent development in the sector has led to centralised gains and limited benefits at the local level. The two papers also have a high degree of focus on what is done in other countries and are positive for the Scottish area rent on harvested volumes. James Barr Limited and Professor Dear (2011) explain how the Scottish tax is calculated and why the level of tax on quantity produced in Scotland was raised. Neither report did discuss the reason for, or the design of, the tax on quantity.

None of the reports, books or papers we have found on the topic has evaluated the different taxes against each other or given any recommendations to which tax is best suited for the purpose. This new approach is the core of our thesis. Our analysis will bring up more in-depth knowledge of the topic, look for possible effects of a new tax and contribute with relevant information for the final decision on which tax to implement.

2   Salmon farming – an introduction

This chapter starts by an introduction of the Norwegian salmon industry. Next the salmon farmers need for area is presented before we look into the municipalities wish for more income. We end the chapter by presenting how a tax can increase the benefit for both fish farmers and the municipalities.

2.1   About the Norwegian salmon farming industry

Seafood is Norway's second largest export product, after oil (Ministry of Foreign Affairs, 2011). From 2010 export of salmon[2] has been the greatest of all seafood both in terms of value and tonnes (Statistics Norway, 2013 B).

Today's salmon farming industry started out in Norway in the 1980s. The start was challenging and the industry been through a remarkable growth with increased production volumes and improved technology, productivity, husbandry practice and management. The salmon industry has developed from a "one man – one licence" industry through mergers and restructures into a global industry with several large multinational companies. Fish farming today is capital intensive, vertically integrated and export oriented. Listed multinational companies like Marine Harvest, Cermaq, Lerøy Seafood Group, SalMar and Grieg Seafood dominates the Norwegian industry (Liu, Olaussen, & Skonhof, 2010).

Figure 2-1 illustrates the growth in salmon production and also the total export value. About 95 per cent of salmon produced in Norway are exported. In 2012 Norway exported salmon for almost 30 billion NOK (Statistics Norway, 2013 A).

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[2] We want the reader to bear in mind that we include other salmon species when we write salmon. The two species produced in Norway (Atlantic salmon and rainbow trout) are very much alike we have therefore not included two separate discussions for the two.
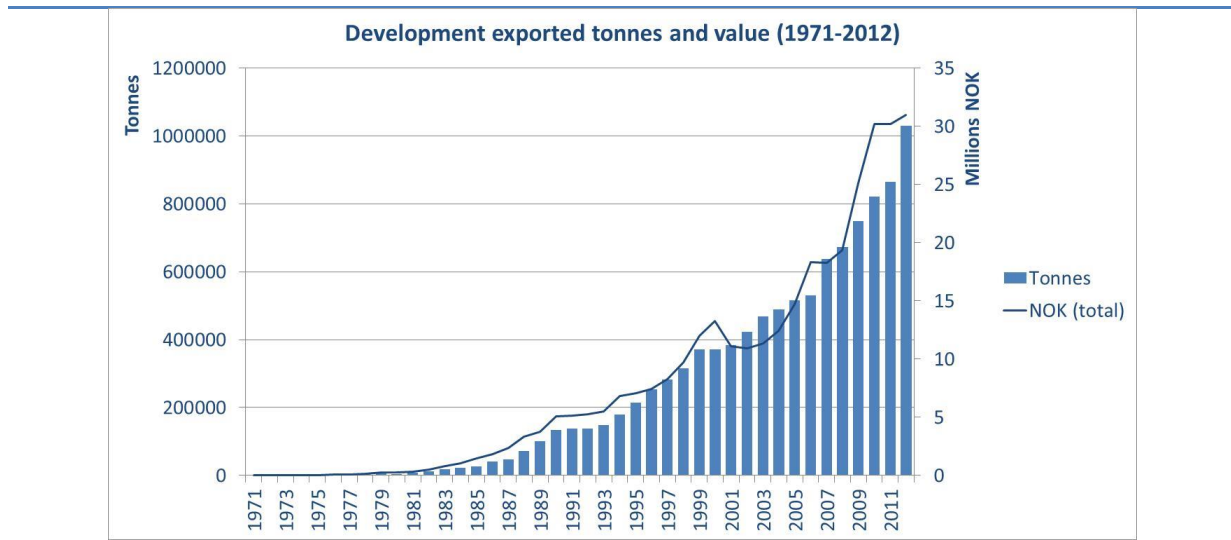
Figure 2-1: Development exported tonnes and value (1971-2012)
Preliminary figures for 2012 (Statistics Norway, 2013 A).

The main importers of Norwegian salmon are listed in Table 2-1 below. Norway exports fresh salmon and different processed products.

Exports of fresh salmon 2012	Salmon	Trout
Total	825 899 tonnes	48 854 tonnes
EU 27	568 758 tonnes	4 207 tonnes
Russia	126 275 tonnes	
France	114 164 tonnes	
Poland	105 173 tonnes	

Table 2-1: Norwegian export of fresh salmon measured in tonnes
Total calculated exports (fresh, frozen and fillets) 1 141 942 tonnes. (Norwegian Seafood Council, 2013).

Salmon production is dependent on natural conditions like seawater temperature, currents and a shelter coastline in order to succeed. The Golf Stream gives the sea waters in Norway a stable temperature and the Norwegian coastline has large differences between high and low tide, which contributes to good water circulations and gives clean and nutritious water. Many islands and deep fjords also help to shelter the aquaculture sites from harmful storms and secure a stable production in most years. The global salmon production is dominated by Norway and Chile (Marine Harvest ASA, 2012 A). Figure 2-2 below illustrates that Norway was the dominant producer in 2012.

Global production 2012
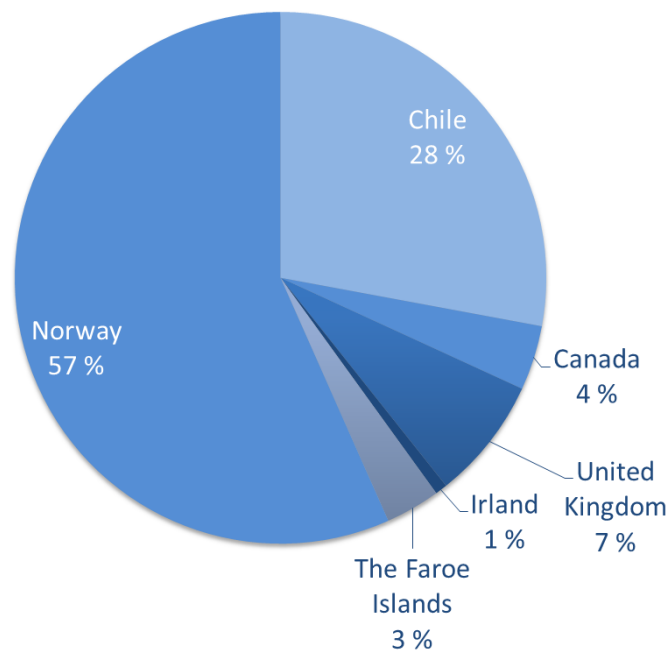
Figure 2-2: Global production of salmon and trout (Nystøyl, Øksenvåg, Kosmo, Eikrem, & Kirkholt, 2013)

The shares in global salmon production have been shifting the last years due to massive disease problems in Chile. Before the disease outbreak started in Chile around 2007, their production was close to half the Norwegian production (Asche, Hansen, Tveteras, & Tveteras, 2009).

2.1.1 Production costs

The salmon farming industry is dependent on optimal natural conditions in order to produce fish in the most efficient manner. Between and within municipalities there are great differences in natural conditions, which result in differences in production costs and efficiency. Because all sites are applied for and approved by the county, no sites are unsuitable for production.

Variable costs develop for increased production with an individual rate for all producers. Production costs vary with the quality of the site and production skills among producers. Fish farmers also face costs that are difficult to control for, such as water quality, diseases and sea lice problems. Development in variable costs is included to create a better understanding before the analysis of the three taxes and how they can affect the industry differently.

Feed is the greatest variable cost for producers and represent about 50 per cent of the total production costs (Directorate of Fisheries, 2013 A). Better knowledge on how to feed the right amount and reduce spill-overs is therefore of high value among producers. Much left over feed is also expected to attract wild fish, which may spread diseases if swimming between different production sites. Other costs, such as smolt and wage, differ among producers and production sites. Different equipment and production skills also determine variations among producers.

Feed use per kilogram of fish produced, feed conversion, varies depending on the size of the fish and by the production site. If the fish is fed optimally economies of scale are not possible to achieve. The only way to increase fish growth relative to feeding is through technological developments or development in ingredients.

2.1.2 Sales price

The sales price per kilogram of salmon produced is subject to random variations, seasonal trends and consumer trends. In the years from 2006 to mid-November 2013 the Fish Pool Index (FPI) shows that average monthly price has been between 20.64 to 44.10 NOK per kilogram (Fish Pool ASA, n.d.). The lowest price on a weekly basis has been 18.99 NOK per kilogram, and the highest 46.06 NOK. Only in 2011 did the weekly price range from 44.44 NOK per kilogram in mid-April to 18.99 NOK per kilogram in late October. So far in 2013 is the high–low difference 17.93 NOK, with a high price of 46.06 NOK per kilogram and a low price of 28.13 NOK per kilogram. This illustrates highly volatile prices and income risks for the aquaculture industry.

Table 2-2 below summarize some of the price fluctuations in the industry in the past three years. Year 2011 stands out as the year with the greatest difference between high and low price, while 2012 was a year with rather moderate difference.

Year	High	Low	Difference high-low	Monthly average	High-Average	Average-Low
2011	44.44	18.99	25.45	31.99	44.44 -31.99 = 12.45	31.99 -18.99 = 13
2012	32.48	22.43	10.05	26.58	32.48 -26.58 = 5.9	26.58-22.43 = 4.15
2013*	46.06	28.13	17.93	38.70	46.06 – 38.70 = 7.36	38.70–28.13=10.57

Table 2-2: Weekly price fluctuations 2011, 2012 and 2013 (NOK/kg)
(Fish Pool ASA, n.d.)
*preliminary numbers for January to mid-November 2013.

Large differences result in challenges for fish farmers with an individual sales price close to the low value in the table. Compared to an average sales price, the loss for this fish farmer would be between 4.15 and 13 NOK per kilogram, calculated in the column Average-Low. On the contrary, fish farmers selling in high-price periods earned an additional 5.9 to 12.45 NOK per kilogram.

2.2 Need for more area

Salmon farming production occupies area in the sea. To increase Norwegian production volumes the present production sites must produce more volumes or new sites must be approved.

In addition to the need for area because of increased production, has regulations on coordinated fallowing recently increased the demand for area in zones in compliance with the regulations. This was the situation for the small fish farmer Salaks (Dokka, 2013). The firm is demanding more area to produce cost effectively while obeying the rules of fallowing. This case is an example of how the need for area has changed for some firms even though the produced volumes are not changed much.

More information on regulations will be given in chapter 3.

2.3 The municipalities want more revenues from the salmon industry

In the report by Nofima the property tax is estimated to between 0.92 and 2.3 øre per kilogram slaughtered salmon (Isaksen, Andreassen, & Robertsen, 2012). A property tax of this size

generates tax revenues between 10 and 23 million NOK to the host municipalities. The government earns in comparison much more from MAB-license, corporate tax revenues and other taxes paid by the industry than the moderate tax revenue to municipalities.

With a new tax municipalities experience a trade-off between facilitating for production and earning tax revenues, or having unoccupied area. Increased production within the municipalities' boarders leads to higher income for the host municipality. Network Fjord and Coastal Municipalities (NFKK) and the industry want the tax to be transferred directly from producers to host municipalities to highlight the benefits from facilitating for production for municipalities' and their inhabitants (Network Fjord and Coastal Municipalities, n.d.; Network Fjord and Coastal Municipalities, 2013).

2.4 How to acquire more area?

Municipalities want more tax revenues and firms want more area. Use of classic economic behaviour can combine these two requirements and increase the benefit for both fish farmers and the municipality. Compensation (tax revenues) related to aquaculture production is expected to increase the municipalities' willingness to facilitate production sites. This happens because municipalities want more tax revenues. As the municipalities do not distribute MAB-licences, the only way they can try to influence quantity produced is by making more high-quality areas available for salmon production.

The reader should bear in mind that no firm can increase production when more area is acquired unless the firm also have the permission to produce more salmon (excess MAB-licences). More information on regulations follows in the next chapter.

3 Existing regulations and tax schemes

To allow for a better understanding of the industry and how a new tax can affect production, an explanation of the relevant regulations and limitations is presented in this part. The relevant regulations are in particular related to production volumes and geographical positioning. The challenges associated with diseases and parasites and regulations that can affect how salmon is produced optimally are also explained. The already implemented property tax and other tax schemes used in other countries are also briefly presented in this part.

3.1 Introduction

The salmon industry in Norway is a highly regulated industry with more than 60 laws and regulations. Many governmental bodies are involved in distributing MAB licences, approving production sites and providing permission for production.

Several of the already implemented regulations are imposed to protect the environment and surroundings. This is of interest for both the Government and the Norwegian inhabitants. Fish farmers also benefit from a clean and healthy production environment, with a low rate of diseases and contamination of parasites. Research and development to improve production and develop a sustainable industry is conducted by the Norwegian Seafood Research Fund and by the different firms.

3.2 MAB licences

Every fish farmer in Norway must have a licence to produce salmon. The Ministry of Fisheries and Coastal Affairs distributes licences in cycles. This year, up to 45 licences are to be distributed after an application process (Lovdata, 2013). A licence fee can be demanded by the ministry (Lovdata, 2001); today this is set at 10 million NOK. 35 of the 45 licenses are distributed for the price of 10 million NOK and the remaining 10 are distributed by a closed auction (Lovdata, 2013, § 7).

Licences are often distributed according to given criteria or guidelines and are bound to a concrete region. Typical criteria or guidelines can prefer companies with production in certain regions of the country where the sitting government wishes to see more industry development, companies with a required profile (e.g. high/some level of value adding on site) or smaller

rather than large companies. Because of this, salmon farming in Norway has to some extent been seen as a district policy tool[3] (Norwegian Seafood Association, 2009; Ministry of Finance, 2009 B, p. 87).

3.2.1 Maximum Allowed Biomass (MAB)

The licence states the maximum level of salmon the fish farmer can have in the sea at any time during the production process. The level is named the maximum allowed biomass (MAB) and is settled in tons of fish (biomass). The MAB per licence is 780 tons in most counties, except Troms and Finnmark, where the limit is set at 945 tonnes (Ministry of Fisheries and Coastal Affairs, 2013). The difference in MAB limits per licence comes from the reduced conditions for growth of fish in the north (Guttormsen, et al., 2012, p. 9).

The MAB regulation is valid both on the company level and for the specific production site. Neither the company MAB nor the site MAB shall be exceeded at any time. Fish farmers try to stay as close as possible to the MAB limit at all times to produce the maximum capacity of salmon. If either the company or the site MAB is exceeded, a penalty is given to ensure that the fish farmer cannot earn profit from the exceeding MAB (Directorate of Fisheries, 2008; Ministry of Fisheries and Coastal Affairs, 2011 B).

The number of MAB licences indirectly limits the fish farmer's total production, as optimal utilization of the given MAB limit will result in production trending towards a given maximum. An exceeded MAB limit results in increased maximum production. In the coming analysis, we use maximum production as a constraint in the model. In the analysis, the maximum production limit is static. Over time, fish farmers can potentially increase their maximum production slightly without additional MAB licences because of improved best practice and technological innovations.

3.3 Aquaculture site

After an MAB licence has been acquired, the fish farmer can apply for an aquaculture site related to this particular MAB licence or include the new licence in an already acquired site. An aquaculture site is a limited geographic area approved for aquaculture production of one particular species (Norwegian Seafood Federation, 2010 A). The production site is regulated

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[3] distriktspolitisk virkemiddel

for a limited biomass, the site MAB. After having received inputs from a number of consultative bodies, the county is the final decision provider (see Figure 3-1 below). Inhabitants in the municipality can state their opinion to the municipality as part of the distribution process (Fisheries.no, 2010).
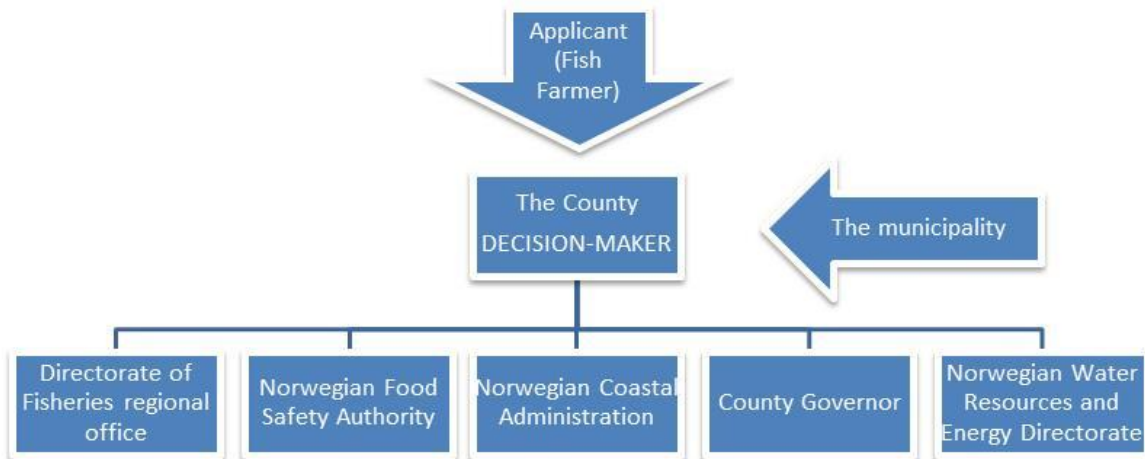
Figure 3-1: The application process for aquaculture sites (Fisheries.no, 2010)

The municipality has often already developed a zoning plan for the given areas. Zoning plans are used by municipalities to provide or prevent areas from being utilized for aquaculture. This happens because the plan identifies the areas that are approved and those that are not approved for aquaculture and in the application process the county must obey the municipality's zoning plan (Lovdata, 2005, § 30). The salmon industry hopes that a new tax will give municipalities further incentives to provide more sites for salmon production in future zoning plans, as municipalities' income increases.

Laws for how many production sites each fish farmer can operate were changed in the late 1990s (Asche & Bjørndal, 2011). Today, each production site can produce several MAB-licenses.

Municipalities argue for a tax by claiming that the industry is not paying for the use of production sites. This means that municipalities do not earn money from facilitating production sites. That being said, fish farmers experience costs for every site owned. The regulations on maintenance and certifications related to each site must be fulfilled even if

production is paused at the site, e.g. because of fallowing. As far as we understand, these payments represent considerable costs, and a fish farmer will not keep a site without plans to utilize it in the near future.

In addition to the costs of keeping sites, the law determines the required minimum use to keep a site. If less than one-third of the site MAB has been used over a two-year period, the site is revoked by the Directorate of Fisheries (Lovdata, 2005, § 38). The costs and requirements of having production sites are important to bear in mind during the later discussion of the use of area and the possibility of having too much area available.

The regulation on Salmon Location Permits determines that fish farmers are not allowed to move licences to production regions other than the region to which it is bound (Lovdata, 2005, § 33). Because licences are bound to a region and the production site is bound to the licence, it is not possible to move the production site outside the given region. This is especially relevant to the later discussions on the effects of the difference in quality of production sites.

If the natural conditions on site are good, the site MAB is large and several MAB licences can be used at each site. After the last years escapes, the Government has set the limit on the maximum number of fish in one cage to 200 000 fish (Ministry of Fisheries and Coastal Affairs, 2011 A).

Economic theory expects the most favourable production sites to be developed first. Since the beginning of the salmon farming industry, innovation in both technical installations and knowledge of fish welfare has improved. The earlier preference for sheltered sites is now forsaken as the preferences have changed. Production sites are now located further off shore where the water circulation and water quality are seen as more favourable.

The use of and access to the area around a fish farm is regulated by the Norwegian Law. It is illegal to fish closer than 100 metres to the cages, and people without permission cannot come closer than 20 metres to a cage (Lovdata, 2008, § 18). The area occupied by each production site is therefore perceived to be larger than the areas occupied by cages and other production installations. This regulation exposes some of the unfavourable consequences of a fish farm for the inhabitants. Lund and Jensen (2013) express a wish to tax the entire regulated area (100 metre).

3.4   Environmental regulation

In order to keep a high environmental standard in Norwegian fjords and on aquaculture sites, the government has implemented strict environmental regulations as well as a control regime for nutrients and organic matter. Every site must have a discharge permit from the Environmental Protection Agency before the site is approved. The discharge permits are regulated by the Pollution Control Act (Norwegian Seafood Federation, 2010 B).

The environmental regulations are relevant for the coming analysis as an unfavourable environment impacts on the production of salmon might reduce growth and fish welfare. The level of illnesses and parasites is also closely related to the quality of the water and seabed and these again cause a more difficult production environment.

The Pollution Control Act protects the water and seabed quality by regulations and standards. The site MAB is set in compliance with the specific site's water quality, currents and risk of affecting the environment.

Regulations related to sea lice and fallowing are intented to protect the environment. These regulations also directly affect the production of salmon. Sea lice are a troubling parasite and can lead to high costs and great losses. Fallowing is used as a tool to combat the parasite and return the production sites to a less affected state after a production period.

3.4.1   Sea lice

Sea lice are one of the main priorities to the Norwegian government as they can influence the fish and cause wounds, reduced appetite and stress (MSD Animal Health, 2013; Ervik, Alsvåg, Asplin, Aure, Døskeland, & Stigebrandt, 2007). If the number of sea lice exceeds the legal limit determined by § 8 in the Regulation for the Control of Sea Lice, the salmon must be treated medically with liquid substances or by additions to the feed (Lovdata, 2012). The treatment is costly and can possibly stress the fish, thereby reducing their living condition and growth. Especially on the western coast of Norway, the high cost related to sea lice treatments is a challenge for many salmon farmers. The cost of delousing differs among companies and production sites. Sea lice are a factor that can differentiate the demand for production sites.

Sea lice float with the current and coordinated delousing and fallowing have therefore been initiated in order to remove all the sea lice in the area at the same time (Norwegian Food Safety Authority, 2010).

3.4.2 Fallowing

Once the salmon at a site are harvested, the site must lie fallow for at least two months before new fish can be released into the cages (Norwegian Seafood Federation, 2010 B). In addition, a rather new regulation from the Norwegian Food Security Authority regulates coordinated fallowing in certain areas (Norwegian Food Safety Authority, 2013). Coordinated fallowing is thought to have a long-term effect on the general environmental condition of the area and on the sea lice level. Fish farmers are able to produce one generation of fish between each fallowing in the area.

There are potential difficulties of fallowing for smaller fish farmers. If all the production is within one area, all the sites must be fallowed at the same time. This means that the fish farmer has to stop production completely before releasing new smolt. Fallowing also increases the price risk, as all the fish are harvested at the same time. A small fish farmer with all the production within the fallowed area cannot divide the harvest over several months or years and thus hope to achieve a good sales price for (at least) parts of the harvest. The price risk would be decreased if the harvest and sale were distributed over a longer period of time. This is easier for larger fish farmers to accomplish as he has production in several fallowing zones.

3.5 Tax payments to the municipality

The tax we investigate is a tax intended to increase the income for municipalities. As will be further described in the analysis, municipalities often prefer a stable tax income. This can be obtained in two ways:

- The tax can be fixed: not varying from year to year, or
- The tax can be collected by the government and redistributed to the municipalities in average shares over several years.

The latter point is more beneficial for firms as they can pay taxes depending on how well they or the market performs each year (profit or revenues). This is also how municipalities in

Norway to a large extent are financed already (Ministry of Local Government and Regional Development, 2010). Governmental transfers can easily be made close to static from one year to another and can thus secure a stable founding and facilitate long-term plans and projects in the municipality.

Different kinds of income that fluctuate from year to year will not produce the same economic stability. Of the three taxes we analyse later, the tax on revenue is correlated with the market cycles. The tax on quantity is also dependent on fluctuations in the market, but more important are the production challenges and differences in growth and illnesses from year to year. With a highly fluctuating tax based on unpredictable business cycles, we have to consider the possibility that the government will change the tax level to smooth the tax revenues for the municipality.

3.5.1 Property tax

Property tax was first implemented in 1665 and is still in use in Norway (Ministry of Finance and Customs, 1996). Municipalities can choose to implement a tax on property to increase their incomes. Today's property tax is paid directly to the municipality hosting the property (Ministry of Finance, 2010). Property tax is well suited to being directed to the funding of municipalities because of the immobility of the taxed asset and therefore the stability of the tax payment (Ministry of Finance, 2009 A).

In 2009, the law was extended to include properties for aquaculture. Municipalities could from this date onwards tax the value of cages and other floating equipment related to fish farming (Ministry of Finance, 2009 A).

3.5.1.1 Property tax on aquaculture sites

Gullestad et al. (2011) estimate the tax payments from property tax per aquaculture site to be between 25 000 and 70 000 NOK per year. The total tax payment for all production sites is estimated to be between 27 and 76 million NOK per year (Gullestad, et al., 2011, p. 38). In 2010, 114 of the 157 municipalities with fish farming had implemented the new property tax (Isaksen, Andreassen, & Robertsen, 2012). Lund and Jensen (2013) explain the number by the too little income to the municipalities. This is explained as a result of the great costs related to valuating the property, and much of the tax income would be used to cover such administration costs.

In addition to the high cost of taxing fish farming equipment, are fish farmers with new and valuable investments taxed harder than those with old equipment. This might work contradictory and reduce the speed of investments or upgrades in new and more optimal production equipment.

3.6   How other countries tax the salmon industry

Gullestad et al. (2011, p. 185) state that "in most salmon producing countries one must pay some kind of annual rent or fee for the use of sea area for aquaculture purposes". Different legislation uses different tax designs in the salmon producing countries around the world. The following section briefly describes how other salmon producing countries tax the production or areas used for the production of salmon. Some of these have been used as inspiration for the implementation of a new tax in Norwegian waters.

Possible options for an area tax or a tax to municipalities are of interest to us. The following paragraphs are written on the basis of findings from Kontali Analyse's report and the Gullestad report (Liabø, Nystøyl, Lassen, & Kjønhaug, 2011, pp. 22-27; Gullestad, et al., 2011, pp. 35-38).

In the *Faroe Islands*, the parliament discussed an annual fee of DKK 12 million, but it was later changed to an additional tax on profit. Companies do not pay rent for the used area today (Gullestad, et al., 2011). Kontali Analyse (2011) writes that the taxes on the Faroe Islands are paid to the central government or divided between the central and local governments as fixed shares given for all income taxes. The Faroe Islands are much smaller than Norway, with only six districts (Statistics Faroe Islands, 2013, p. 6).

Both in *Canada* and in *Chile*, fish farmers must pay a rent or a tax to the national government for the use of the area. In Canada, a site is rented for 10 or 30 years at a time (Gullestad, et al., 2011). The rent depends on the area used and different areas are taxed differently depending on their use (Liabø, Nystøyl, Lassen, & Kjønhaug, 2011). As far as we can understand the text by Kontali Analyse, this means that a corresponding Norwegian tax level would be different for the three different areas:

- Cages and other equipment,
- The 20 metre trespassing ban and

- The 100 metre fishing ban zone.

In Chile, salmon farmers must pay an annual licence fee per hectare used for production. The fee is fixed, but varies with the monthly inflation (Liabø, Nystøyl, Lassen, & Kjønhaug, 2011).

While few talk much about the different taxes or fees in other countries, the annual rent paid in *Scotland* is mentioned as a possible guide for a tax design that can be implemented in Norway (Grytøyr, 2011; Longvastøl, 2011; Lura, 2013). In these newspaper articles, and in the Kontali report (Liabø, Nystøyl, Lassen, & Kjønhaug, 2011) and the law proposal by Lund and Jensen (2013), a tax at the level of Scotland's is mentioned as appropriate for the Norwegian industry. In Scotland, the harvest volume is taxed by £0.0225, or about 0.22 NOK[4] per kilogram on the main land (James Barr Limited & Dear, 2011).

Tax on quantity in Scotland differs between production areas. Salmon from Shetland, Orkney Islands and the Outer Hebrides are subject to a tax rate 10 per cent lower than that for the rest of the production areas. The tax is in addition defined for a price threshold between £2.80 and £6.00 (NOK 27.38 to 59.22). If spot prices stay outside the interval for more than six months, an additional rent review with a possibly changed tax rate will be held (James Barr Limited & Dear, 2011). The tax rate in Scotland is fixed for five years at a time and will therefore not follow fluctuations in the industry's prices unless the mentioned threshold is violated for more than six months.

We analyse a tax like the one in Scotland in chapter 4.5.

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[4] exchange rate 9.78

4 Analysis

4.1 Explaining the three taxes

In this paper we ask what tax is better suited to combine the different preferences of the two conflicting groups, the municipalities and the firms. To investigate this, we look at these three taxes:

- Tax on quantity produced
- Tax on revenue
- Tax on area used

Tax on quantity produced and tax on area used have often been discussed on seminars, in newspaper articles, blog posts and by both the municipality and the salmon industry. We therefore found these especially interesting to compare. Contrary, tax on revenues has not had much focus before. Despite this we have chosen to analyse this tax because it correlates with profit and is closer linked to a tax on resource rent than the other two taxes. We find all three taxes suitable to increase municipalities' income from the salmon industry. All three taxes have a different tax base and the combination is therefore useful to illustrate the different effects of a new tax on the salmon industry.

Later in the analysis the tax on quantity is closely linked to the corresponding tax in Scotland and how the tax is designed there. A tax on area used is implemented in Chile and Canada, but little information of the actual tax design is available. The analysis therefore is independent from their tax schemes.

Before analysing all taxes in the case of the Norwegian market, we guide you through seven evaluation criteria and use a stylized model to demonstrate how the three taxes affect the firms bound by production constraints. At the end of the thesis we present some remarks on how to implement a tax before we conclude on which tax to recommend.

4.2 Method for analysis

Before we describe concrete differences in the three taxes, we explain a set of evaluation criteria used in the analysis. The criteria we have chosen to investigate are: whether or not the tax is distorting, regional differences, production incentives, profit risk for fish farmers, income uncertainty for municipalities, unwanted consequences, innovation decisions and bureaucratic challenges. Some criteria are chosen to improve the understanding of the effect a new tax will have, while other criteria are often up for discussions in the media. How the different taxes will affect different types of firms, fairness, is also drawn attention to several times. Regional differences have also been historically important when distributing MAB-licences.

4.2.1 Distorting/non-distorting taxes

The ideal tax to reallocate capital from the firms to the municipalities is non-distorting. A tax can be non-distorting depending of the level of it. The individual firm's willingness to pay for the taxed factor depends on their profitability and is derived from the production differences between municipalities and firms.

If the differences between municipalities are large can a flexible tax with different tax levels for the individual municipalities be a solution. The national government can make the tax voluntary to implement and let the municipalities determine the tax level, or the government can give a maximum and minimum level from which the municipalities can decide. If the tax level is set according to the total benefits and challenges of having production within the municipalities' boarders individual tax levels will reduce the differences in production costs. A locally determined tax level is expected to give a more suitable tax level than a nationally chosen tax level (Oates, 1999).

It must be noted that there also can be large differences in production costs within municipalities. Differences between firms can be taken into account by giving each firm its own tax level. This is close to impossible to accomplish because of the difficulty in determining the right, individual tax level. Individual taxes will also give producers incentives to demonstrate a lower quality of the site than the true quality. Profit-maximizing producers will illustrate lower willingness to pay for the taxed factor if costs related to this are lower

than the future earnings of a lower tax. This can create further challenges for municipalities with intentions of setting the best possible tax.

All three taxes we analyse are non-distorting for a low tax level. Because of this, we will only look at this evaluation criterion generally for all taxes at the same time.

4.2.2 Regional differences

One of the possible changes in economic behaviour is a change in geographic orientation of production. It is interesting to examine regional differences because changing geographic positioning affects the municipality's income and disturbs settlements and job opportunities in the area left behind. The Norwegian government and municipalities have traditionally opposed such changes.

The ideal, non-distorting tax does not affect the industry's geographic positioning and keeps production where it is today. A move to another municipality can happen because of increased regional differences in costs and revenues as a result of the implemented tax. Different local conditions and firms determine what tax level is right for the individual municipality. High-quality locations with lower production costs can take on a higher tax than less suitable sites.

Differences in environment and infrastructure affect the quality of a site and thus the producer's profitability. Differences in tax levels will also affect producers' demand for specific sites. The national government can decide whether the tax should be mandatory and if the tax level is to be equal for all municipalities. A maximum and minimum level from which the municipalities can decide can also be given. The possibility for municipalities to use a flexible tax level is interesting to examine because it can be used to reduce differences between municipalities. A municipality that implements a low tax level can use this as a tool to attract more producers to a specific municipality.

Neither municipalities nor national governments have perfect information and cannot be compared to a benevolent planner. It is therefore impossible to set a perfect tax and reach full economic efficiency.

The marginal utility for the municipality is given by the marginal willingness to facilitate for production sites. If the tax is set too high, production sites of low quality are made unprofitable. The benefit for municipalities with only low-quality sites can be higher without

a tax, or with a low tax. This is the case if the downside of losing all production is greater than having fish farming industry without the new tax income.

Norwegian regulations do not permit fish farmers to move production sites and licences to other production regions. Different municipalities can be used, but there must be strong reasons for moving licences to another production region.

4.2.3 Production incentives

Based on economic theory, fish farmers want to maximize profit and behave thereafter. The optimal production quantity can change for increased costs, for example from a new tax. Norway wants large volumes of high-quality fish, and wishes to avoid changes in production incentives. We will examine the effects the different taxes have on the actual production. If the new tax affects production volumes, the tax is distorting.

4.2.4 Profit risk for fish farmers

The Norwegian government, the municipalities and the industry as a whole benefit when profit risks are small, and the firms are financially solid as this leads to secure jobs and spin offs effects from the industry. The financial stability is challenged as fish farmers experience business cycles because of highly volatile prices and challenging production conditions. The design of a tax can lead to more devastating downturns in economically difficult years. A fixed tax, with the same amount to be paid in good years and bad years, increases the risk of deficits for the fish farmers. Contrary, a tax based on factors correlating with price and profit fluctuates with the producers' profitability, as the tax will be lower in periods of low price and low production.

Marginally profitable firms will suffer the most from a fixed tax payment. These fish farmers have a generally higher risk of deficits than other producers and increased fixed costs increase the risk of deficits, especially in economically difficult years.

4.2.5 Income uncertainty for municipalities

The discussion often revolves around municipalities' need of rather stable revenues in order to fulfil their obligations to inhabitants (Ministry of Local Governments and Regional Development, 2008). Predictable taxes are suitable for planning long-term investments and

welfare services that benefits the inhabitants. The most stable taxes are based on immobile assets such as property (Ministy of Finance, 2009).

The proposed Norwegian tax is expected to be paid directly to the municipalities and not redistributed by the national government. If the central government were to redistribute tax revenues to municipalities, the income could be secure and stable. This is not what the industry or the municipalities wish for as they want direct transactions and the transfers to be publicly known (Fish.no, 2011; Network Fjord and Coastal Municipalities, 2012).

Implementation of a tax leads to decreased profit and potential mergers of firms. Lower profitability increases incentives for higher efficiency and economies of scale when producing salmon. This can change the tax base in the host municipality and be either favourable or irrelevant. Solid and profitable firms are of importance for municipalities. Risk of closures and reduced number of employees is unfavourable.

4.2.6 Unwanted consequences

Introduction of taxes and regulations have led to, and can lead to, unwanted and unexpected changes. Depending on the changes, it can be more difficult for a municipality to estimate the actual tax payment if there are unwanted or unforeseen consequences of the tax. It is therefore important to analyse possible outcomes before introducing a new tax. We will analyse consequences for production under all taxes and investigate how firms can or will change production to limit tax payments.

4.2.7 Bureaucratic challenges

Some municipalities have chosen not to implement the property tax on aquaculture production because of low revenues and high costs (Isaksen, Andreassen, & Robertsen, 2012, p. 40). This happens as much of the tax payments are used to cover for bureaucratic work. It is important for the municipalities that the new tax revenues exceed the costs of implementing and executing it. If not, there are no reasons to impose it and the tax will fail. When implementing a tax to increase municipalities' income, it is therefore essential to take workload (bureaucratic work) into account.

The level of bureaucratic challenges to be expected by governments, municipalities and producers depends on the specific tax and how it is formed. Flexible taxes with regional or

individual adjustments might lead to a higher workload for the regulating authorities. We only expect bureaucratic challenges to be an issue on tax on area used. For the other two taxes the potential bureaucratic challenges are only briefly mentioned as data on harvest and revenue are already reported.

4.2.8 Innovation decisions

A new tax reduces the sector's competiveness in the international market and the expected return on investment because of a reduced profit. New innovations are crucial and preferable to increase efficiency or profitability and to develop the industry further. Innovations leading to higher quality or lower costs for the sector will lead to higher revenues. Being leading in the sector gives competitive advantages to the firm because of new technology and improved production skills. Most economists would agree that today, innovations are crucial in effective competition and economic development.

4.3 A stylized model

Our analysis uses a stylized model as a tool to better illustrate the effects of the different taxes. The model does not include capital, as this would challenge the simplicity of the model. In the following we will present and explain the model and relevant assumptions taken. We continue with explaining the shadow prices of the two constraints (area and MAB) before relating the stylized model to the three taxes; tax on quantity, tax on revenues and tax on area.

4.3.1 Presenting the model

The variables we use are listed below.

π: profit

p: price

Q: quantity of produced salmon

$VC(Q)$: variable costs given as a function of quantity, excluding fish feed

t_a: tax on area

$A(Q)$: taxable area in use as a function of quantity

t_q: tax on quantity

t_r: tax on revenue

$\overline{Q}$: maximum produced quantity of salmon for each company

$\overline{A}$: maximum area occupied by the firm that no one else can use. Area around cages available for the firm that are not in use is included

Table 4-1: Variables

All included variables affect the firm's profit. Producers are expected to be profit maximizers and thus produce the quantity that maximizes their profit, for the given constraints. To maximize profit, the Lagrange equation is used, illustrated by equation (1) below.

$$\pi = pQ - VC(Q) - t_a A(Q) - t_q Q - t_r pQ \qquad (1)$$

4.3.1.1 Constraints

The two constraints on area use and quantity must be satisfied. Regulation described in chapter 3 determines the limitation in quantity and area. This cannot be violated in the model.

$Q \geq \bar{Q}$	Quantity produced cannot exceed maximum allowed produced quantity (given by the government)
$A \geq \bar{A}$	Used area cannot exceed maximum available area.

Table 4-2: Constraints

4.3.1.2 Assumptions

The two following parts explain the assumptions on variable costs and area use. Storage of fish is not included and we assume that all salmon produced is sold.

$VC'(Q) > 0$	$A'(Q) \geq 0$
$VC''(Q) > 0$	$A''(Q) < 0$
Quantity produced is equal to quantity sold.	

Table 4-3: Assumptions

Variable costs

In the stylized model, variable costs are given as functions of quantity. The function is increasing and convex (positive derivatives of first and second order). This is plausible because all variable costs will increase for additional salmon production. Variable costs can include, among others, feed, vaccination costs, sea lice treatment, disease control, fuel, electricity and labour.

Use of area

Area use is also given as a function of quantity. All producers need area to produce salmon. The need of area varies with production quantity, but will decrease relatively for a larger production. The area curve is increasing and concave with $A'(Q) \geq 0$ and the $A''(Q) < 0$. Figure 4-1 illustrates an area curve.

4.3.2 Explaining the model

Equation 2 and 3 are the Lagrangian equation. When deriving this equation with respect to quantity, the first order condition (equation 4) illustrates how profit changes by a marginal change in production quantity. We use one first order condition when determining the effect of the different taxes on profit and quantity produced.

$$\mathcal{L} = \pi + \lambda(\bar{Q} - Q) + \mu(\bar{A} - A) \tag{2}$$

$$\mathcal{L} = pQ - VC(Q) - t_a A(Q) - t_q Q - t_r pQ + \lambda(\bar{Q} - Q) + \mu(\bar{A} - A) \tag{3}$$

$$\frac{\partial \mathcal{L}}{\partial Q} = p - VC'(Q) - t_a A'(Q) - t_q - t_r p - \lambda - \mu(A'(Q)) = 0 \tag{4}$$

The derivative of lambda with respect to quantity produced gives the change in profit by a marginal change in quantity. When the first order constraints (equation 4) equal zero ($\bar{A} = A$ or $\bar{Q} = Q$), the maximum or minimum level of equation 2 is reached. The tax scheme and tax level change the optimal production level because all tax payments affect income or costs. Tax payments vary with quantity produced and all tax are therefore included in equations (2), (3) and (4).

The optimal production quantity is where profit is maximized. Equation 4 shows that the three taxes affect profit alone or in combination with price or the area function. This determines how much optimal production is changed by the three taxes and is explained closer in part 4.3.4 where we explain the model for each of the three taxes. All terms in equation (4) are affected by the change in quantity.

If the optimality condition holds, we can rearrange equation (4) to illustrate that marginal revenue (p) must equal the sum of marginal production costs, the tax on quantity and shadow prices of quantity and area. The last unit sold is marginally profitable. This is shown in equation (5).

$$p = VC'(Q) + t_a A'(Q) + t_q + t_r p + \lambda + \mu(A'(Q)) \tag{5}$$

Fish farming firms are price takers in a competitive and highly regulated market. Binding limitations in produced quantity hinder the optimality criteria (equation 5) to be satisfied. The price is higher than the cost of production, which leads to high profits for companies.

The difference between production costs and sales price has been substantial in the years from 2008 to 2012, illustrated in Table 4-4 below. This can be a consequence of the given production limitation. As Norway has market power the limited production can affect the market price. However, this is outside the scope of the analysis.

	2008	**2009**	**2010**	**2011**	**2012**
Operating income per kilogram	21.91	24.97	31.44	25.83	22.90
Operating cost per kilogram	21.04	20.15	22.84	22.23	21.98
Operating margin per kilogram	0.87	4.82	8.60	3.60	0.92
Operating margin as per cent of revenue	10.2 %	20.9 %	32.9 %	16.4 %	6.5 %

Table 4-4: Operating income, cost and margin in NOK

Calculations above illustrates that the industry has a positive operating margin (Directorate of Fisheries, 2013 A)

An operating margin between 6.5 % and 32.9 % is a first indication that the industry most probably can afford an additional tax.

4.3.2.1 A brief illustration of the model

Figure 4-1 below illustrates a producer in a competitive market, constrained by area. The figure provides background information and a better understanding for the coming analysis. We therefore start out by explaining the figure before further analyses are made.

An important assumption from economic behaviour theory is the expected result of increased potential revenues. Economic behaviour theory presumes that increased tax income to the municipalities from aquaculture industry leads to an incentive to provide more production sites. This happens because municipalities want more tax revenues. More salmon must be produced to increase tax revenues. Municipalities can initiate increased production by facilitating more production area to increase tax payments. Area will be provided until the marginal income for providing the area equals the marginal cost for host municipalities.

A higher supply of production area will lead to higher maximum area available to fish farmers and more salmon can potentially be produced. In Figure 4-1 the optimal production quantity for a producer in a competitive market is where the price curve intersects the marginal cost curve (MC), in Q*. The situation illustrated in the figure is a case where the producer is limited to use area equal to A1, and the firm can thus produce Q1 kilograms of salmon.
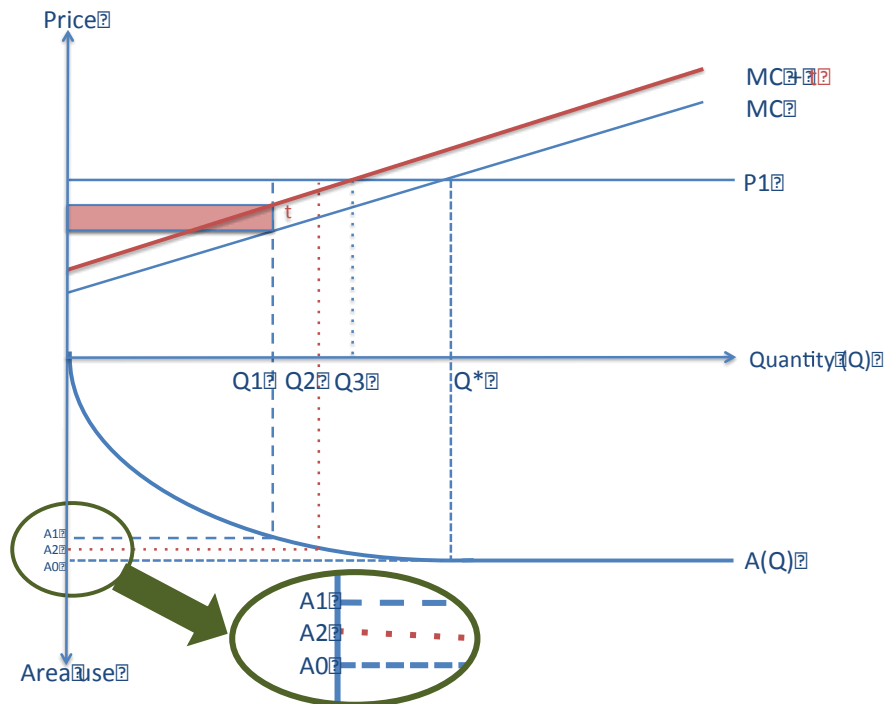
Figure 4-1: Area use, quantity produced and price

Q* is the quantity a producers would supply in a perfect competitive market without area limitation as the price (P1) would be equal to MC. By limiting area, the production quantity is limited to Q1.

The tax payment reduces the producer's profit by the red area, and increases the municipalities' income with the same amount. For an increase in available area to A2, the production increases to Q2. Price is kept constant, as the firm is a price taker.

The tax is non-distorting.

The introduced tax is added to each quantity produced and increases marginal cost (MC) to MC + t (tax). This decreases the optimal production from Q* to Q3, determined by the point where MC + t intersect with the price curve. As long as the area constraint is binding, the production is still Q1 and the tax is non-distorting. The firm cannot affect the market price and the produced salmon is still sold for P1. The red area marks the reallocation of capital from firms to the municipalities and the consumers' surplus is not affected.

Increased revenues give the municipalities incentives to increase available area for example to A2. When more area is available the production can increase to Q2. Both the firms profit and municipalities' tax income will increase for a production of Q2.

Fish farmers will earn income for every unit sold up to the point where marginal costs equal the price. The distance between the marginal cost curve and price curve illustrates the producer's profit. This gap also represents the firm's willingness to pay for increased production. When the last unit produced is only marginally profitable the willingness to pay is zero. In the Norwegian market, a fish farmer can be constrained by both area use and MAB-licenses. From the above figure we cannot determine which of the two constraints he has a willingness to pay for. If the producer is only limited by area (as in this example), he's willingness to pay for additional area is positive as long as the production is lower than Q3.

4.3.2.2 Production sites

The difference in quality among sites is not included in our stylized model. In the above figure the fish farmer is limited by area and has willingness to pay for additional area. In the real market, the producer can have a different willingness to pay for different production sites, due to individual preferences. In order to get better-suited production sites it is also possible that producers not constrained by area, still have a willingness to pay for additional area.

Firms prefer to use the best available production sites to produce most efficiently. Municipalities with less favourable production sites can lose production volumes to better suited areas, when more area is provided. This is especially relevant if some municipalities' implement a tax and others do not or if earlier profitable sites are no longer profitable because of the tax implementation.

4.3.3 Shadow prices

An important part of the discussion is to analyse how the different taxes will change firms' behaviour. From the first order condition (equation 4) it is possible to analyse changes determined by a marginal change in quantity of salmon produced. A discussion about the shadow price in different scenarios will be presented in the following.

The Norwegian aquaculture industry has set limits on both quantity produced and area used. Firms that are bound by one or both production constraints ($\bar{A}$ or $\bar{Q}$) can have a shadow price on one or both of the two input factors. The shadow prices affect how firms behave for different tax implementations: if the shadow prices are high the tax is more likely to be non-distortive.

Marginally profitable firms choose production levels unconstrained by the regulatory limits. Their optimal production is equal to or lower than the maximum production level, and the shadow prices are both zero. When a tax is added to the marginal cost or subtracted from the marginal revenue, optimum production is reduced and the tax is distorting.

4.3.3.1 Shadow price on quantity (λ)

The MAB regulation described in detail in part 3.2 on page 10 limits the tonnage of fish in the cages (biomass). Production is limited by both MAB and external factors like depth, currents and temperature. This production limit is denoted by $\bar{Q}$ in the model. Every fish farmer optimizes production and tries to utilize MAB to the maximum. If production is constrained, (I) the number of licences (MAB) must increase, (II) utilization of already acquired MAB-licences must be improved, or (III) the production site must be changed for one in a more favourable environment before the fish farmer can increase production.

If the fish farmer produces $\bar{Q}$ (the maximum production of salmon), the shadow price of MAB (λ) might be positive. With a positive shadow price the company is willing to pay for increased MAB. High willingness to pay for increased MAB (large λ) illustrates that every kilogram of salmon produced is highly profitable the producer is unlikely to reduce production as a result of a new tax. The tax is non-distorting for a lower tax level than λ.

Marginally profitable firms have low willingness to increase production and a low but positive λ. The optimal production is equal the maximum production level. The firm earns money on every unit produced, but the last unit is only marginally profitable. The firm has no willingness to pay for increased MAB, and production may be reduced as a consequence of the tax – the tax is distorting. Marginally profitable firms can become unprofitable and sell out or merge as a result of the tax. In this case will competitors buy and produce their production capacity (MAB) and the national production is not reduced.

Available production capacity is not fully utilized when produced quantity is lower than the maximum production volume. This can occur when producers maximized profit at a lower quantity than $\bar{Q}$. These companies' shadow price of the MAB constraint (λ) equals zero, and the firms are not willing to pay for additional production capacity.

Companies not fully utilizing production capacity are less profitable than firms with a willingness to pay for additional MAB. Norwegian fish farming companies are in general highly profitable. Mergers and acquisitions happen on a regular basis. Highly profitable firms have incentives to buy less profitable firms, and their production capacity and number of sites.

In an economic model with a perfect market, all production capacity would be fully utilized in the long run. Available production capacity or capacity from low-profit firms would be acquired by producers with the highest willingness to pay for it.

4.3.3.2 Shadow price of area (μ)

Area limitation as defined in the model is highly simplified. Fish farmers are in need of good production sites with favourable production conditions. The value of Norwegian production sites depends not only on its size, but also on the quality, the concrete location and environmental condition. The area use constraint does not include quality differences and the shadow price is therefore only representative of an average production site.

The maximum available area ($\overline{A}$) is given by the amount of area that the different fish farmers have available and account for when planning production. Total available area can be higher than actually utilized area. Fish farmers do not pay for unused area, but equipment regulations require investment and maintenance on the site. In a perfectly competitive market the shadow price of area would equal the market price for it. Firms can acquire more area through mergers and acquisitions or by applications to the host county (see part 3.3 Aquaculture site).

Firms not using their entire designated area have the possibility to change production sites. This is likely to happen if production costs differ between municipalities. We will not discuss this matter in detail, but we expect that a fish farmer using an area below the limitation level has the possibility to increase his area use.

Shadow prices for area in the Norwegian salmon industry include values from zero and up. The shadow prices vary between firms, areas and production sites. There are a number of reasons for differences in firm-specific preferences such as environmental or geological (depths, currents, etc.) conditions. Fish farmers can also have a particularly high or low individual value regarding sites in a concrete region. Because of personal production

preferences, a site e.g. close to already excising sites or harvest plants can give the producers a higher willingness to pay for that specific site, compared to competitors.

In economic theory it is optimal that the firm with the highest benefit, and therefore also highest willingness to pay for the site, receives it. In Norway it is possible for firms to obtain unused or unprofitable area owned by other firms by renting the site or by mergers and acquisitions. As far as we know is it only possible to sell production sites bundled with licences in Norway.

If a firm uses all available area the shadow price is equal to or greater than zero. A high shadow price illustrates a correspondingly high willingness to pay for more area. Firms with high shadow price for area use their present area in an effective manner. Their high willingness to pay for more area is derived from an expectation that the firm can increase its profit if more area is made available.

Every firm with a positive shadow price of area is restricted by the area constraint and cannot increase production further. Fish farmers restricted only by area use can produce more for additional area. Production cannot be expanded before a new production site has been approved. According to a change in regulations, producers can utilize several licenses at one site compared to before when one site had one license. This can also be one of the reasons why most fish farmers in Norway are (also) restricted by the MAB constraint and cannot increase production for only an increase in available area.

The discussion in the industry about area use reflects a high demand for more area. It seems likely that most of the Norwegian salmon farming industry presently has a high shadow price for area. There have also been some examples of fish farmers not being able to utilize their MAB to the maximum because they have less area than is required. A description of such a case is given in part 2.2 on page 8.

Firms with excess of area

Area quality is not included in the model and a marginal profitable firm has no shadow price of area use. With no shadow price of area, the firm is optimizing its profit for a lower use of area than is available. When all other factors are kept constant the producer does not demand additional area. An increased tax level increases the production costs or reduces the sales

revenue and thus the firm's profits. Taxes imposed on area use increase incentives to reduce use of area. Area use is a function of quantity produced and reduction in area can thus lead to lower quantity produced.

The extent of the reduction in quantity produced as a result of a reduction area used depends on the slope of the area curve. The slope depends on the individual firm and where the firm is positioned along the curve. A producer positioned at the flatter part of the curve has to reduce production quantity greatly to reduce use of area and thus tax payments. This is illustrated in the Figure 4-1 on page 29 where area is a function of quantity for a chosen firm.

4.3.4 Stylized model on the different tax schemes

Before analysing the different taxes in the terms of the Norwegian market, we look at the three taxes, tax on quantity, tax on revenue and tax on area used, in light of the stylized model. The following paragraphs illustrate that the effect on profit depends on the design of the different taxes.

To ease the reading, we remind the reader of the Lagrangian equation (3).

$$\mathcal{L} = pQ - VC(Q) - t_a A(Q) - t_q Q - t_r pQ + \lambda(\bar{Q} - Q) + \mu(\bar{A} - A))$$

4.3.4.1 Tax on quantity produced

Tax on quantity solely depends on the amount of salmon produced, as producers will pay a certain amount of tax for every kilogram produced. When evaluating a tax on quantity, the Lagrangian equation is derived with respect to quantity produced. Tax on quantity (t_q) has a value, while all other taxes equals zero ($t_r = t_a = 0$). Equation (6) below gives the marginal effect on profit for a one-unit change in quantity with a tax on quantity produced. A one unit increase in quantity results in a t_q increase in tax payments. Profit maximization requires the optimality condition below to hold. As has been described earlier – this is probably not the case for most of the Norwegian salmon industry.

$$\frac{\partial \mathcal{L}}{\partial Q} = p - VC'(Q) - t_q - \lambda - \mu(A'(Q)) = 0 \tag{6}$$

4.3.4.2 Tax on revenue

Tax on revenue depends on both sales price and quantity sold. When analysing tax on revenue t_r is positive, while all other taxes equals zero. The optimality criteria below, equation (7), needs to be fulfilled to maximize the producer's profit if the market were perfectly competitive.

$$\frac{\partial \mathcal{L}}{\partial Q} = p - VC'(Q) - t_r p - \lambda - \mu\big(A'(Q)\big) = 0 \tag{7}$$

For every unit of change in production, will also tax payments be change by the amount $t_r p$. If $t_r = t_q$ and the sales price per kilogram is higher than one, tax on revenue is increased more than tax on quantity from an increased production ($t_q < t_r p$). A price lower than one ($p < 1$) payments from tax on revenue will be lower for the producer than tax on quantity. The two tax levels are most certainly not equal, and we later analyse for a fixed NOK value on tax on quantity and a percentage tax on revenue. The stylized model does not determine this.

4.3.4.3 Tax on area used

While the two other taxes are closely linked to production is tax on area dependent on an input factor (area) for production. The size of the tax will vary with production as area used varies with quantity produced. However, some Norwegian producers can have much higher production per cubic metre compared to others. For tax on area, t_a is positive while the two other taxes equals zero. To optimize producers' profit in a perfect competitive market, the optimality condition below (8) needs to be fulfilled.

$$\frac{\partial \mathcal{L}}{\partial Q} = p - VC'(Q) - t_a A'(Q) - \lambda - \mu\big(A'(Q)\big) = 0 \tag{8}$$

Equation (8) shows that a marginal change in quantity results in a $t_a A'(Q)$ change in tax payments. As illustrated in Figure 4-1, use of area is increasing and concave and dependent on production quantity. It is therefore difficult to compare the increase in tax payments from a one unit increase in quantity with the increased tax payments from the two other taxes.

Where the slope of the area curve is close to zero the company can increase production almost without increasing use of area. When the area use is given, the tax payments are fixed for the producers because it is impossible or difficult to change area use in the short run. This can

lead to higher incentives to increase production on the given area. Increased production for the same utilized area reduces tax payment per kilogram produced.

4.3.4.4 Summarizing the stylized model

All taxes will most probably lead to greater incentives for municipalities to facilitate for production, and new production sites of better quality can be made available. In the stylized model, tax on quantity produced is preferred for fish farmers when $t_r = t_q$ and $p > 1$, and tax on revenue is preferred for $p < 1$, as tax payments are lower per production quantity.

If $t_r p = t_q$ the effect on producers profit by the two taxes is equal for a change in production quantity. For our later analysis it is more reasonable to investigate a situation where the three tax payments are more or less equal ($t_r p = t_q = t_a A'(Q)$).

Tax on area used is difficult to compare with the other two tax payments as it depends on the individual firm's positioning on the area curve. How the three different tax schemes affects the industry will depend on the level of the tax and the firm's profitability.

4.4 Analysing the first evaluation criteria

We have now described the three taxes in light of the stylized model.

Before the main analysis of the three taxes, we discuss two factors with similar effects for all three taxes. The first factor to be described is whether or not the tax is distorting for firms bound by one, both or none of the constraints. The second factor is about the effect on innovation after a tax is implemented.

4.4.1 Distorting/non-distorting tax

The effect of a new tax depends on each individual firm. If the shadow price of the taxed factor is close to or equal to zero (i.e. lower than the imposed tax), the result is decreased production. Based on economic theory, additional costs will reduce production further and the tax is distorting.

Marginal costs of production will increase with a higher tax as illustrated in Figure 4-1 on page 29. The higher the marginal cost of production, the lower the optimal production quantity will be. The lower the optimal production quantity, the lower the shadow price of the taxed factor. A high tax can make the fish farmer reduce production.

A fish farmer with preference to produce more than the constrained production has a high shadow price of additional production volume. For producers in this situation a tax will not result in changed volume and the tax will be non-distorting for this specific fish farmer.

All firms have individual productivity and thus unique shadow prices. The unique shadow prices result in different optimal tax levels for every producer. A tax is non-distorting for the entire industry if the tax is below the lowest firm's shadow price for the taxed factor. Every firm with a shadow price lower than the implemented tax level may reduce production. Their profitability are reduced so much that the shadow price becomes zero and the constraint is no longer binding. It is impossible to find every producers shadow price in a market without perfect information.

4.4.1.1 *If a firm is not bound by the constraints*

Municipalities taxing firms with low shadow prices for MAB constraints and/or area use must pay attention to possible changes in production. The most important risks to consider are:

- Reduced production
- Reduced use of area and/or
- A shift in production from one municipality to another

If the tax results in reduced production and the firm's income is reduced, jobs can be lost and there might be less trade with local firms. High taxes can also lead to closedowns and reduced tax payments. Such changes affect the host municipality, the neighbouring municipalities and the salmon industry. Related industries such as transportation, feed, smolt factories and harvest plants are also affected by the reduced salmon production. If the firm is merged with another firm, the consequences to some extent depend on the new owner's local ties. The local industry's revenues can be reduced if a local company is merged with a large multinational company with national or global contracts for equipment, feed and transportation.

A flexible tax can be of high preference for municipalities hosting low quality sites and marginally profitable firms. If firms are in deficit after implementation of a new tax, production can close down.

Aquaculture firms can experience economies of scale when production increases. When this happens the municipality can be affected. Higher tax payments are achieved if jobs and production (activity leading to tax revenue) are moved to their area, while lower tax payments occur if the firm leaves the municipality.

When municipalities receive lower tax incomes, their ability to offer services for inhabitants is reduced. This can cause negative consequences for public services, but is not within the scope of this thesis.

4.4.1.2 *If a firm is bound by one or both constraints*

Fish farmers earning high profits have a high willingness to pay for more MAB and/or area. These firms have a low risk of deficits, and are unlikely to reduce production because of the new tax unless the tax is larger than their shadow prices for these constraints. Despite the reduced profit, they are not as close to deficit as marginally profitable firms.

Firms bound by the constraints have marginal costs equal to or less than the market price and earn profits. Fish farmers in compliance with the constraints on both MAB and area use will

not change their behaviour if the tax is smaller than their individual shadow price. If this is the case for all producers, the tax is non-distortive.

4.4.2 Innovation decision

Investments and innovation is closely related. We start off by explaining why the willingness to invest is reduced by a new tax before investigating the effect on innovation and how innovation can be used to increase production and earnings for firms bound and not bound by the production constraints (MAB and area).

4.4.2.1 Reduced willingness to invest

Introduction of a tax reduces future profit and the firm's ability to compete in the market. Return on investments is consequently reduced. When return on investments is reduced, it can be more profitable for investors to invest in companies or industries with higher return.

Return on investment is not the only factor that determines if an investor puts money into the company. Risk profile and belief in the organization and industry is also crucial. Investors are to be compensated for the risk taken when investing in companies. A lower expected return on investment results in a reduced willingness to take on risk.

Investments in smolt and production equipment can also be affected by increased taxes, as the expected profit decreases, and also because accumulated profit in terms of equity might be reduced.

4.4.2.2 Innovation

Innovation decisions are affected by the reduced return on investments caused by a new tax. Incentives to invest in new technologies depend on what is limiting the individual fish farmer's profit. The fish farmer's production can be limited by MAB, area or other factors such as sea lice level or available capital. Such issues are not discussed here. The following analysis is valid for every production constraint the fish farmer can improve his use of.

A fish farmer does not have incentives to reduce area use or make better use of the MAB constraint when neither of the two constraints are binding. He only has incentives to innovate to increase profits. Increased profit is accomplished by decreased production costs and/or increased quantity produced (as this increases the revenue).

If both constraints are binding, incentives to innovate are changed. Such firms have a (high) willingness to pay for excess use of the binding constraints, which means that the firm also has a (high) willingness to pay for innovation to increase utilization of both MAB and area use. In order to increase profit, the fish farmer must increase production or sales price or reduce production costs.

The fish farmer can innovate to increase utilization of the MAB constraint, as this can result in a higher production. This again can result in the producer no longer being constrained by MAB. As the fish farmer, after having increased the utilization of the MAB constraint, is only in compliance with one constraint (area). The fish farmer must innovate to reduce area use per kilogram of fish produced to make use of the already increased production capacity. If both these challenges are accomplished, the fish farmer can produce more salmon and a higher profit can be earned.

It is important to remember that research and development in the salmon farming industry, is financed by FHF (The Norwegian Seafood Research Fund) in addition to the research and development done by the different fish farmers and in related industry. FHF is financed by the salmon exports duty (The Norwegian Seafood Research Fund, n.d.). The exports duty fluctuates with the sales price and that might influence the research level. Other than that, the fund and its innovation decisions are not expected to change much.

The evaluation criteria on distorting/non-distorting tax and innovation decisions are not analysed further as the effect is close to equal for all taxes.

4.5 Tax on quantity produced

We have now presented our evaluation criteria and a stylized model for the Norwegian salmon market. The previous part analysed the effect on two of the criteria, distorting/non-distorting and innovation, as these are equal for all taxes. In the following the three taxes are analysed according to the other described criteria. We start with tax on quantity, followed by tax on revenue and last tax on area.

Quantity produced depends on the actual production of salmon. The tax is concrete and is easy to estimate and control for both fish farmers and municipalities. A similar tax is already implemented in Scotland and seems to work well in there. The tax level for a tax on quantity is presumed to be equal to the Scottish level of 0.22 NOK per kilogram (James Barr Limited & Dear, 2011) in this analysis.

4.5.1 Regional differences

If regional differences are present and the government fear for a change in geographic positioning the tax on quantity can be made flexible. Governments can let municipalities choose whether or not to implement the tax, and the tax level. Host municipalities familiar with the firm's high/low shadow prices of the MAB constraint should take this knowledge into account when setting the new tax level. How the municipality will impose the new tax on quantity produced depends on two main factors:

- Can the firms move to other municipalities where the production environment is as good as or better than the current municipality?
- How high is the tax level relative to the tax level in other municipalities to which the firms can move?

Different costs of production result in different shadow prices. Producers seek production sites with high quality and low taxes. The municipalities can compete for more fish farming activity by providing preferred production sites and/or by lowering taxes. This implies that fish farmers can experience a trade-off between municipalities with low quality and low tax and municipalities with high quality and high tax. Host municipalities need to take quality and demand for sites in their region into account when calculating the maximum imposable tax level.

4.5.2 Income uncertainty for municipalities

It is possible to estimate production volume, the tax base, based on licences in use and the past year's production in each municipality. Diseases, temperature variations and other factors can result in higher or lower production than first estimated. Moderate production quantity variations happen every year and are thus accounted for in the expectations. The expected production is therefore quite stable in most years.

A municipality with several production sites are less affected by risks of troublesome production, as all sites are not expected to have production issues at the same time. With this said there have been disease outbreaks earlier that have caused great problems in large regions during the history of salmon farming, but these happen less frequently.

For a fixed tax, income stability for the municipalities depends on how often the tax is reviewed and adjusted by the national government. Large and sudden tax adjustments are challenging for a municipality to adjust for. Corrections every fifth year, as in Scotland, are considerably less challenging. With predictable revisions we expect every municipality to be able to adapt their investments to a new revenue level well before the tax rate is changed. It would be even better if the tax did not have to be adjusted every five years. This is e.g. achieved with a tax on revenue as will be discussed in part 0.

If flexible tax levels are implemented, they are also expected to stay stable for several years at a time. This will secure a predictable production condition for producers in all municipalities.

The constant tax on quantity described in Scotland suits municipalities that host high-quality production sites and firms with high shadow prices. The tax is then non-distortive. If the firms' shadow prices, on the contrary, are low or equal zero, quantity produced is possibly reduced. The tax level is constant for several years even though the tax base fluctuates and prevents the tax from being fixed.

4.5.3 Profit risk for fish farmers and production incentives

A tax on quantity is close to uniform in most years. The tax depends on volumes harvested and does not take the quality or the value of the fish into account. Fish farmers with stable production quantity and low quality fish in all years will reduce profits and pay a higher tax per NOK income than fish farmers with higher quality and income in all years. If a firm's quality fluctuates much from year to year the profit risk is increased because of varying

income and a stable tax payment. As the profit risk increases, the fish farmer's incentive to produce high quality salmon is kept high.

Examples of reasons for production quantity variations are disease and parasite outbreaks and temperature variations. High seawater temperatures in the summer increase the growth of the salmon but also increase the level of sea lice and pancreatic disease (PD). Both sea lice and PD can reduce growth and lead to increased mortality. Another relationship is the two negative factors of sea lice and winter wounds. Sea lice increase the risk of winter wounds and declassification. Winter wounds do not have to lead to lower production quantity unless it raises mortality.

As mentioned above might the tax levels change every five years. As long as the tax level is determined by a changed production profit, the profit risk is not necessarily changed.

4.5.4 Other factors – (un)wanted consequences

This part presents the most relevant consequences of a tax on quantity – both wanted and unwanted – for the municipalities. We examine improved smolt quality, destroyed fish and how processing can be favourable for fish farmers.

4.5.4.1 Improved smolt quality

A new tax on quantity results in increased production costs. Improving the smolt quality can result in lower production costs and/or higher salmon quality. The different firms are expected to be price takers; however they can try to plan sales in high price periods.

Because of different size and quality, salmon can have different production cost and value. Every fish responds individually to feed, treatments and diseases. The individual responses lead to divergent feed factors and appetite (or growth). Weak salmon of low quality have a lower value than other salmon.

If a tax on quantity is implemented, we can expect a tougher selection of smolt to be put in sea, in order to prevent loss of fish. Weak and unproductive fish should be avoided. This selection and investments will only happen if the marginal benefit of this is higher than the marginal cost. Test projects regarding keeping fish on shore in a secure environment also can be more profitable if costs caused by diseases or sea lice are minimized. Fish farmers are

today constantly trying to improve the survival rate of salmon by testing their disease resistance at different sizes.

4.5.4.2 Destroyed fish – ensilage

Could it be more profitable to destroy low-value fish instead of selling it, as a consequence of the tax?

Calculating a tax on quantity is done without taking the value or the quality of the fish into account. Production costs of all fish, including sick and unhealthy individuals, increase with a tax on quantity produced and previously marginally profitable fish might now experience a loss per kilogram. The salmon is taxed per kilogram sold and can be kept off market to reduce tax payments.

Instead of selling the salmon, the fish can be made to ensilage. After talking to fish farmers, we understand it is not an option to destroy fish instead of selling it, as the cost of destroying is high. If fish farmers are to consider this option, the cost of destroying the fish needs to be greater than the sales price less the tax ($sales\ price - tax\ < -ensilage\ cost$).

4.5.4.3 Calculations – HOG/fillets

We assume the point of measurement is when the fish leaves the harvest plant. Head-on-gutted is the tax base used in Scotland and also the first step in the process of turning the fish into a processed product.

If the salmon leaves the harvest plant as fillets or other products, a fixed calculation can be used to calculate the tax base. A fixed calculation gives fish farmers incentive to adjust the cut of fillets or portions to the calculation. If the calculation is favourable or unfavourable when processing the fish, the result can be higher or lower production of this product(s) and a possible reduction in tax payments. Fish farmer maximizes profits and produces the product with the lowest production cost (including the tax) relative to the revenues from sale.

If the fish is weighed as it enters the harvest plant, the possibility to reduce tax payments described in the last subsection is eliminated.

4.5.5 Other taxes using quantity as tax base

Hydro power production in Norway is taxed in several ways. Two of the taxes, the Natural Resource Rent and the License Fee, are dependent on production. In the following paragraphs we give a short description of the two taxes and how they differ from the main analysis done in this section in order to shed light on two other ways to design a tax on quantity.

The Natural Resource Rent uses the average production in a facility over seven years as the basis for taxation. This reduces the income uncertainty for municipalities, but can be harmful for fish farmers with challenging environmental and biological conditions and fluctuating production and thus income. The tax will be relatively high in challenging years compared to the profit earned, while being lower in booming years with higher production and sales prices.

The License Fee is a tax on maximum theoretical production quantity. The tax rate and the tax base are fixed for several years and in the short term the tax is therefore at a constant level. When fish farmers are taxed by a fixed level the tax is more challenging in difficult years as salmon prices and thus profits fluctuate considerably from year to year.

4.5.6 Summarizing tax on quantity produced

A tax on quantity produced is an easy tax base to estimate for the municipalities. The production in each municipality will fluctuate, but the more production in the municipality, the lower variations we expect to see year over year. It can be a minor challenge for municipalities and firms that the tax base most probably will change every five years or so, as in Scotland. It is more predictable with a constant tax rate; however producers can face higher risks if the tax is not adjusted to the industry's profitability from time to time. As the tax does not take quality and price into account, fish farmers with fluctuating quality and price experience increased profit risks.

4.6   Tax on revenue

Tax as a percentage of revenue is not a proposal from the organizations or the industry. We still find it relevant to investigate this tax because it follows the fluctuations of the market prices.

The tax base can be the national annual average sales price (for a calendar year) calculated by e.g. Fish Pool or NASDAQ[5], or the individual firm's revenue. We will look into the implications related to both tax bases. The tax rate can be kept constant and predictable for municipalities and firms, compared to a fixed tax level that must be revised with changing market conditions. Tax on revenue is easy to calculate and understandable for both the public and for producers.

We start off by explaining the possible tax designs and then evaluate the tax by using the chosen evaluation criteria. The main findings will be summarized before we start on the analysis of the final tax; tax on area used.

4.6.1   How to design the tax?

Individual revenues depend on the sales period, declassification of fish, sickness, ulcer problems, contract prices, demand for different sizes, etc. Salmon prices also depend on the total supply. Years with large production challenges, e.g. caused by diseases outbreaks, result in low supply and normally a higher price per kilogram sold.

A tax on revenues can be designed in several ways. Two important issues to decide on are whether the tax should be flexible and what price to use as basis for the tax. The tax can be based on the national annual average price (a reference price) or individual revenues. The national annual average sales price is easy to obtain from different salmon price indices. Such price will be equal for all producers and similar to a tax on quantity. The individual average price is better adjusted to the individual fish farmers' circumstances. It is also possible to use the national weekly or monthly average, but we choose to overlook this and only analyse the effect for the national annual average and the individual average price.

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[5] Both Fish Pool Index and NASDAQ Salmon Index are noted in NOK per kilogram salmon.

4.6.2 Regional differences

Regional production differences will not increase as a consequence of the new tax. Based on economic theory, we expect fish farmers to move where the most profitable production sites are situated. The weekly sales price of Norwegian salmon measured by Fish Pool Index, NASDAQ Salmon Index or Statistics Norway is often close to uniform regardless where in the country the salmon is produced. Production costs are highly dependent on area or the concrete production site and the fish farmers' profits vary depending on the quality of the production site.

In the data from the Directorate of Fisheries (2013 A) we cannot see a great difference between the given production regions. We therefore cannot predict a change in geographical positioning of the Norwegian salmon production. The lack of differences between regions does not give evidence of equal production costs on the different sites.

A flexible tax is particularly relevant if there are large differences between municipalities quality of production sites. Large differences in site quality and tax levels between municipalities can increase incentive to change geographic position if the tax implementation makes some area less profitable.

Fish farmers not bound by any of the two constraints optimize production at a level below the given maximum production quantity and maximum area. A tax on revenue results in lower income for the fish farmer. This, in turn, leads to both lower optimal production and possibly also less area needed for fish farming. As previously explained we find it reasonable to expect that firms with low profits will be purchased by and/or merged with more profitable firms. Based on economic theory we expect all production capacity and area utilized maximally in the long term.

Differences among producers selling in high-price periods and producers selling in low-price periods will be slightly reduced as a consequence of the tax. This as the tax rates are the same, while the tax payments increase for increased price and quantity.

4.6.3 Profit risk for fish farmers

The profit risk for fish farmers depends on what tax design is chosen. We first present the effects of a national average sales price as tax base, before we elaborate on the individual revenues.

4.6.3.1 *National average sales price*

If the national annual average sales price for a calendar year is used as the tax base there may be large differences in terms of tax payments as a share of individual revenues among fish farmers. This can increases the fish farmer's price risks and risks of deficit. Producers selling in low-price periods pay higher taxes per kilogram sold than producers selling in high-price periods. A national price level can also be considered particular unfavourable for unlucky or less skilled producers (always) selling a low-quality product. Declassified salmon receive a substantially lower price in the market and this is not taken into consideration when taxing the national average price. This tax design does not take the individual quality or sales price into account and is very much alike a tax on quantity.

4.6.3.2 *Individual revenue*

Individual revenues in comparison do not increase the fish farmer's risk significantly. Compared to tax on quantity or tax on national average sales price, are the risks of deficit much lower as individual quality and price is taken into account. With individual revenues as tax base producers selling fish in peak price periods are paying a higher tax than less fortunate fish farmers. Declassified fish with a low sales price also will be taxed at the same percentage as a high-priced product; the total tax payment will be lower. In years of low price and production due to diseases, tax payments are reduced correspondingly.

Fish farmers can experience a large difference if taxed by the national annual price compared to the individual revenue. Producers with production difficulties suffer the most with national average sales price used as the tax base.

If a high level of transparency and openness is required with a tax on individual revenue, can the tax be a challenging issue as more public information on the individual company might result in reduced competitiveness. This can be the case for example when competing for a MAB-licence in a closed auction.

4.6.4 **Production incentives**

Salmon farmers always have incentives to maximize profit. By selling the most fish at the highest possible price – the profit is maximized. If the national average sales price is determining the tax level, producers selling at a high price benefit from this. Their tax payments are a relatively low share of their individual sales price. Contrary, producers selling

at a lower price than the national average price level suffer, as their tax payments are a relatively high share of their income compared to the competitors'. This can further decrease profits for producers having a year of low production quantity and/or quality.

A tax on individual revenues does not result in this additional production effect. Every unit produced is taxed according to the average sales price and the fish farmer must only continue to improve production as he also did prior to the new tax.

Incentives to work for pressing the price up will be marginally lower after a tax on individual revenue is implemented as the taxation leads to a modestly lower return of sales price negotiations. We have not looked further into this aspect of the tax.

4.6.5 Income uncertainty for municipalities

Income uncertainty for municipalities comes from instabilities in salmon prices and production quantities within their borders over time. Business cycles and biological challenges are difficult to plan for and lead to increased tax payment risks and uncertainty for both the salmon industry and for host municipalities. This risk is not favourable for municipalities and makes budgeting and planning more difficult. If the risk of fluctuating tax revenues is large and unfavourable for the municipality while being favourable for fish farmers the municipality might demand a higher tax rate to compensate the risk.

Municipalities with several production sites are less affected by individual changes in production or if one firm sell salmon at a very low price. At the same time, a tax determined by national annual sales prices is expected to be more favourable than a tax on individual revenue, as national price fluctuations might be lower than the price fluctuations experienced by each individual firm. Also on a national level there are great price variations from one year to another. Municipalities are, on the other side, possibly negatively affected by a higher profit risk among salmon producers from a national average tax base. Closures as a result of the tax will affect the municipalities' income and services offered to their inhabitants negatively. If stable income is very important for the municipality, the government can collect the tax payments and redistribute more stable transactions.

4.6.6 Unwanted consequences

A tax based on revenues does not affect the incentive for fish farmers to maximize profit by harvesting at the most cost-efficient size and selling at the highest possible price. Other

unwanted consequence can still happen. The effect the new tax can have on long-term contracts and creative accounting is explained below, as these two seems to be the most relevant consequences for this tax.

4.6.6.1 Long-term contracts

Long-term contracts at stable prices have been said to increase the global consumption of salmon the last decades because of the stability it creates when processors develop new salmon products. With a new tax, the effect of such a contract can be changed for the fish farmer.

Using the national annual average price (a reference price) as tax base can lead to tax payments not correlating with the actual revenues of a fish farmer. This can affect the incentives for long-term contracts between fish farmers and processors. If the contract price is entered at a low level, the fish farmer will not achieve the same revenue as without a contract. With a tax based on the national average sales price, the firm is not taxed by the actual price achieved. This is unfavourable for fish farmers selling at a lower contract price than the reference price used as tax base. The supply for long-term contracts might therefore decrease.

If the tax level is high can the effect be devastating and the tax might result in a reduced contract level and potentially a reduced rate of product development in the years to come. This has been seen in the Norwegian oil sector with e.g. Saga Petroleum securing the oil price at a low level in 1998, while being taxed at the reference price (Sletmo, 2013).

4.6.6.2 Creative accounting

Creative accounting may occur if the risks of being caught are low. A tax based on sales price gives producers incentives to simulate a lower sales price. No fish farmer is interested in actually lowering the sales price, but wants to imitate lower sales to achieve a lower tax base. Fish farmers can develop contracts where the sales price is reduced while the buyer pays higher non-taxed sales costs. An example of a non-taxed sales cost is transportation.

Even though the average price in the market is high, fish farmers are allowed to sell fish at a low price. Selling at a low price can be explained by, for example, the importance of maintaining relations with a long-term client. Valid reasons for lowering sales prices complicate the possibility for municipalities or controlling authorities to find out if the firm is maintaining strategic alliances or trying to reduce the tax payments.

Creative accounting is possible as long as the fish farmer invoices for more than just the fish. In a case with transportation services, the fish farmer can rent transportation services and then sell the service for a much higher price. Creative accounting can potentially lead to increased fluctuations in tax revenues for the municipality.

4.6.7 Tax on net revenue

The above analysis has been conducted on a tax on gross revenue. It is also possible to tax net revenues, or revenues less a chosen set of costs. A tax on net revenue is favourable for producers with high costs relative to income, as these can be subtracted.

A larger firm has stronger market power and can thus negotiate lower input costs than a smaller firm. In general, smaller firms are therefore expected to have higher production costs per kilogram salmon and would subtract a higher share per kilogram produced compared to the larger firms. In industries with large differences in production costs related to company size or production area, a tax on net revenue can lead to fewer distortions than a tax on gross revenue. A tax on net revenue can also be preferable if an equal tax level for all municipalities is preferred, as some differences between firms and sites are corrected for.

Tax on net revenue is used in the Norwegian oil sector as large investments are needed to extract the oil. This prevents distortions and reduced willingness to invest in oil fields with uncertain profit. The rather moderate investment costs in the salmon industry makes the two industries different and it is not as important to subtract costs of production in the salmon industry as for the oil companies. A tax on gross revenue, like every other tax, is non-distorting for a low tax level. With a low enough tax combined with the presumed economic rent in the industry, we do not expect distortions and have therefore chosen to not examine a tax on net revenue in closer detail.

4.6.8 Summarizing tax on revenues

Tax based on individual revenues stands out as more preferable for producers than a tax on national average sales price. The national average sales price can increase risks of deficits because it only varies depending on national or global changes in price and production. In addition the tax can reduce the incentives to enter long-term contracts. In comparison, individual sales price takes both quantity and quality into account, and correlates with the firms' profit. Individual prices can increase incentives for creative accounting.

Both the two tax designs discussed vary with business cycles and production volumes. Of the two different kinds, individual revenue is less preferred among host municipalities as the tax payments are even more volatile than a tax on national average sales price.

4.7   Tax on area used

When evaluating a tax on area used we use the law proposal by Lund and Jensen (2013) as basis for the analysis. The law proposal states that the area taxed should be based on the visible fish farming installation and the 100 meter zone around cages where people are prevented from fishing. If the anchorage is exceeding the 100 metres fishing ban zone, does Lund and Jensen suggest this area also to be included in the tax base. The tax level is suggested to be 200 NOK tax per square metre, a fixed tax without any corrections regarding where in the country the fish farm is located, how deep the cages are or if the cages are inshore or offshore.

Similar to the tax on quantity and tax on revenue this tax will be analysed due to our evaluation criteria, before we summarize our findings.

4.7.1   Regional differences

Unlike the other two taxes is a tax on area based on a limited input factor. Fish farmers' use of production sites is highly regulated. The producer's willingness to pay for a production site depends on the quality of present sites, but also on the quality of new, available sites. The individual need for additional area and where the producers are positioned along the area curve also determine the willingness to pay for area. Regulation on coordinated fallowing, as was described in part 3.4.2, is also important when a fish farmer determines his willingness to pay for a new site. The different willingness to pay for sites comes from, among other factors, the individual growth conditions for salmon at each site, infrastructure and accessibility.

The proposed tax level from Lund and Jensen (2013) (200 NOK per square metre) is not equal the shadow price of area for all producers in Norway. This can lead to distortions unless the tax level is lower than every firms' willingness to pay for area.

4.7.1.1   *Determining the need for area*

For a positive slope of the area curve we can expect increased use of area for increased production. This also results in greater tax payments to municipalities. For $A'(Q) > 0$, reduced production will lead to reduced area use and tax payments. Fish farmers will therefore have the incentive to reduce production when a cost is added to the use of area. The tax is distorting if the shadow price of area is lower than the imposed tax for every firm.

Producers with $A'(Q) \approx 0$ have no need for additional area if they receive more MAB, as area use does not change with a (small) change in Q. These firms have low willingness to pay for additional area. It seems reasonable to expect that larger fish farmers are more likely to have $A'(Q) \approx 0$. This can be because of the potential large number of production sites they have acquired in several production regions, and potentially several licenses per site. If so, it is reasonable to expect $A'(Q)$ close to zero and also $\mu \approx 0$. It is still important to remember that every site is of different quality and that firms always prefer to change for better production sites. The willingness to pay for a site of higher quality is dependent on the increased profit that can be achieved.

Producers can utilize several licences per production site, and the need for area is therefore uncertain. Small producers are likely to need new area in order to increase production. Large producers with high site-MAB's, on the other hand, can more easily distribute new licences on already existing production sites. In the industry it is commonly understood that Norway needs to facilitate more production sites to be able to increase salmon production substantially.

4.7.1.2 Flexible tax levels

With a flexible tax the municipalities' quality differences in sites are better compensated for. Municipalities with generally high production per square metre can choose to implement a higher tax than municipalities with generally less suitable sites. Differences within the same municipality cannot be compensated for by a flexible tax level.

As earlier discussed, the willingness to pay for area depends on a number of factors. Area is therefore a complex asset to set a good tax level for, and we expect large difficulties for the municipalities when determining the tax level. Having said that, a flexible tax level determined locally is expected to result in a more ideal tax level than a nationally chosen tax level.

4.7.1.3 Production incentives and unwanted consequences

An area tax does not affect the fish farmers' incentive to maximize profit. An area tax can, unlike the two other taxes, affect *how* the fish is produced. Use of area is one of the input factors in the production and use of this will be reconsidered when a cost is added.

If profitable for firms, innovations are increased to reduce tax payments. Producers will experience a trade-off between investing in more effective use of area and paying the tax. Innovations to better utilize existing sites and reduce area use are preferred when the net present value of innovation costs is lower than the net present value of tax payments. Possible innovation can be related to new cages, mooring and other equipment.

The tax can make it profitable to increase the depth of cages, as only the surface is taxed by the proposal by Lund and Jensen (2013). If it is not possible to increase the depth or the efficiency of area use, this may be seen as a disadvantage of this area and result in preferences to move to another site. Cases like these are unfavourable for less suitable municipalities, while profitable for those with more favourable production area.

Norway needs to prepare for adaptations to the new tax from producers. It can be profitable for producers to increase the circumference and depth of cages. Today the maximum number of fish in a cage is limited to 200,000 and a wider and deeper cage would not let fish farmers increase the number of fish. A producer with many large and deep cages is able to produce more fish per site and per square metre than a producer with few and shallow cages at each production site. The tax payments depend on the distance between the cages and the taxable area outside them. Producers with several cages per site can benefit, as the 100-metre zone for restricted fishing is not settled by area occupied by cages. A tax based on area used is therefore favourable for producers with deep cages and several MAB licences at one site.

Small sites with e.g. four cages will not pay half the tax paid by producers with eight cages. Taxable area outside the cages always is 100 metres and how cages are placed therefore will affect the total tax payments more than the number of cages. This is illustrated in Figure 4-2 below. If four cages are placed next to each other in a row, while eight are placed two-by-two in a row of the same length, the tax payment for the area outside the cages is close to equal for the two different sites or producers. Were the four cages also placed two-by-two, the area use at this site would be much lower than that at the larger site. The relationship between taxable area and kilograms produced is therefore not constant and the tax can be seen as unfair for smaller producers as there are clear economies of scale related to area use. Producers with few licences per site and shallow cages have a higher tax cost per kilogram of produced salmon.
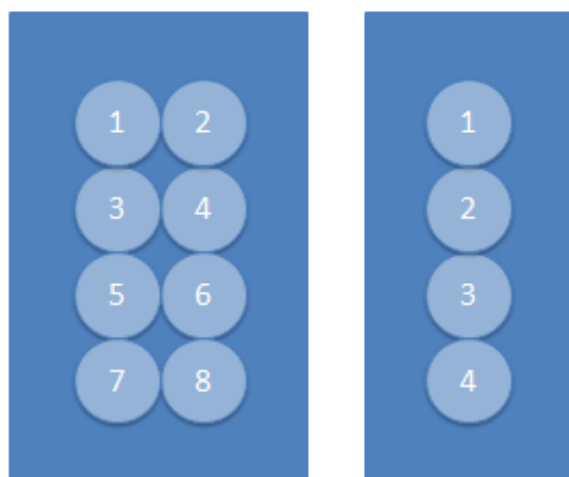
Figure 4-2: Location of cages impacts the tax base
Economies of scale are achieved as twice the cages do not double the area use. Area use per cage is smaller on the right production site than on the left.

Fish farmers with few MAB-licenses have greater difficulties in reducing area use per kilogram of fish produced. The table below gives an overview of the different circular cages available. It is also possible to purchase square cages, although these are less common. The smallest cage size is shallow and with the same top area, the cage can be made deeper. A fish farmer with a higher MAB limit at the site could invest in deeper and larger cages to reduce tax payments per kilogram of production.

		Circular cages (circumference)				
		60 metres	**70 metres**	**90 metres**	**120 metres**	**157 metres**
Depth	**10 metres**	Small	Small	Small	Medium	Large
	20 metres	Small	Small	Medium	Large	Very large
	30 metres	Small	Medium	Medium	Large	Very large
	30 metres with cone			Small	Medium	Large

Table 4-5: Size of cages for different depths and circumference
The different characteristics (small, medium, large and very large) are determined in the source. (Directorate of Fisheries & Norwegian Food Safety Authority, n.d., p. 15)

A tax based on area use can harm small producers more than larger producers, unless the small firms cooperates in producing salmon. Small producers with few licences and production sites can suffer from lower efficiency in terms of area use. This is a consequence of less MAB-licenses less production sites and therefore a lower flexibility in production.

56

Discrimination against smaller producers that does not cooperate is seldom favourable for municipalities or national government, and is not a desirable consequence of the tax.

A tax based on area use will, on average, favour producers with several licences at each production site. This means that producers with an already existing advantage will benefit the most from a tax based on area.

Deeper and wider cages might require investment in new feed systems. Deeper cages can make feeding more difficult, as the feed must not drift away with the current. There has already been a change in production towards larger cages and more production at each site. Technological development has made it possible to feed at increased depth, and this does not seem to be a relevant obstacle.

Another possibility is new adaptations related to anchorage of cages. If the anchorage points are outside the fishing ban zone (100 metre), shall this area be included in the tax base (Lund & Jensen, 2013). Fish farmers are then given an incentive to minimize their anchorage range. It is possible to use the same anchorage for several cages and larger production sites can occur as a consequence of the tax.

Specific descriptions for mooring are given when new sites are approved. Mooring is highly regulated because of the risks of breakdowns, damages and escapes. It is also possible that producers need to apply for changes in anchorage, and municipalities will not approve changes involving high environmental risks. By not including the anchorage area in the tax base are incentives for changing mooring from the optimal positions eliminated.

Issues related to deeper and wider cages can be avoided by introducing a tax per cubic metre used. Clear regulations related to quantity, biomass and anchorage also limit possible unwanted consequences. It is also possible to tax only the area installations and cages occupies. This will reduce some of advantages large producers with several cages might have (illustrated in Figure 4-2).

4.7.2 Profit risk for fish farmers

Area used for aquaculture production is close to constant for every production year. A constant area will lead to a constant tax, and therefore increase fish farmers' risks of deficit. A tax based on area, compared to a tax on sales price or production quantity, does not fluctuate with market prices and trends.

Taxing area use by a fixed value can only be set for a certain time period. As the market and the industry changes, the tax level must be adjusted to the new market conditions. Uncertain tax levels might be difficult for firms (and municipalities) to plan for. However, it is reasonable to expect that the new tax level correlates with a changed profitability in the industry. Firms are better off by a tax that fluctuates with changed market conditions every e.g. fifth year, than the risk of paying stable, high taxes if profit decreases.

4.7.3   Effects for municipalities

Tax based on occupied area is more predictable and stable for host municipalities compared to a tax on revenue and a tax on quantity produced. The fish farmer can make some adjustments and innovations to reduce area use per kilogram and limit tax payments when the tax is implemented. After the initial adjustments are made, the tax is fixed and will give municipalities a predictable income.

Municipalities with less favourable production sites will experience lower demand for their sites after a tax is introduced, unless the tax is voluntarily implemented and differences in quality will be partly eliminated (or reduced) because of differences in tax levels.

Firms with good quality surplus area have a low willingness to pay for additional area. With the implemented tax, these firms have a reduced incentive to keep the already distributed area they do not use. If the tax results in reduction of area use, it is by definition distorting. This is not the main goal for the municipalities. However, better utilization and increased efficiency of area can be a positive consequence for municipalities and inhabitants.

A tax on area can depend on the depth of the cages or a different tax level for inshore and offshore sites can be imposed. If the depth is taken into account smaller fish farmers with shallow cages can benefit, and municipalities without deep fjords might keep production. This can keep producers from changing geographical position and shadow prices can be more equal.

If a different tax level is imposed inshore and offshore, we believe the level to be lower offshore than inshore as these sites affects the local inhabitants less than those inshore. With this said, we do not know how a tax depending on whether the cages are inshore or not might change behaviour. The trend the recent years has been a change from sheltered inshore

production sites to offshore production, and if these are taxed by a lower level than the inshore might this trend continue to increase.

Production sites that are not in use over the whole year due to fallowing have been raised as a troubling issue. It is most likely and recommended that a tax is paid on a yearly basis and on the area the producer has available for production. Only areas with full access to the public should be excluded from the tax basis.

4.7.4 Summarized tax on area used

The main benefit of a tax on area used is the stable tax revenues to host municipalities.

A tax on area used, similar to the tax on quantity, might be changed if the firms' profitability are permanently changed. Negative aspect with the fixed tax payment is increased profit risk for fish farmers and unfair consequences for smaller producers. Municipalities without the possibility to provide area intensive production sites can also be unfavourable treated by a tax on area use, as fish farmers might prefer other municipalities.

4.8   How to implement a tax?

Before presenting our conclusion, we will guide you through relevant information to bear in mind before a new tax is implemented. Throughout the thesis we have expected economic rent for the industry. In the following are calculations presented to support this expectation. Later we suggest further investigations to be done by the government before implementing a new tax.

4.8.1   Economic rent

In order to determine if a tax can be implemented without causing distortions to most firms in the Norwegian salmon market, we present calculation that verify an economic rent. Our main findings from the calculations are given in Table 4-6 below.

	2009	**2010**	**2011**
Average price per kilogram exported from Norway	31.42 NOK/kg	37.49 NOK/kg	31.97 NOK/kg
Number of companies	106	101	92
Number of companies initially in deficit	18 firms (17 %)	3 firms (3 %)	27 firms (29 %)
Number of firms that cannot satisfy the 10 % required rate of return on equity	24 firms (23 %)	4 firms (4 %)	32 (35 %)
Average profit after adding a 10 % rate of return on equity	22 434 176 NOK	60 868 245 NOK	16 485 519 NOK
Number of firms in deficit after adding a tax on quantity (0.22 NOK/kg)	25 firms (24 %)	4 firms (4 %)	33 firms (36 %)
Total tax payments from a tax on quantity (0.22 NOK/kg)	148 million NOK	155 million NOK	169 million NOK
Tax rates for tax on revenue that equals tax payments as a tax on quantity	0.88 %	0.70 %	0.85 %
Number of firms in deficit after adding a tax on individual gross revenue (3 %)	26 firms (25 %)	4 firms (4 %)	35 firms (38 %)
Total tax revenues from a tax on individual gross revenue (3 %)	505 million NOK	666 million NOK	597 million NOK

Table 4-6: Profitability in the Norwegian salmon farming industry (Statistics Norway, 2013 C; Directorate of Fisheries, 2013 B)

Many companies have the same owner(s) and the reduction in companies over the three years can be a result of restructures of subsidiaries in one or several companies.

Our findings determine large differences between the three years with substantially lower average profit in 2011 and 2009 compared to 2010. The large difference is most probably caused by the much higher sales price in 2010 compared to the two other years. Between 3 and 29 per cent of the companies in the dataset were in deficits already before a cost of capital was added, and an additional tax is expected to be distorting for these firms. It is reasonable to expect that unutilized sites and MAB-licenses will be rented or purchased by more profitable firms in the long run. This can determine fewer distortions and that the industry can take on even higher tax levels before the production volumes are reduced.

We have chosen to use a required return on equity of 10 per cent. This is most certainly too high compared to the actual demand from investors. The required rate on equity used for listed salmon companies are below 10 per cent and, a reasonable interval for unlisted companies can be between 6 and 10 per cent. When using this rate of return on equity we expect risks for investors to be included.
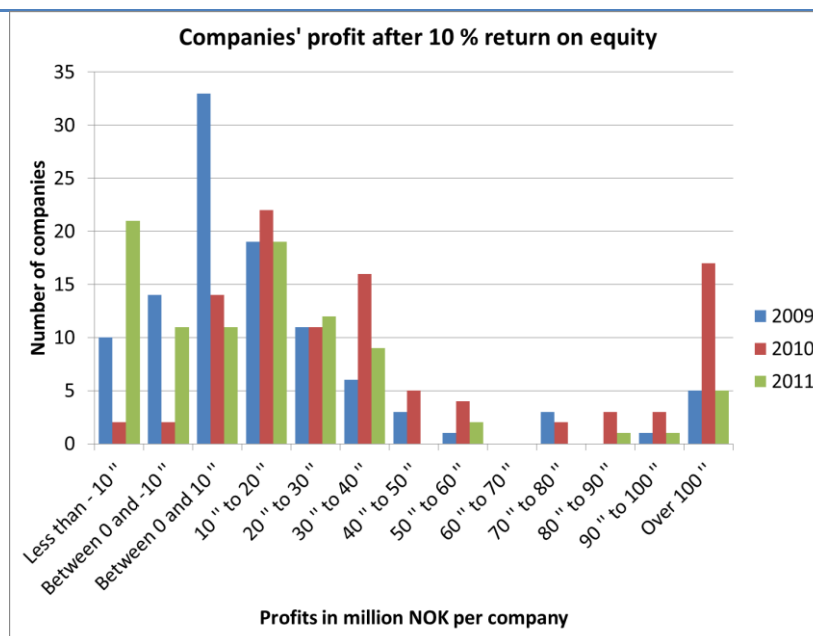
Figure 4-3: Histogram illustrating companies' profit after 10 % return on equity (Directorate of Fisheries, 2013 B)

From the histogram we can see that there are many highly profitable firms and that the industry as a whole can afford a new tax. The industry demands more area and the incentives for municipalities to facilitate for increased production is therefore important. A new tax can reduce profitability and lead to more mergers and fewer, larger companies as an effect of this.

After subtracting the return on equity from the companies' results, we discover that most firms are able to pay a 10 per cent return to investors all years. The results of this calculation also reveal the number of companies not able to pay this return. Up to 35 per cent of the companies do not manage to pay the required return to investors which indicates difficulties of implementing a new non-distorting tax in the industry. With this said; profit varies greatly and most companies are highly profitable in all three years. The above histogram illustrates the profit for salmon producers after a 10 per cent return on equity is subtracted. The highly profitable companies can afford an additional tax without any distortions. The higher the economic rent, the higher is the tax level where distortions appear.

4.8.1.1 Determining the tax level

In order to investigate how the companies' profit will change after a new tax is implemented, we have made calculations for two of the taxes we have analysed: tax on quantity produced and tax on individual revenue. We have not included tax on area in these calculations as nothing in our dataset determines each company's area use.

In the calculations for tax on quantity produced we have used the same tax level as is implemented in Scotland, 0.22 NOK per kilogram (James Barr Limited & Dear, 2011). This tax level does not cause great change in the number of firms with negative results (no change in year 2010, increase by one firm in 2009 and 2011).

A tax on individual revenue fluctuates according to both price and quantity produced and does not correlate perfectly with a tax on quantity. To see the difference in the two taxes for the three years we have calculated the tax rate for tax on total revenue that corresponds to the total tax payments from tax on quantity the three years. This fluctuates between 0.70 and 0.88 per cent.

By adding a 3 per cent tax on revenue we investigate how higher tax payments can affect the industry and in particular the number of firms with losses. This increases tax payments by

about two thirds, while the number of firms estimated to be in loss is increased by two companies in 2009, zero in 2010 and three in 2011.The percentage increase is large, but compared to the number of firms in deficit initially the numbers are rather small. From this we interpret that many firms in the dataset are highly profitable and can afford an additional tax.

All three taxes, tax on quantity produced, tax on revenue and tax on area used, might cause distortions if the tax level is larger than each of the firms in the industry are willing to pay. Adding a tax can cause distortions for firms in deficit initially or after the tax is implemented. The calculations cannot give evidence to a discussion on whether or not the two taxes will cause reduced production by any of the firms. We still expect marginally profitable firms and firms without profit to reduce production as a new tax is implemented.

We have only presented calculations for three years. Several years should be taken into account to create more valid results. This is especially important if the three years we have analysed are not representative for normal fluctuation in the Norwegian salmon industry.

4.8.2 Further investigations

Before a new tax is implemented, we recommend focusing on the different evaluation criteria we have used in our analysis to better prioritize and value each criterion. The analysis conducted of the three chosen taxes should also be extended to include other taxes and redistributive tools. The possibility of making further developments in the property tax and auctions of production sites are briefly explained below. Difficulties in determining the tax base for tax on area are also briefly explained.

4.8.2.1 *Property tax*

The existing property tax can be developed to increase tax revenues to host municipalities. The tax base can be changed to include other values, such as the salmon on site. As the property tax is designed today, the value of installations and equipment is a part of the tax base. This is a disadvantage, as producers with new and possible safer production equipment are taxed harder than those with old equipment.

4.8.2.2 *Auction*

Closed auctions are already used to allocate some of the production licenses in Norway. Bids in auctions are expected to be close to the producers' willingness to pay for the site. Auctions

together with setting up a market place for trade in sites might be a useful tool to distribute sites among producers and give the municipality revenues.

Auctions must give a right to use the site for one year or a longer defined time period like quotas in the wild catch industry.

4.8.2.3 The tax base for tax on area use

Defining the tax base for tax on area use is more difficult than determining the tax base for tax on revenues and tax on production quantity. The tax on area was not implemented in 2009 because of difficulties in defining what area to tax. Tax on area used also leads to a discussion of whether this tax shall be valid for all industries and firms occupying area in the sea or if the tax shall only be applied on the salmon farming industry. The government can meet an expectation for tax revenues from aquaculture production also from other species as well as different industries occupying area in the sea. This can lead to negative consequences for new or less profitable industries such as cod farming.

5   Conclusion

We have examined which tax is best suited to reallocate capital from fish farmers to host municipalities through a tax. To evaluate this, we have analysed three different taxes; tax on quantity, tax on revenue and tax on area used. While analysing the three taxes, we have identified benefits and disadvantages with each of them.

5.1.1   General findings

Calculations support the expectation of an economic rent in the Norwegian salmon industry and that every tax can be made non-distorting for a low enough tax level. If there are great differences between the municipalities, we expect the optimal tax level to be achieved by a flexible tax.

The salmon industry is earning high income and the industry organisations are not opposing the implementation of a tax. As host municipalities receive more revenues from the industry, more area is likely to be facilitated. We therefore find implementation of a reallocating tax feasible and presume it to be beneficial for both the municipalities and the industry.

5.1.2   Tax level

Which tax suits the municipalities and the industry the most depends on the concrete design of the tax, and in particular the tax level. Tax on individual revenue takes quality and production quantity into account and is therefore presumed to be favourable for producers. A stable tax, like a tax on area use, is less favourable for fish farmers, unless the tax payment is relatively lower. Fish farmers can be willing to pay a higher tax if it fluctuates with market trends compared to a fixed tax level for all years. The willingness to pay depends on individual risk preferences. Municipalities might also agree on a fluctuating tax (a higher income risk) if they are compensated with higher possible tax revenues.

We have presented calculations to illustrate the possibility of introducing a tax and have shown that some firms are in deficit after the proposed tax levels. In the long run and if the firms are owned by other salmon farmers, the tax does not have to lead to reduced production volumes for the industry.

5.1.3 The three taxes

The Norwegian government and different political parties might have certain preferences on what the tax shall be adjusted for. Distortion, production incentives, innovation decisions, bureaucratic challenges and unwanted consequences are evaluation criteria that are close to similar and difficult to compare for the three analysed taxes. We therefore will not conclude on these.

Not to increase regional differences by changing geographical positioning (keeping local jobs), that a new tax should not increase the profit risks for producers (fluctuating with market trends) and municipalities wish for a stable income have been a substantial part of the discussion of an area fee. In addition to these three criteria we have added a fourth factor, fairness, which has been a part of several discussions in our analysis. These four preferences are presented below with a presentation of which tax best complies with the criteria.

5.1.3.1 *Tax payments that fluctuate with market trends*

If the government's main focus is to provide firms with stable operating conditions, tax payments that vary with market trends can be preferred. A tax on individual revenue is then the most suitable tax because the tax fluctuates with income, and therefore sales prices. The tax adapts to market trends and firm specific differences in sales price.

A tax that fluctuates with profit does not provide stable tax revenues for municipalities. Municipalities might be willing to take on the risk of unstable income if they are compensated for this risk by a higher tax rate. Redistribution of the tax payments via the government can be another solution to achieve tax payments fluctuating with revenue and stable tax income to the municipalities. This argument is also valid if a tax on quantity is chosen.

5.1.3.2 *Stable tax revenues*

Stable tax payments can be of priority for the government if the municipalities' investment possibilities are highly valued. For this criterion is tax on area use the most suitable tax as the tax base is immobile and provides stable tax revenues. Increased future production, and thus area use, can increase the tax base and tax revenues.

Municipalities with much production are more likely to receive more stable tax income compared to municipalities with less production. This is particularly valid for tax on area and

quantity produced, but is also relevant for tax on revenue. When several producers are present, they probably do not all suffer from losses at the same time and the tax base varies less.

The stable tax payments from a tax on area can challenge firms' profits in years with low sales prices and production. A government concerned of endangering jobs and unstable tax payments for municipalities can implement a tax that is paid directly to the government and thereafter redistributed to the host municipalities. As stable revenues easily can be achieved by redistributions by the national government, we do not put much weight on the argument of stable tax revenues.

5.1.3.3 *Fairness for producers*

Fairness for a certain group of firms can be of great political importance. Both a tax on area used and a tax on quantity can be regarded as unfair taxes. A tax depending on area used and not for example the firm's production volume is unfavourable for producers with few licenses and an area intensive production. Producers with several licenses at each site will benefit from this. How the cages are positioned also affects the tax base and can be relatively higher for smaller producers with few cages. A tax based on occupied area is likely to be relatively higher for smaller producers compared to larger producers. It can therefore be perceived as unfair and discriminating for small producers and the tax is unsuitable for a government that value fair taxes.

Tax on quantity, is unfavourable for firms with low salmon quality as this is not included in the tax base. Quality varies depending on production skills and external factors such as site quality and diseases. Quality is less likely to vary as much as use of area and production per cubic metre between small and larger companies. If the low quality of the harvest comes with other production difficulties, we acknowledge the fish farmer's challenge and that such a tax also can be experienced as unfair.

Tax on revenues calculated using national average sales prices is also potentially unfair if the producer's individual sales price is consistently lower than the national average. This can be solved by using individual revenue as tax base. Even though the tax on individual revenue does not take differences in production costs into account, the tax includes more firm specific elements than the other taxes we have examined. Tax on individual revenue takes low

production and quality into consideration, as low quality and production lead to low incomes and therefore a lower tax base.

5.1.3.4 Keeping local jobs/regional differences

Intentions of keeping and creating jobs in the rural are often mentioned as important for the government and municipalities. A flexible tax level adapted to the production conditions in each individual municipality can best avoid relocation of salmon production and companies. A low tax level can be used as a political tool to attract firms to certain areas. This is valid for all three taxes.

In addition to keep the production where it is today, predictable future tax levels are important to the firms. Both tax on quantity and tax on area used are expected to be given as a fixed level per kilogram or square meter and must be revised for changes in the industry and market. A tax on revenue is given as a percentage of income and can be kept constant and predictable in low and high profit years.

5.2 Which tax benefits the municipalities and the industry the most?

The base for our thesis was the discussed implementation of an area fee specific for the salmon industry. Due to our analysis and for equal tax payments a tax on revenue is most likely preferred among producers, while a tax on area is expected to be the favoured tax for municipalities. Municipalities can also value infrastructure and job opportunities within their region and are therefore concerned of losing the industry or not receiving any tax.

A tax on area is highly predictable for the industry because of the stable area use. If this tax is set lower than the other taxes the unfavourable effect of the tax is compensated and can be of preference also among producers.

We do not have enough information to evaluate all aspects of the three taxes and it is also very difficult to weight the different positive and negative aspects against each other. Given these limitations, however, we conclude that a tax on individual revenue seems to be the tax that benefits the municipalities and the industry the most.

6 Bibliography

Asche, F., & Bjørndal, T. (2011). *The Economics of Salmon Aquaculture.* Chichester: Wiley-Blackwell.

Asche, F., Hansen, H., Tveteras, R., & Tveteras, S. (2009). *The Salmon Disease Crisis in Chile.* Kingston: Marine Resource Economics.

Directorate of Fisheries. (2008, January 25). *Fiskeridirektoratet.* Retrieved November 16, 2013, from Overtredelsesgebyr og overskridelse av maksimal tillatt biomasse (MTB): http://www.fiskeridir.no/akvakultur/aktuelt/2008/overtredelsesgebyr-og-overskridelse-av-maksimal-tillatt-biomasse-mtb

Directorate of Fisheries. (2013 A, November 14). *Matfiskproduksjon, laks og regnbueørret.* Retrieved November 16, 2013, from Hele landet: http://www.fiskeridir.no/statistikk/akvakultur/loennsomhet/matfiskproduksjon-laks-og-regnbueoerret

Directorate of Fisheries. (2013 B, September 25). Anonymisert lønnsomhetsdata for selskap med matfiskproduksjon av laks og regnbueørret i 2009, 2010 og 2011. Bergen, Norway.

Directorate of Fisheries, & Norwegian Food Safety Authority. (n.d.). *Utredning: For stor merd eller for mange fisk? Fiskeridirektoratet og Mattilsynets anbefalinger.*

Dokka, M. (2013, February 11). *Folkebladet.* Retrieved November 5, 2013, from Får drive i to år til: http://www.folkebladet.no/nyheter/article7090727.ece#.URltymf6BJt

Ervik, A., Alsvåg, J., Asplin, L., Aure, J., Døskeland, I., & Stigebrandt, A. (2007). *IMR.no.* Retrieved September 11, 2013, from Kapittel 1 Forvaltning av kysten. MOLO: Miljøtilpassing og rasjonell arealbruk for akvakulturnæringen: http://www.imr.no/filarkiv/2007/03/1.15_MOLO_miljotilpassing_og_rasjonell_arealbruk_for_akvakulturnaringen.pdf/nb-no

Fish Pool ASA. (n.d.). *Fish Pool ASA*. Retrieved September 27, 2013, from Weekly, Monthly, Annual Average: http://fishpool.eu/iframe.aspx?iframe=fpbackoffice/pricedetails.aspx&pageId=53

Fish.no. (2011, April 6). *NSL støtter forslag om arealavgift*. Retrieved October 14, 2013, from http://www.fish.no/oppdrett/4412-nsl-stotter-forslag-om-arealavgift.html

Fisheries.no. (2010, October 27). *Fisheries.no*. Retrieved September 4, 2013, from Licence requirements in aquaculture: http://www.fisheries.no/aquaculture/Laws-and-regulations/licence_requirement/

Grytøyr, G. (2011, March 18). *Lokalavisa NordSalten*. Retrieved September 24, 2013, from Vil ha arealavgift: http://www.nord-salten.no/no/nyheter/politikk/vil-ha-arealavgift.7710

Gullestad, P., Bjørgo, S., Gudding, R., Osland, A. B., Eithun, I., Hansen, H., et al. (2011). *Effektiv og bærekraftig arealbruk i havbruksnæringen - areal til begjær*. Oslo: Fiskeri- og kystdepartementet.

Guttormsen, A., Davidsen, T., Sæther, K., Berg, I., Knutsen, G., Ellingsen, L., et al. (2012). *Videreutvikling av MTB-systemet Rapport fra arbeidsgruppe nedsatt av Fiskeri- og kystdepartementet.* Oslo: Fiskeri- og kystdepartementet.

Hersoug, B., & Johnsen, J. (2012). *Kampen om plass på kysten: Interesser og utviklingstrekk i kystsoneplanleggingen.* Oslo: Universitetsforlaget.

Isaksen, J. R., Andreassen, O., & Robertsen, R. (2012). *Kommunenes holdning til økt oppdrettsvirksomhet.* Tromsø: Nofima.

James Barr Limited, & Dear, P. (2011). *The Crown Estate Fin Fish Farm Leases Rent Review at 1 January 2012.* Glasgow: James Barr Limited.

Liabø, L., Nystøyl, R., Lassen, T., & Kjønhaug, A. F. (2011). *Arealavgift for oppdrettslokaliteter - Utredning av grunnlaget for innføring av arealavgift eller ressursskatt i akvakulturnæringen.* Kristiansund: Kontali Analyse AS.

Liu, Y., Olaussen, J. O., & Skonhof, A. (2010, November 17). Wild and farmed salmon in Norway - A review. *Marine Policy*, pp. 1-6.

Longvastøl, I. (2011, March 17). *Firda*. Retrieved September 27, 2013, from Må betale 2,4 millionar ekstra: http://www.firda.no/nyhende/article5531195.ece

Lovdata. (2001, June 15). *Vederlag ved tildelig av konsesjoner for matfiskoppdrett av laks og ørret.* Retrieved September 4, 2013, from Lov om endring i lov 14.juni 1985 nr. 68om oppdrett av fisk, skalldyr m.v.(vederlag ved tildelig av konsesjoner for matfiskoppdrett av laks og ørret).: http://lovdata.no/cgi-wift/wiftldles?doc=/app/gratis/www/docroot/ltavd1/filer/nl-20010615-050.html&emne=fiskeoppdrett*&

Lovdata. (2005, January 1). *Laksetildelingsforskriften.* Retrieved November 24, 2013, from Lovdata: http://lovdata.no/dokument/SF/forskrift/2004-12-22-1798

Lovdata. (2008, June 17). *Akvakulturdriftsforskriften.* Retrieved September 5, 2013, from FOR 2008-06-17 nr 822: Forskrift om drift av akvakulturanlegg (akvakulturdriftsforskriften): http://lovdata.no/for/sf/fi/xi-20080617-0822.html

Lovdata. (2012, December 5). *Forskrift om lakselusbekjempelse.* Retrieved September 5, 2013, from FOR 2012-12-05 nr 1140: Forskrift om bekjempelse av lakselus i akvakulturanlegg: http://www.lovdata.no/cgi-wift/ldles?doc=/sf/sf/sf-20121205-1140.html

Lovdata. (2013, June 24). *Forskrift om løyve til havbruk med matfisk.* Retrieved November 29, 2013, from http://lovdata.no/dokument/SF/forskrift/2013-06-24-754

Lund, C., & Jensen, K. C. (2013). *Betenkning: forslag om endring i Akvakulturloven - innføring av areal/naturavgift for oppdrettsvirksomhet (oppdrettsavgift).* Oslo: Advokatfirmaet Lund & Co DA.

Lura, H. (2013, March 20). *Tidens krav*. Retrieved September 27, 2013, from Vil ha skatt fra vindkraft og oppdrett: http://www.tk.no/nyheter/article6560919.ece

Marine Harvest ASA. (2012 A, July 17). *Marine Harvest.* Retrieved September 10, 2013,
from Salmon Farming Industry Handbook 2012:
http://www.marineharvest.com/PageFiles/1296/2012%20Salmon%20Handbook%201
8.juli_høy%20tl.pdf

Ministry of Finance. (2009 A, December 18). *Finansdepartementet*. Retrieved September 4,
2013, from Eiendomsskatt:
http://www.regjeringen.no/templates/RedaksjonellArtikkel.aspx?id=558685&epslangu
age=NO

Ministry of Finance. (2009 B, October 9). *Finansdepartementet.* Retrieved November 26,
2013, from Prop.1 S (2009-2010) Skatte-, avgifts- og tollvedtak:
http://www.regjeringen.no/pages/2250899/PDFS/PRP200920100001SKADDDPDFS.
pdf

Ministry of Finance. (2010, October 5). *Finansdepartementet*. Retrieved September 19, 2013,
from Endringer i eiendomsskatten:
http://www.regjeringen.no/nb/dep/fin/pressesenter/pressemeldinger/2010/endringer-i-
eiendomsskatten.html?id=619596#

Ministry of Finance and Customs. (1996, September 26). *Finans- og tolldepartementet*.
Retrieved September 19, 2013, from Ny lov om eiendomsskatt. NOU 1996:20:
http://www.regjeringen.no/nb/dep/fin/dok/nouer/1996/nou-1996-20.html?id=116120

Ministry of Fisheries and Coastal Affairs. (2011 A, December 20). *Fiskeri- og
kystdepartementet*. Retrieved September 29, 2013, from Nye tiltak mot rømming og
lakselus:
http://www.regjeringen.no/nb/dep/fkd/pressesenter/pressemeldinger/2011/nye-tiltak-
mot-romming-og-lakselus--.html?id=667455

Ministry of Fisheries and Coastal Affairs. (2011 B). *Ny bestemmelse om utmåling av
overtredelsesgebyr.* Oslo: Ministry of Fisheries and Coastal Affairs.

Ministry of Fisheries and Coastal Affairs. (2013, June 25). *Fiskeri- og kystdepartementet*.
Retrieved September 5, 2013, from Forskrift om tildeling av løyve til havbruk med

matfisk av laks, aure og reinbogeauge i sjøvatn i 2013:

http://www.regjeringen.no/nn/dep/fkd/Dokument/lover-og-

reglar/Forskrifter/2013/forskrift-om-tildeling-av-loyve-til-havb.html?id=731666

Ministry of Foreign Affairs. (2011, November 18). *Utenriksdepartementet.* Retrieved

September 10, 2013, from Meld. St. 7 (2011-2012) Melding til Stortinget:

Nordområdene - visjon og virkemidler. Fiskeri, havbruk og marin bioprospektering:

http://www.regjeringen.no/nb/dep/ud/dok/regpubl/stmeld/2011-2012/meld-st-7-

20112012/11.html?id=663476

Ministry of Local Government and Regional Development. (2010, August 24). *Kommunal- og*

regionaldepartementet. Retrieved September 19, 2013, from Finansiering av sektoren

samlet, herunder øremerking, innlemming med mer.:

http://www.regjeringen.no/nb/dep/krd/tema/kommuneokonomi/finansiering-av-

sektoren-samlet-herunder.html?id=552048

Ministry of Local Governments and Regional Development. (2008, May 15). *Regjeringen.no.*

Retrieved September 19, 2013, from St.prp. nr. 57 (2007-2008),

Kommuneproposisjonen 2009, 6.2 Selskapsskatt:

http://www.regjeringen.no/nb/dep/krd/dok/regpubl/stprp/2007-2008/stprp-nr-57-2007-

2008-/6/2.html?id=515772

Ministy of Finance. (2009, December 18). *Finansdepartementet.* Retrieved September 19,

2013, from Eiendomsskatt:

http://www.regjeringen.no/nb/dep/fin/tema/skatter_og_avgifter/kapitalbeskatning/eien

domsskatt.html?id=558685

MSD Animal Health. (2013). *MSD Animal Health*. Retrieved September 5, 2013, from

Konsekvenser for fisken: http://www.teamaquatic.no/lus-06-lakselus-

konsekvenser.aspx

Network Fjord and Coastal Municipalities. (2012, December 13). *Nettverk fjord- og*

kystkommuner. Retrieved November 5, 2013, from -Sentralisering og konsentrasjon av

eierskap i havbruksnæringen kan svekke mulighetene for vekst:

http://kystnettverk.no/nyhetsarkiv/_sentralisering_og_konsentrasjon_av_eierskap_i_ha
vbruksn_ringen_kan_svekke_mulighetene_for_vekst/

Network Fjord and Coastal Municipalities. (2013, November 8). *Nettverk fjord- og
kystkommuner*. Retrieved November 19, 2013, from Mer penger til
havbrukskommunene, men varig løsning manlger:
http://kystnettverk.no/nyhetsarkiv/mer_penger_til_havbrukskommunene_men_varig_l
osning_manlger/

Network Fjord and Coastal Municipalities. (n.d.). *Nettverk fjord- og kystkommuner*. Retrieved
October 17, 2013, from Arealavgift vil sikre vekst og utvikling i laksenæringen: En
avgift som for øvrig næringen har råd til å betale:
http://kystnettverk.no/NETTVERKFORFJORDOGKYSTKOMMUNERNFKK/nyhets
arkiv/arealavgift/

Norwegian Food Safety Authority. (2010, December 6). *Mattilsynet.* Retrieved November 29,
2013, from Vedlegg 6: Soneforskrift TMR:
http://www.mattilsynet.no/fisk_og_akvakultur/fiskehelse/fiske_og_skjellsykdommer/l
akselus/vedlegg_6_soneforskrift_tmrpdf.8949/BINARY/Vedlegg_6_Soneforskrift%2
0TMR.pdf

Norwegian Food Safety Authority. (2013, March 22). *Mattilsynet*. Retrieved November 5,
2013, from Soneforskrifter mot lakselus:
http://www.mattilsynet.no/fisk_og_akvakultur/fiskehelse/fiske_og_skjellsykdommer/l
akselus/soneforskrifter_mot_lakselus.3980

Norwegian Seafood Association. (2009, February). *Norske sjømatbedrifters landsforening*.
Retrieved September 28, 2013, from Tildelig av nye konsesjoner:
http://nsl.no/fagomrader/oppdrett/tildeling-av-nye-konsesjoner

Norwegian Seafood Council. (2013, September 25). *Norges sjømatråd*. Retrieved September
6, 2013, from Statistikk: http://seafood.no/Markedsinformasjon/Statistikk/(stats)/6756

Norwegian Seafood Council. (n.d.). *NSC Facts.* Retrieved September 6, 2013, from Norway -
world leader in salmon:

http://norwegianseafoodcouncil.drupalgardens.com/sites/norwegianseafoodcouncil.drupalgardens.com/files/06_nsc_facts_norwayworldleaderinsalmon.pdf

Norwegian Seafood Federation. (2008, October 7). *Fiskeri- og havbruksnæringens landsforening*. Retrieved November 25, 2013, from Likevel ikke arealavgift: http://fhl.no/likevel-ikke-arealavgift/

Norwegian Seafood Federation. (2010 A, November 29). *Fiskeri- og havbruksnæringens landsforening*. Retrieved September 6, 2013, from Havbruksnæringen tar mijøansvar!: http://www.fhl.no/hovedsiden/havbruksnaeringen-tar-miljoeansvar-article3760-5.html

Norwegian Seafood Federation. (2010 B). *Lovverk som regulerer oppdrettsnæringen på miljøområdet. Kort oversikt.* Oslo: Norwegian Seafood Federation.

Nystøyl, R., Øksenvåg, J., Kosmo, J., Eikrem, M., & Kirkholt, M.-A. (2013). *Monthly Salmon Report February 2013.* Kristiansund: Kontali Analyse.

Oates, W. E. (1999). *An Essay on Fiscal Federalism.* Maryland: Journal of Economic Literature Vol. XXXVII (September 1999) pp. 1120-1149.

Office of the Prime Minister. (2013, October 16). *Politisk platform.* Retrieved November 25, 2013, from Politisk plattform for en regjering utgått av Høyre og Fremskrittspartiet: http://www.regjeringen.no/nb/dep/smk/dok/rapporter_planer/rapporter/2013/politisk-plattform.html?id=743014

Robinson, J. (1962). *A Neo-Classical Theorem.* Stockholm: The Review of Economic Studies, Vol. 29, No. 3 (Jun., 1962), pp. 219-226.

Skeie, K. (2011, May 25). *NRK Nordland*. Retrieved November 25, 2013, from Krever egen skatt for oppdrett: http://www.nrk.no/nordland/krever-egen-skatt-for-oppdrett-1.7648508

Sletmo, D. (2013). *FishPool.eu.* Retrieved November 18, 2013, from Risk & decision making: http://fishpool.eu/uploads/sletmo.pdf

Statistics Faroe Islands. (2013, July). *Hagstova Føroya.* Retrieved November 26, 2013, from Faroe Islands in figures 2013: http://www.hagstova.fo/portal/page/portal/HAGSTOVAN/Statistics_%20Faroe_Islands/Faroe%20Islands%20in%20figures%202013.pdf

Statistics Norway. (2013 A). *Statistisk sentralbyrå*. Retrieved September 10, 2013, from Akvakultur - Lag egne tabeller og figurer: https://www.ssb.no/statistikkbanken/selecttable/hovedtabellHjem.asp?KortNavnWeb=fiskeoppdrett&CMSSubjectArea=jord-skog-jakt-og-fiskeri&checked=true

Statistics Norway. (2013 B, May 24). *Statistisk sentralbyrå*. Retrieved November 10, 2013, from Utenrikshandel med varer, Lag egne tabeller og figurer Tabell: 09283: Eksport av fisk, etter land/handelsområde/verdensdel.: https://www.ssb.no/statistikkbanken/SelectVarVal/saveselections.asp

Statistics Norway. (2013 C). *Statistisk sentralbyrå*. Retrieved November 16, 2013, from Eksport av laks, Lag egne tabeller og figurer, Tabell: 03024: Eksport av fersk og frosen oppalen laks: https://www.ssb.no/statistikkbanken/selectvarval/Define.asp?subjectcode=&ProductId=&MainTable=EksLaksUke&nvl=&PLanguage=0&nyTmpVar=true&CMSSubjectArea=utenriksokonomi&KortNavnWeb=laks&StatVariant=&checked=true

The Norwegian Seafood Research Fund. (n.d.). *Fiskeri- og havbruksnæringens forskningsfond*. Retrieved November 15, 2013, from The Norwegian Seafood Research Fund - FHF: http://www.fhf.no/hot-topics/about-fhf/

Tviberg, S. (2008, January 23). *Namdalsavisa*. Retrieved November 30, 2013, from Skeptisk til arealavgift: http://www.namdalsavisa.no/Nyhet/article3301264.ece

Velasco, A. (1999). *Debts and deficits with fragmented fiscal policymaking.* New York: Journal of Public Economics 76 (2000), pp 105–125.