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Fish Farm Ecology

A conceptual framework and empirical investigation of the CSR
performance of Marine Harvest ASA and Cermaq ASA

by

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This thesis was written as a part of the master program at NHH. Neither the institution, the supervisor, nor the censors are - through the approval of this thesis - responsible for neither the theories and methods used, nor results and conclusions drawn in this work.

Abstract

The purpose of this master thesis is to give business participants, regulatory authorities, researchers and the broader community awareness of priority areas within the fish farming industry. In this sense, we have developed a conceptual framework; Fish Farm Ecology (FFE). The FFE model equates three spheres; economy, ecology, and ichthyology. It has flexibility and can be used both as an analytical tool for a broader interest group and as a management tool for companies within the industry. The conceptual framework and the empirical investigation are based upon five context areas; fish feed, sea cages, escaping, sea lice, and the slaughter process. In the empirical investigation, which is concentrated around two companies; Marine Harvest ASA and Cermaq ASA, perspectives of CSR and ethics are included. The CSR-FFE performance of Marine Harvest lies within the upper edge of a minor link, while Cermaq's lies within the intermediate link.

Preface

First of all, we are grateful to our supervisor, Professor Knut J. Ims, for leading us into choosing the topic fish farming. This topic fitted well into the prospects of the authors, which care about companies' socially responsible performance. Furthermore, we appreciate the freedom Ims has given us through our work. This has given room for independent thinking and has indeed shaped the frame of this thesis. Behind this freedom lies a great deal of responsibility and the need for personal discretion. We have tried our best in making this thesis accessible for a wide audience. The inclusion of the context chapter reflects this, as it reduces the reader's need for background information related to fish farming specifics prior to reading this thesis. The context chapter will also provide essential information necessary to better understand the empirical analysis. Even though the context chapter makes the thesis longer, we used our freedom and personal discretion to include it as we think it makes the thesis more accessible.

We have learned a lot from working on this thesis, both with regards to fish farming issues as well as general theory used throughout the thesis. We have also gained considerable experience related to gathering, prioritizing, structuring and analyzing data. Considering that we knew little about issues related to fish farming prior to writing this thesis (with the exception that one of the authors had previously taken a short visit to a fish farming site), the level of detail we provide in e.g. the context chapter have required considerable amounts of extra effort to counterbalance our lack of formal education within the area.

Valuable insights from previous courses taken at NHH have brought added value to the theoretical applications used in this thesis. Also regarding the methodological foundations in doing research, the experience from NHH has given valuable insights. Learning curves has stretched across several areas. As we have faced difficulties during the work, the tough choices have contributed to increased personal maturity and independence. This is highly appreciated as this is a valuable experience we can bring further in our lives. This applies both on the professional as well as on the private arena. Both of us have felt that it has been valuable to cooperate in creating this thesis. We have learned from each other's experiences and challenged each other's learning curves, which have thus enabled a higher learning outcome.

This thesis would not have become a reality without cooperation between research institutes, NGO's and business participants. In the process of achieving a richer understanding of im-

portant aspects related to the fish farming context, insights from the Institute of Marine Research has been important. Here the authors would like to thank principal scientist, prof. dr. philos. Erik Slinde. He has given us a wider perspective with regards to the topic and thus enriched the competence of the authors regarding specific fish farming considerations. In the process of gaining wider perspectives, the contribution of WWF has been valuable, as they can provide critical viewpoints. Head of the Marine Programme, Karoline Andaur, has contributed by emphasizing factors related to fish farming the authors otherwise would not know about. We therefore appreciate the time she put aside for us. The experience of visiting the slaughterhouse Slakteriet Brekke has given us added value when we confront it with the theoretical fish farming knowledge we have gained. The authors really appreciate the way we were met by Knut Strømsnes, director at Slakteriet Brekke. We would also like to thank the friendliness and openness of the other staff members, who seemed happy to explain and describe the activities they took part in. This has enabled us to emphasize important aspects when analyzing the slaughter process both from a practical and theoretical stance.

Since performance of Marine Harvest ASA and Cermaq ASA makes the foundation of the empirical investigation in this thesis, their contribution must be highly recognized. Even if there have been some particular challenges related to this part of our work, the meeting at the two companies headquarters have given added value to this thesis. We appreciate that both companies accepted to let us interview them and participate in this thesis. The author's would in this sense direct recognition to the director of corporate communications in Marine Harvest, Jørgen Christiansen, who even before the interview took place provided us with constructive feedback in our early methodological stage. With regards to Cermaq's contribution in the empirical analysis of this thesis, the authors appreciate the cooperativeness of director of corporate affairs, Lise Bergan and sustainability coordinator, Kristin V. Hurum. Both described high interest in our work and the topic of this thesis.

In chapter 1 we give an overview of the fish farming industry with focus on some key financial figures and production volume. The production process is also mentioned. The scope of the thesis is also discussed in this chapter and linked to the research questions. In chapter 2 we go through five fish farm specific issues which frame the scope of the thesis. We have called this chapter; context areas. In chapter 3, a literature review is done within three areas; the art of solving the right problem, corporate social responsibility and ethics. A reference frame is given in chapter 4, which constitutes the two areas ecology and ichthyology. This chapter is important for the conceptual framework developed in chapter 6. In chapter 5, methodological

aspects relevant for the analyses are discussed. This chapter is building the bridge between the theoretical foundation and the analyses. Analysis I is given in chapter 6, which deals with developing the conceptual framework. This framework is based on insights derived from chapter 4, as well as from the literature review related to the art of solving the right problem, and linked up against the context areas. In chapter 7 we give a brief overview of the two companies; Marine Harvest ASA and Cermaq ASA with some key financial performance indicators and harvest volumes as well as ownership structures. The results of the empirical investigation are given in chapter 8. Here the results of the two companies' broader CSR perceptions as well as the results within the five context areas are given. The results of our meetings with the Institute of Marine Research as well as WWF are also presented here. The results from our visit at the slaughterhouse Slakteriet Brekke are given as the last part of this chapter. Analysis II is done in chapter 9, which is based on the empirical results. Here we use knowledge from the context areas and the literature review related to CSR and ethics theories, to discuss the findings. The discussion is evaluated against the conceptual framework developed in Analysis I. The conclusions of analysis I & II is drawn in chapter 10. The thesis ends with some suggestions for future research in chapter 11.

With regards to critical reflections surrounding this thesis, the authors would prefer to have had more empirical results to base analysis II on. The limited data we got from the company interviews means that analysis II will not be as in-depth as we would have liked.

Bergen, June 2012

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Abbreviations

ASC – Aquaculture Stewardship Council

CAGR – Compounded Annual Growth Rate

Cermaq – Cermaq ASA

CSR – Corporate Social Responsibility

E3 error – The nature of solving the wrong problem correctly

EBIT – Earnings Before Interests and Taxes

EBITDA - Earnings Before Interests, Taxes, Depreciation and Amortization

EFSA – European Food Safety Authority

FAO – Food and Agriculture Organization of the United Nations

FCR – Feed Conversion Ratio

FFE – Fish Farm Ecology

FIFO – Fish In – Fish Out

IFFO – International Fishmeal and Fish Oil Organization

HOG – Head-On Gutted

IMR – Institute of Marine Research

IUU – Illegal, Unregulated and Unreported fishing

Marine Harvest / MH – Marine Harvest ASA or Marine Harvest Group

MODR - Marine Oil Dependency Ratio

MPDR - Marine Protein Dependency Ratio

MSC – Marine Stewardship Council

ROA – Return On Assets

RS – Responsible Supply

SAD – Salmon Aquaculture Dialogue

WWF – World Wide Fund for Nature

1 INTRODUCTION

1.1 WORLD OUTLOOK ON AQUACULTURE AND SALMON FARMING

As can be seen from Table 1-1 below global capture production has remained stable and global aquaculture production has risen considerably over the last years. Also worth noticing is the steady increase in human consumption of fish both totally and per capita.

Table 1-1: World fisheries and aquaculture production (in million tonnes) and utilization (adapted from FAO, 2010a; 2012a).

World production (million tonnes):	2004		2005		2006		2007		2008		2009	
Total capture (marine & inland)	92.4	68.8 %	92.1	67.5 %	89.7	65.4 %	89.9	64.3 %	89.7	63.1 %	90.0	62.0 %
Total aquaculture (marine & inland)	41.9	31.2 %	44.3	32.5 %	47.4	34.6 %	49.9	35.7 %	52.5	36.9 %	55.1	38.0 %
- Atlantic Salmon (marine)	1.3	0.9 %	1.3	0.9 %	1.3	1.0 %	1.4	1.0 %	1.5	1.0 %	1.4	1.0 %
Total production	134.3	100.0 %	136.4	100.0 %	137.1	100.0 %	139.8	100.0 %	142.2	100.0 %	145.1	100.0 %
Utilization:												
Human consumption	104.4	77.7 %	107.3	78.7 %	110.7	80.7 %	112.7	80.6 %	115.1	80.9 %	117.8	81.2 %
Non-food uses	29.8	22.2 %	29.1	21.3 %	26.3	19.2 %	27.1	19.4 %	27.2	19.1 %	27.3	18.8 %
Population (billions)	6.4		6.5		6.6		6.7		6.8		6.8	
Per capita food fish supply (kg)	16.2		16.5		16.8		16.9		17.1		17.2	

The capture production can be divided into capture for food and industrial purposes, as shown in Figure 1-1 below. Figure 1-1 shows that capture for industrial purposes has remained stable over the entire time period. Capture for food has risen gradually over the years before reaching stability around 1995. Just as Table 1-1, Figure 1-1 shows a significant growth in aquaculture production.

Figure 1-1: World fisheries production 1970 – 2005 (in million tonnes) (adapted from Schipp, 2008, p. 5)

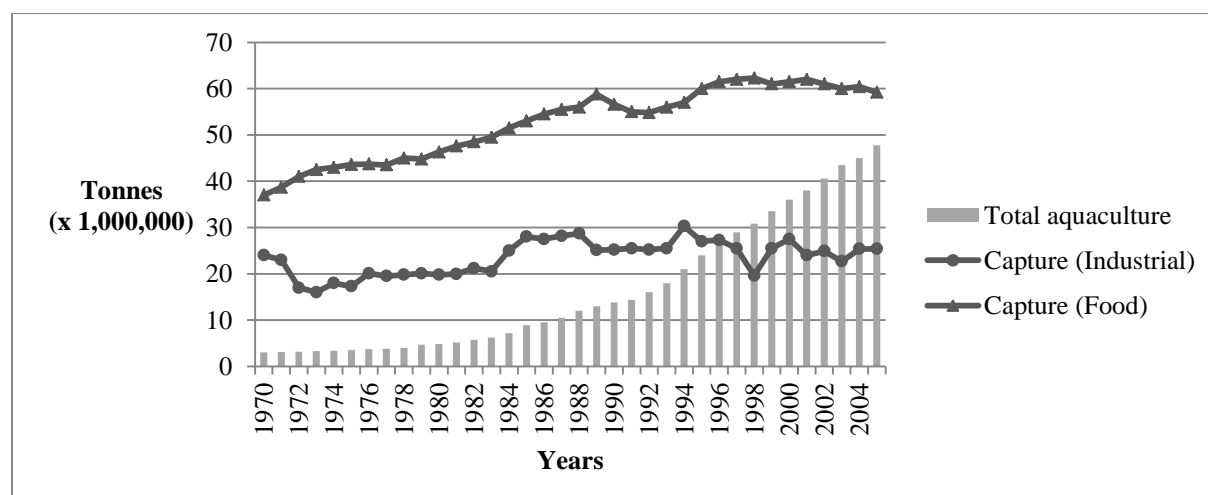


Figure 1-2 below shows the global production of wild and farmed Atlantic salmon. It may appear as if farmed production has gradually replaced wild production, but as the Figure 1-2 indicates from a closer inspection, this is clearly not the case. From now on, to avoid repetition, the two terms salmon and Atlantic salmon will be used interchangeably.

Figure 1-2: Wild (left) and farmed (right) production (in thousand tonnes, but notice the different units on the axes) of Atlantic salmon (based on data from FAO, 2012a; 2012b)

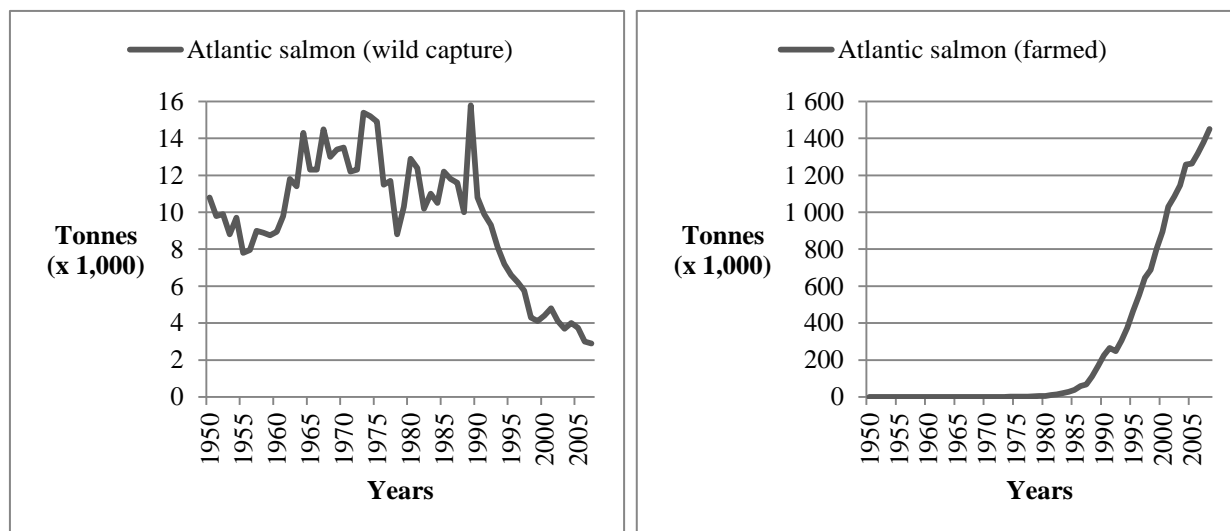


Figure 1-2 makes it clear how capture of wild salmon is marginal, and also how farmed Atlantic salmon constitutes only a small part of total aquaculture production. From 2004 to 2009 world production of Atlantic salmon has risen gradually from 1.26 million tonnes in 2004 to 1.44 million tonnes in 2009 (FAO, 2012a). In 2009 this amounts to 2.61 % of the worlds total aquaculture production, and 0.99 % of the worlds total production (capture and aquaculture).

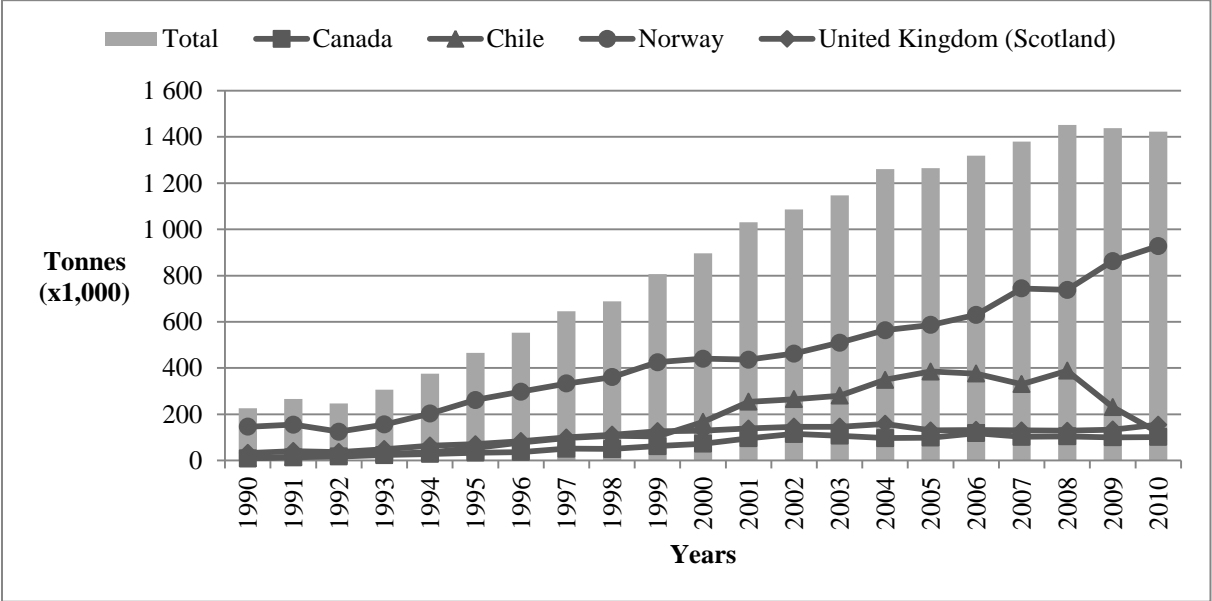
According to FAO (2010a, p. 22), Norway and Chile are the biggest salmon producers in the world, with shares of 36.4 % and 28 % of global production each, respectively.¹ Atlantic salmon tends to be the most profitable species to cultivate, and its share of total salmon production has risen over the years. Global production of Atlantic salmon in 2008 was roughly 1.5 million tonnes (FAO, 2010a, p. 22). This represents more than 76 % of total salmon production that year (Asche & Bjørndal, 2011, p. 17).

Figure 1-3 below shows production of Atlantic salmon for the four principal production countries in the world, which in addition to Norway and Chile are the United Kingdom (Scotland)

¹ While salmonid production in Norway is mainly Atlantic salmon, the share of Atlantic Salmon in Chile in 2008 was only 56.2 % of total production (salmon trout and Coho salmon constituted the rest, with a 26.6 % and 17.2 % share, respectively) (Asche and Bjørndal, 2011, p. 23).

and Canada. Figure 1-3 also depicts the world’s total production of Atlantic salmon. As seen, there has been a tremendous growth over the years, particularly in Norway, but also in Chile up until the Chile crisis.²

Figure 1-3: Atlantic salmon production (in thousand tonnes) in the four principal production countries as well as the world total (based on data from FAO, 2012a)



As seen from Table 1-2, Marine Harvest was by far the largest salmonid producer in the world in 2008, with roughly 3.5 times higher production than Cermaq, which just barely held second

Table 1-2: The world’s 10 biggest salmonid producers (in tonnes) in 2008 (adapted from Asche & Bjørndal, 2011, p. 40)

Rank	Company	Company HQ	Production (tonnes)
1	Marine Harvest	Norway	398,300
2	Cermaq	Norway	113,700
3	Aquachile	Chile	113,500
4	Lerøy Seafood	Norway	103,000
5	Cooke Aquaculture	Canada	78,000
6	Grieg Seafood	Norway	57,500
7	Norway Royal Salmon	Norway	54,000
8	Pesquera Camanchaca	Chile	48,300
9	Pesquera Los Fiordos	Chile	46,900
10	Salmones Antartica	Japan	33,300
Total production of all 10:			1,046,500

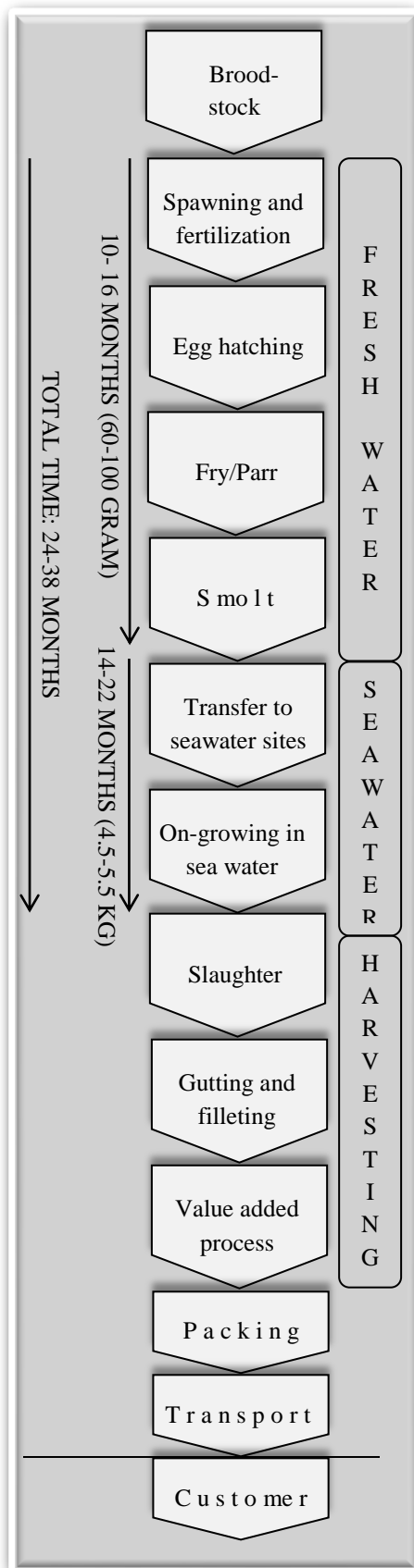
place. According to Cermaq’s own numbers, Atlantic salmon constituted approximately 75 % of the company’s total production in 2008, which translates to just over 78 000 tonnes (Cermaq, 2012).³ Marine Harvest does not explicitly state the share of Atlantic salmon in their total production, but it is their main product.

² The large setback in Chile from 2008 onwards was mainly due to a virus outbreak.

³ According to Cermaq’s annual report for 2011 their total production in 2008 (all salmonids) was 102 000 tonnes. In other words there is a slight mismatch between Cermaq’s numbers and those in Table 3-2. Either way Cermaq is still one of the biggest producers in the world.

1.2 THE PRODUCTION PROCESS OF SALMON

Figure 1-4: The production process of Atlantic salmon (based on data from Marine Harvest, 2011)



Salmon are anadromous fish and lay their eggs in fresh water, where the juvenile salmon stay until it becomes smolt. It then migrates to sea, where it lives for 1-4 years, depending on species, before it returns to spawn in its birth river. Atlantic salmon usually dies after spawning, but some survive to spawn more than once (Asche & Bjørndal, 2011).

As we can see from Figure 1-4 to the left, the production cycle of Atlantic salmon consists of two main phases; one in fresh water and one in sea water. From spawning and fertilization until harvest it takes around 24-36 months, i.e. around 2-3 years.⁴ This means that the capital has to “work” for a long time before you can hope to get anything back. Unforeseen events such as a disease outbreak could cause mortality rates to skyrocket and thus “eat” up your capital. Because of this, and due to the large amounts of salmon present in fish farms at any point in time, the industry is considered capital intensive and with a risk element. In addition to this, the salmon price itself is highly volatile, meaning that by the time the fish is ready for harvest, the price might no longer cover the costs you have had. However, despite this negative potential, salmon farming has overall been a profitable industry (this will be discussed in more detail in the next section).

⁴ While total production time is listed as 24-38 months in the figure, Marine Harvest (2011), whose data Figure 3-4 is based upon, gives a total production time of 24-36 months, i.e. in there is a small inconsistency in the source material.

There are diversified opinions on the duration of the production cycle. Asche and Bjørndal (2011, p. 11) state that Atlantic salmon will weigh between 2-8 kg after two years, which gives an average weight of 5 kg.

1.3 PROFITABILITY WITHIN THE SALMON FARMING INDUSTRY

The volatility risks related to price fluctuations and the long production cycle has not kept profit-hungry investors away from the industry. Headlines indicating profitability often covers the news headlines and sounds like:

“Cermaq presents its best results ever – proposing dividend of NOK 5.40 per share” (Oslo Børs, 2011a).

“Cermaq presents solid Q1 results with operating profit of NOK 101 million” (Netfonds, 2012).

“Strong results and strong performance” (Oslo Børs, 2011b).

“Continued focus on growth and utilization of capacity” (Oslo Børs, 2011c).

“Marine Harvest: good results in a strong market” (4-traders, 2009).

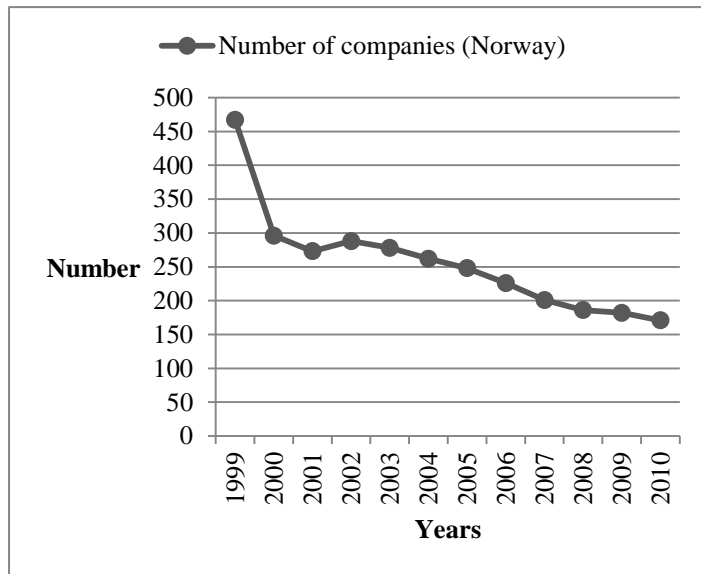
Also in other parts of the fish farming value chain we can find evidence of strong profitability:

“Morpool ASA reports strong improvements in processing margins for third quarter” (Netfonds, 2011).

“Sølvtrans – solid utilization gives record high EBITDA” (Thomson Reuters One, 2012).

Salmon farming started out as a small-scale industry, operated by locally owned small enterprises. As the industry became more sophisticated in terms of production and marketing however, economies of scale appeared. This in turn set the stage for the emergence of larger companies. Ownership regulations in Norway initially limited Norwegian companies from investing domestically, making them invest abroad instead and actively build up the industry there (Asche & Bjørndal, 2011, p. 35). However, over the past decade there has been a considerable consolidation in the Norwegian industry. Figure 1-5 below portrays a sharp decline in the number of companies in the sector. From 1999 to 2010 the number of companies has been more than halved.

Figure 1-5: The number of companies in the fish farming sector in Norway
(adapted from the Directorate of Fisheries, 2012a)



The Norwegian fish farming industry experienced rapid growth in the 1980s. Because the sector was profitable, investors had strong incentives to invest in the industry to meet the rising worldwide demand. Bjørndal et al. (1987) was among the first contributors to give in-depth knowledge related to the demands for financial knowledge regarding starting and running a fish farm. With yearly

growth rates as high as 47 % in the early 1980s, Bjørndal et al. (1987) claimed intensified competition will require the industry to shift focus from being production oriented to focusing on sound financial management. Their work goes deep into the management of fish farming, but exclusively from a financial perspective. Industrial structure, framework, investment calculations for hatchery and fish farms, as well as thorough mathematical theories related to optimal slaughter processes, were among the concepts discussed.

With regards to fish farming being a capital intensive industry, estimates from the Directorate of Fisheries (2011a) found that the average fish production and value creation of each full-time worker in the biggest fish farming companies in Norway in 2010 was equivalent to 340,690 kg fish and NOK 11,641,741, respectively.⁵

As mentioned, salmon farming has been a rapidly expanding and profitable industry. Despite farmed salmonids (Atlantic and Coho salmon and salmon trout) account for only around 4 % of the world's total aquaculture production, they make up almost 13 % of the production value (Asche & Bjørndal, 2011, p. 1). Asche and Bjørndal (2011) mention further that while a Norwegian cod fisherman receives only 10-25 % of the retail value of whole cod, the corresponding number for a salmon farmer is around 50 % (Asche & Bjørndal, 2011, p. 4).

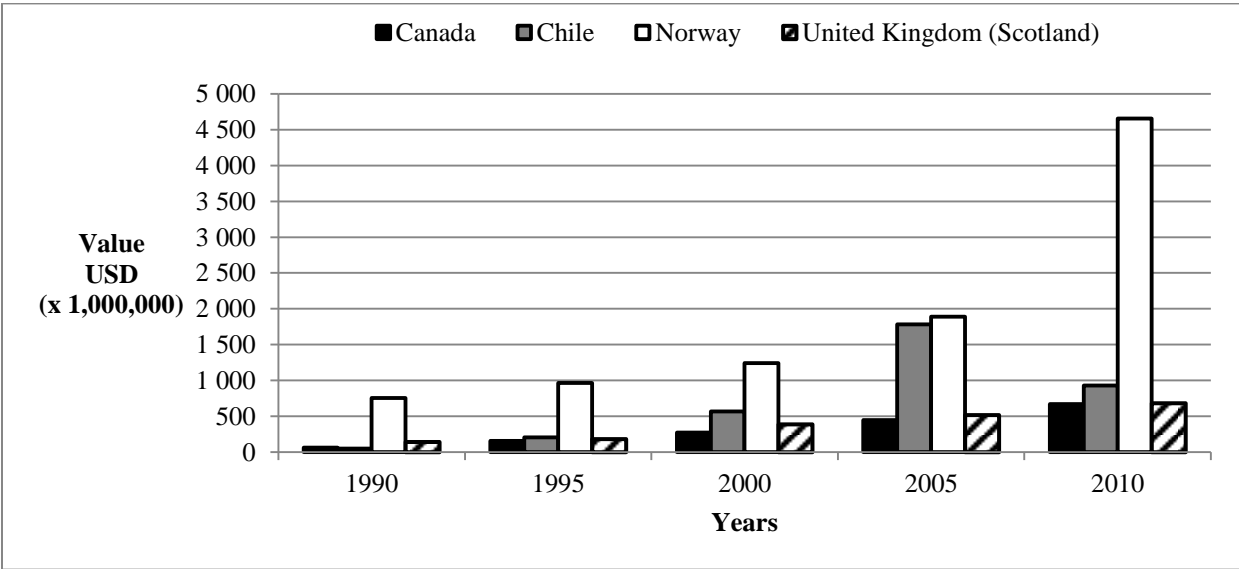
According to Datamonitor (2011a), the value of the diadromous segment of Norwegian aquaculture amounts to 96.7 % of total value. This corresponds to roughly NOK 21.6 billion. The

⁵ A company is categorized as big if it has 20 permits or more (Directorate of Fisheries, 2011a).

same source maintains that the compounded annual growth rate (CAGR) pertaining to the value of the Norwegian aquaculture industry in the period 2006-2010 was 7.6 %. A CAGR of 7.6 % is a lot, but seems reasonable when compared with the graph in Figure 1-3, as most diadromous fish production in Norway is indeed of Atlantic salmon. Datamonitor’s (2011a) outlook for future prospects of the Norwegian aquaculture is still good, albeit the CAGR for 2010-2015 is expected to decline somewhat, to 4.3 %. In Chile, Datamonitor (2011b) expects production to pick up strongly, and forecasts a performance CAGR for 2010-2015 of 15.6 %.⁶

As seen in Figure 1-6 below, the production value of Atlantic salmon farming has doubled several times over the years, with the most growth coming in the last decade. As mentioned, Chilean production is expected to recover strongly the next coming years.

Figure 1-6: Production value (USD millions) of farmed Atlantic salmon (adapted from FAO, 2012a)⁷



Salmon farming is a knowledge-based industry and one of the two leading species in modern industrialized aquaculture (Asche & Bjørndal, 2011, p. 1).⁸ It is in the forefront with regards to technology, innovation and productivity development. It is also intensive in nature. This means the farmer has control over a closed production system, which again means that the farmer does not depend on the wild population of the species. Because of this salmon farming is more like livestock production than fishing (Asche & Bjørndal, 2011, p. 11). Furthermore,

⁶ The diadromous segment of Chilean aquaculture amounts to 83.1 % of the industry’s total value (Datamonitor, 2011b).

⁷ The graph is somewhat misleading, as it only shows the production value of Atlantic salmon. As previously mentioned (cf. footnote 2), while most salmon production in Norway is indeed of Atlantic salmon, in Chile that share is considerably less.

⁸ The other species is shrimp (Asche & Bjørndal, 2011, p. 1).

it is precisely the control of the production process which has made technological innovation possible. This has led to reduced production costs, which in turn has made the industry more profitable and led to increased production. However, in order for salmon farmers to sell more and attract new customers, they have had to reduce prices, which in turn reduce profits. Cost reductions and price reductions has thus followed hand in hand, and had opposite effects upon industry profitability. This creates cycles in profitability. “Over time, the equilibrium is where produced quantity results in a price that gives the investor in the salmon industry the same risk-adjusted return on capital as in any other industry” (Asche & Bjørndal, 2011, p. 4).

Overall the large increase in salmon production is still a strong indicator that the industry has been profitable. “The decline in salmon prices is a result of price reductions aimed at attracting new customers and increasing consumption by current customers” (Asche & Bjørndal, 2011, p. 43). In terms of Norwegian fish farming, reduced export prices have coincided with reduced production costs. In Norway the fall in production costs has actually been higher than the price reduction. In 2008 the average real export price was 30 % of the export price in 1985, whereas the corresponding number for production costs was 28 % (Asche & Bjørndal, 2011). In the long run, the profit margin for Norwegian salmon farmers has remained fairly constant (Asche & Bjørndal, 2011, p. 44). Lower production costs have mainly been passed on to consumers, which suggest that “the production cost is the main factor in determining the price” (Asche & Bjørndal, 2011, p. 45). From Table 1-3 below it is clear that feed is by far the largest cost factor. Wages amount to less than 10 % of total production costs.

Table 1-3: Production cost (NOK) per kg fish produced (round weight) (adapted from Directorate of Fisheries, 2011a) ⁹

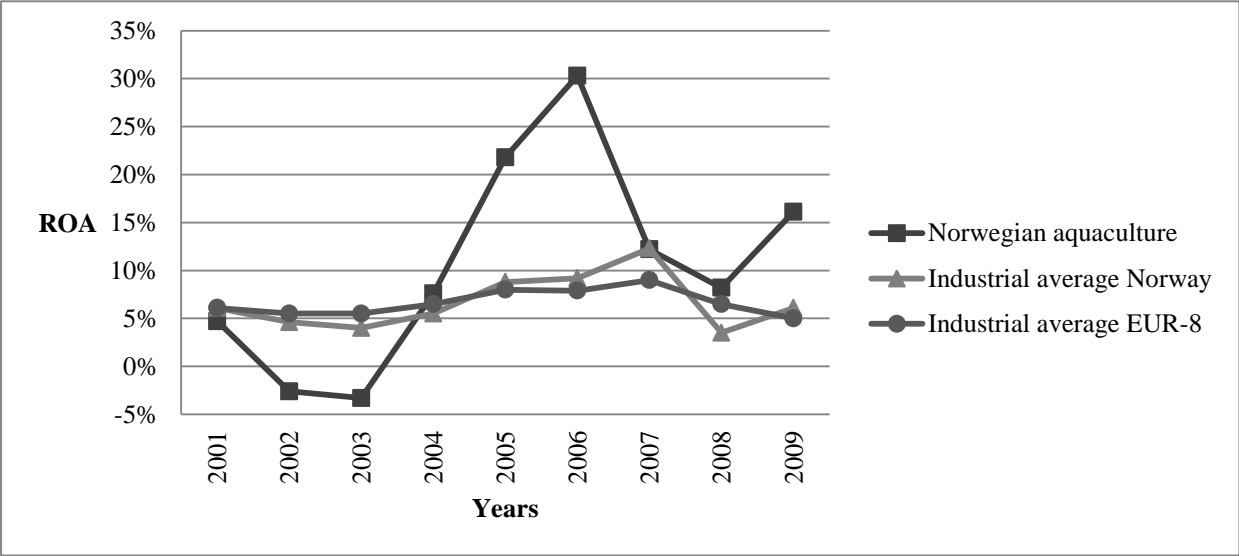
Cost	NOK	Share of total production cost (%)
Smolt cost per kg	2.29	11.24 %
Feed cost per kg	11.05	54.21 %
Insurance cost per kg	0.13	0.64 %
Wages per kg	1.83	8.97 %
Depreciation cost per kg	1.32	6.49 %
Other operating costs per kg	3.39	16.65 %
Financial cost per kg	0.36	1.78 %
Total production cost per kg	20.38	100.00 %
Slaughtercost per kg	2.90	14.23 %
Total cost per kg	23.28	

⁹ Round weight is the weight of the fish after starvation and bleeding (Directorate of Fisheries, 2009).

Cost reduction has been possible due to productivity growth and economies of scale related to the trend of fewer, but bigger operation sites, as well as economies of scale related to activities further down the supply chain (Asche & Bjørndal, 2011).

As we can see from Figure 1-7 below, Norwegian salmonid aquaculture has a volatile, yet generally higher return on assets (ROA) than the general industry average in Norway and EUR-8.¹⁰ The average ROA for Norwegian aquaculture in the stated period is 12.2 %, which is almost twice as much as the corresponding number for the general industry average in Norway and EUR-8, which are both 6.7 %.

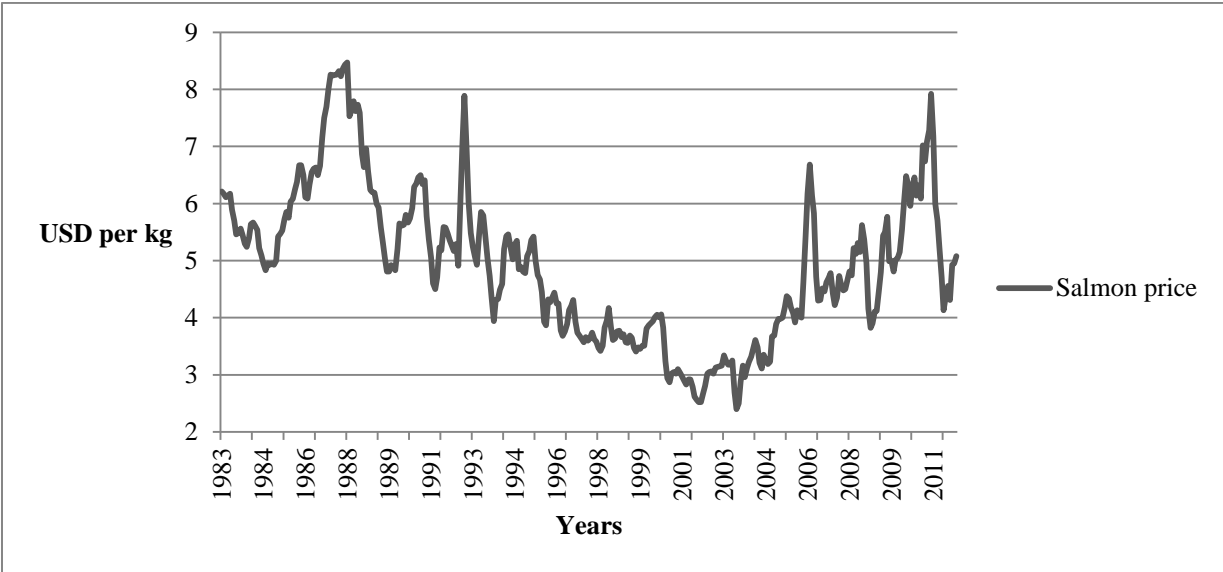
Figure 1-7: Average return on assets (ROA) for Norwegian aquaculture compared with the general industry average in Norway and eight EU-countries (based on data from the Directorate of Fisheries, 2011b; Arbeidsdepartementet, 2011, p. 66)



The salmon market is global in nature; there is for example airfreight of fresh salmon from Europe and South America to Japan and USA. This has made the industry considerably more competitive (Asche & Bjørndal, 2011). The global salmon price is, as seen in Figure 1-8 below, highly volatile. The price development from April 1992-1993 and April 2006-2007 illustrates this particularly well, with prices approximately rising more than 60 % in the space of a few months, only to drop back to the initial price a few months later (and, in the case of April 1992-1993, continuing to drop even further). As the salmon price strongly influences profitability, it presents a continuous risk element. Fish Pool, a global marketplace and provider of financial derivatives, let the salmon farmers’ hedge against this risk and thus achieve greater predictability for the bottom line (Fish Pool, 2011).

¹⁰ EUR-8: Belgium, France, Italy, the Netherlands, Poland, Portugal, Spain and Germany (Arbeidsdepartementet, 2011, p. 66).

Figure 1-8: Monthly price (USD) of salmon per kg (based on data from Indexamundi, 2012a)

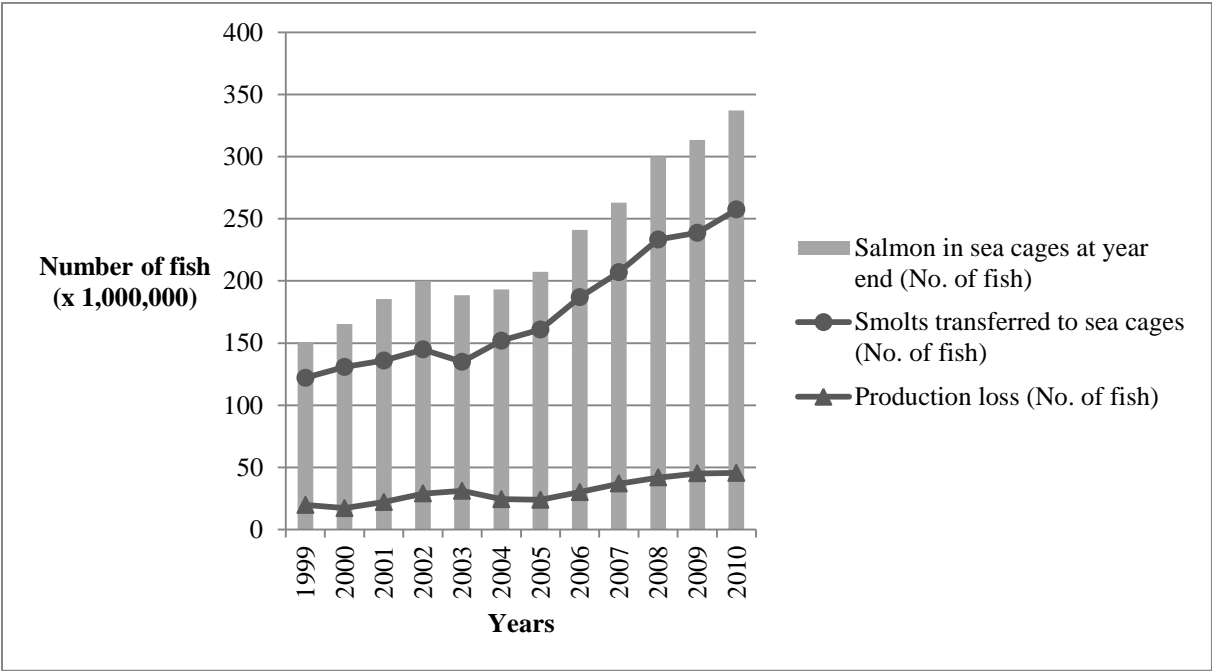


In particular, it is interesting to notice how the low salmon price seen in Figure 1-8 in 2003 coincides with the low ROA for Norwegian Aquaculture the same year, as seen in Figure 1-7. In a similar fashion, the high salmon price in 2006 also coincides nicely with the exceptional high ROA of Norwegian aquaculture that year.

1.4 CRITICAL REFLECTIONS ON SALMON FARMING

As the fish farming industry grows, so does the number of fish currently held in sea cages. In Norway for example, the world’s biggest country producer of Atlantic salmon, there were close to 350 million salmon held in sea cages at year end 2010 (Directorate of Fisheries, 2012a). According to the Directorate of Fisheries (2011c; 2012b) close to 100 million salmon are slaughtered every year in Norway. Many fish also die earlier though, whereas some escape. These incidents are often regarded under the collective industry terminology; production loss. During the time period shown in Figure 1-9 below, all three variables in the graph show the same trend and have more than doubled.

Figure 1-9: No. of individuals (in millions) in Norwegian sea cages (based on data from the Directorate of Fisheries, 2012a)



The rapid growth of the industry coupled with strong consolidation in the same period, means that the fates of an increasing number of fish are in fewer hands. Since the management policies of the remaining companies affect more individuals they have an increased responsibility to operate in a way which takes more than profit into consideration. The industry participants have a responsibility to treat the fish with the respect a living being deserves, and to make sure the environment is not seriously negatively affected by their activities. Hence, there is a need for a framework to consider and evaluate other perspectives in addition to the economic one. Because the industry is attractive, there might be a danger that profit-seeking might lead to ignoring other important aspects, such as ensuring fish welfare and making sure the environment do not suffer. In this sense, it would be valuable to investigate the corporate social responsibility (CSR) performance of some major industry participants. This brings us to the research questions.

1.5 RESEARCH QUESTIONS

The analysis seeks to answer the two subsequent questions:

(I)

How can we develop a conceptual framework that can be related to business participants' overall CSR perceptions and CSR performance in the fish farming industry within the context areas; fish feed, sea cages, escaping, sea lice and the slaughter process?

(II)

How are Marine Harvest's and Cermaq's broader perceptions of CSR and their subsequent CSR performance within the context areas linked to fish farm ecology?

1.6 LIMITATIONS

1.6.1 BROADER LIMITATIONS

Within the time- and cost schemes existing for a master thesis, we have had to make some limitations. One could always raise questions in such a process. With regards to CSR one could take a wide range of approaches within the fish farming industry. For us it was the utmost interest to look at different circumstances on what we perceive as the most important stakeholder – the fish itself. From here, there are a lot of value chain activities and implications that are subjected to a wide range of economical, ecological and ichthyological considerations. In this sense, one could dispute the scope as too narrow. Some would argue that in order to evaluate CSR and ethics, one should look at all industry interaction (e.g. working conditions, corruption, child labor etc.). We fully understand the ones who are missing such an approach when evaluating an industry. On the other hand, we have decided to take a deeper look at parts surrounding CSR and ethical considerations concentrated around the fish itself and the environment. In real life scenarios we are often left with compromises. Hence, one must then carefully evaluate ones options from existing knowledge and then explain explicit the choices that has been made. Our choices have given us a deeper knowledge that we perceive as necessary to obtain a valid evaluation around some core considerations within the

industry. Norway has the most extensive salmonid fish farming industry in the world and this is reflected in the literature. The major salmonid farmers are listed on the Oslo Stock Exchange. The biggest companies have considerable activities in Norway and Chile followed by Canada and Scotland. Atlantic salmon account for the majority of the salmonid production and this is reflected in our work. This has also to do with the current research that has been done on salmon. There have been challenges related to differentiating between Atlantic salmon and other salmonids, as well as between salmon farming and fish farming. This challenge has also been evident in the research literature we have studied. Throughout this thesis, we will therefore use the two terms fish farms and salmon farms. The fact that the larger extent of the world's research community within fish farming is centered in Norway is also reflected in the fish farm literature. Regardless, we have attempted where it has fallen naturally, to supplement with scientific research from other scientific communities within the field. We have attempted to anchor the scientific fish farm literature with the most updated research. Despite the fact that the fish farming industry has only existed for approximately forty years, the amount of research literature is within some areas extensive but of smaller scale elsewhere. In this sense, there might be relevant written material that the authors have intentionally or unintentionally overlooked.

It would certainly be appropriate to relate issues within fish farming to consumer capitalism and consumer responsibility, as the consumer power at the aggregate level is extraordinary. We have looked at these concepts in the ecology chapter (cf. 4.1.3), but as consumer responsibility is not directly relevant when looking at a company's CSR performance, we have not found much room to include thoughts on consumer responsibility in the analyses. The main topic in this thesis is CSR performance of companies and how they operate. Hence, while we certainly recognize the consumer's responsibility, we have therefore, due to time and budget constraints, had to limit our focus on this area.

1.6.2 LIMITATIONS WITHIN THE CONTEXT AREAS

There have been some difficult choices in relation to the further foundation of this thesis, both in terms of the context-related literature review as well as methodological considerations in the study of Marine Harvest and Cermaq. Just because the CSR performance focus is limited to the fish itself and the environment does not mean there are limited areas to look on. A wide variety of topics have been revealed, and tough choices have had to be made. Hence, we have been confronted with trade-offs regarding the amount of areas to look at. One could argue that

too few areas to investigate could be considered as a weak basis for a CSR- and ethics evaluation. On the contrary, too many would lead to a shallow analysis of each area. To maintain a balance that takes into account both factors we have ended up with five context areas. In addition, the case studies are supplemented with some general CSR perspectives. When choosing the five context areas we have tried to maintain a good balance between fish welfare and environmental considerations in addition to the economical ones. This is reflected in that some context areas have a greater extent of one type of considerations. In our overall valuation, we perceive the combination of the five context areas; **fish feed, sea cages, escaping, sea lice and the slaughter process**, to give a substantial contribution in assessing the performance of business participants within the fish farming industry. Several scholars, industry players, pressure groups and others who have an interest in this document are fully entitled to argue against our limitations. Some would possibly argue for other factors such as; diseases, vaccination, toxic waste dispersal, functional feed, as well as other areas, which the authors may be less aware of, as just as important. Also, considering e.g. diseases would perhaps have required a more biological background of the authors in order to create a credible foundation. We fully agree with the relevance and importance of other factors surrounding a social responsible perspective regarding the fish farming industry. But, due to the time- and cost budget suited for a master thesis, we found it necessary to limit our approach.

The five context areas (cf. chapter 2) are written extensively. This was primarily because we felt that extensive background knowledge would be a key factor necessary for obtaining a deeper understanding when we would later do the analyses. In addition, the extensive context chapter serves as a helpful tool for the reader and thus makes the reader more capable of following the reasoning in the subsequent chapters.

Since the authors did not have much experience with the fish farming industry previously, the topics were chosen based on the knowledge we have acquired gradually. As learning by doing is an approach suitable for exploring unknown territory we have therefore went through a considerable learning process. When looking back, one could always raise questions regarding different approaches and different context areas to look at, but we had to base our choices on the information we had in the early phases of this work, not on the knowledge we have now.

Also, one must keep in mind some overlapping instances regarding the five context areas, e.g. consequences with escaping correlate with technical equipment in sea cages, and sea lice

problems may be a direct consequence of escape scenarios. Now we will look a bit closer on the five context areas and describe what we have focused on.

1.6.2.1 FISH FEED

Regarding fish feed, we have focused mostly on the environmental aspects around the topic. Here, we consider the feed conversion and fish in – fish out (FIFO) ratios in order to perceive how the input variables (i.e. feed) relate to the output variable (i.e. salmon). Furthermore, we look at some general thoughts about feed followed by looking more closely at the two major input variables regarding feed; fishmeal and fish oil. Then, we look closer at the sustainability aspect of the reduction fisheries (used to make the fishmeal and fish oil), including the Marine Stewardship Council (MSC) and the International Fishmeal and Fish Oil Organization Responsible Supply (IFFO RS) standards. We also look at the concern related to using industrial fish for direct human consumption rather than for reduction. As we can discover, there is an environmental emphasizing with this regard. Some fish welfare considerations which we could have looked at, but which we felt were either of less importance than the environmental perspective or beyond our time budget, are for example how the pellets the farmed salmon eat are far from their natural diet, or how the salmon often are starved prior to slaughtering.

1.6.2.2 SEA CAGES

When looking at sea cages we will take a closer look at; site selection, cage design, stocking density, net deformations, dissolved oxygen, temperature, light, submergence and sewage. We could, on the other hand, have taken a closer look at waste management, feed waste, salinity and toxic waste disposal. In our study within this context area there is a higher degree of fish welfare consideration than the environmental aspects. Despite this, one must notice the close linkage between environmental concerns and fish welfare concerns. This means that if one performs well with fish welfare concerns, it will give synergies to the environment.

1.6.2.3 ESCAPING

We go through this area taking a look at, among others, the following topics; genetic aspects, escape frequency, escape causes, economic consequences, pre escape steps, post escape solutions, steps suggested by NGO's as well as other steps meant to prevent escapes. Here we could have looked more closely into the field of disease dispersal. But we felt that a more solution-based approach would gain a better understanding of the possibilities of coping with

this issue. Moreover, looking at e.g. dispersal of diseases would perhaps have required a more biological background when considering the fact that one must evaluate how e.g. diseases interrelate. This area is considered from the fish's point of view as well as from an environmental perspective.

1.6.2.4 SEA LICE

Here, we start with an overview of the characteristics and physiology of salmon lice. This is followed up by a review of the effects sea lice have on the wild salmon populations. Then there is an overview of how to combat sea lice with the natural method of using wrasse. Here there are fish considerations as well as environmental concerns. One could say that e.g. diseases have a greater impact on both fish welfare and the environment than sea lice. On the other hand, sea lice often gain media's attention and are a familiar topic with a broader public. Other issues we could have looked at with regards to sea lice include the use of combating sea lice with chemicals and functional feeds, as well as the development of a potential future vaccine.

1.6.2.5 THE SLAUGHTER PROCESS


We take a closer look at the typical slaughter process supported by the study of pump systems, brailing, waiting cages, stunning methods (i.e. percussive, electrical and carbon dioxide) as well as an alternative to the traditional slaughter process. We have focused on the most commonly used stunning methods used in the fish farming industry. Here, we could have looked at other more infrequent slaughter methods involving; asphyxiation in air, asphyxiation on ice, live chilling, pharmacological methods, or more of the latest research on stunning methods presented by the Institute of Marine Research (IMR), involving carbon monoxide.^{11,12} Within this context area there is in general a higher degree of fish welfare considerations than environmental considerations which we think is deserving to look at. Waste treatment and environmental concerns surrounding the waiting cages are examples of environmental concerns we perhaps could have looked more at.

¹¹ Not yet used by the industry.

¹² Institute of Marine Research (IMR): Havforskningsinstituttet.

1.7 CONFLICT OF INTEREST

Neither of the authors have financial ties or personal relationship affiliated with Marine Harvest and/or Cermaq. Nor do the authors have personal relationships or other interests related to the other people or organizations interviewed, that could inappropriately influence or bias the content of this thesis.



2 CONTEXT AREAS

2.1 FISH FEED

Fishmeal and fish oil are two of the most important ingredients in fish feed. Despite the share of fishmeal and fish oil in the fish feed has declined over the years, the strong industry growth has caused concerns over the reduction fisheries. Another concern is based on the premise that small pelagic fish used to produce fishmeal and fish oil could be used for direct human consumption instead. The following chapter will look more into these and other relevant issues with regards to fish feed.

2.1.1 GENERAL FEED INFORMATION

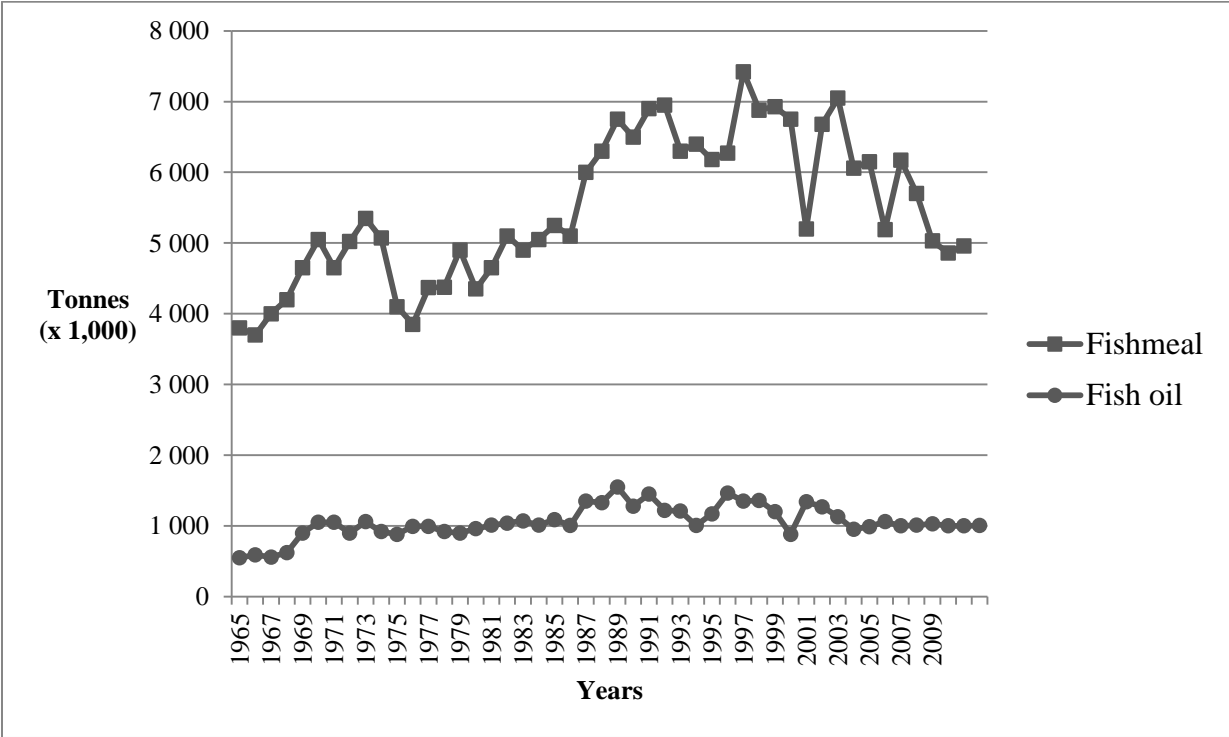
The pellets used as feed in salmon farming are dry and nutrient-rich, and made from wild fish, animal and plant protein. Fishmeal and fish oil have traditionally been the two most important ingredients, but are becoming less so as they are being increasingly substituted. In short, fish oil can be replaced with sunflower, linseed, canola/rapeseed, soybean, olive and palm oils (Naylor et al., 2009, p. 15,107). Fishmeal protein can be substituted with foodstuff from land based animals, including meat and bone meal, feather meal, blood meal and poultry by-product meal (Naylor et al., 2009, p. 15,107). Trimmings and by-products from fish processing plants are also increasingly being used. Since feed typically represents between 50 – 70 % of the fish farmer's total costs (see e.g. Portos, 2010; Table 1-3 in chapter 1.3), fish farmers have incentives to constantly alter feed composition in line with changing input prices, as long as nutritional requirements are met. However, too much substitution might change the texture, taste, and the Omega-3 level of the final product. Consumer preferences may therefore also dictate feed composition. If consumers buy salmon for its Omega-3, substituting too much fish oil (which is where the Omega-3 comes from) might cause a drop in demand. However, it may be possible to acquire Omega-3 at affordable prices directly from microalgae production in the future (Naylor et al., 2009, p. 15,107).

2.1.2 FISHMEAL AND FISH OIL

Fishmeal and fish oil are mainly extracted from various species of small pelagic/forage fish, which are referred to as reduction or industrial fisheries. Different species of fish give different yields of fishmeal and fish oil. Despite each pellet contains less fishmeal and fish oil

today than before due to substitution, the fish farming industry’s rapid growth has caused concerns over the sustainability of the reduction fisheries. Proponents of the industry may point to Figure 2-1 below as evidence for sustainability. As Figure 2-1 shows, the production of fishmeal and fish oil has remained relatively constant over the years. Much of the fish used for reduction are fast-growing and short lived, and their stock size is more dependent on natural cycles rather than the fishing itself. According to Jackson (2009a) the temporary dips in production are due to El Niño’s. Schipp (2008) supports this claim.

Figure 2-1: Global fishmeal and fish oil production (in thousand tonnes) 1963 – 2009 (adapted from Shepherd, 2011)



The utilization of fishmeal and fish oil has shifted considerably the last decades. Figure 2-2 shows how the usage of fishmeal has shifted from feeding animals such as chickens and pigs in the 1960s and 1980s, to almost 60 % of it going to aquaculture production in 2008. Figure 2-3 shows how most of the fish oil today is used in the aquaculture industry, where its Omega-3 will ultimately end up for human consumption. For comparison, in the past more of the fish oil was used for various industrial purposes which destroyed the Omega-3. While Figure 2-2 and Figure 2-3 may indicate a shift to a more efficient resource usage, they do not tell anything about the sustainability of the resources in question. Just because the production of fishmeal and fish oil has remained relatively constant in the long run does not mean the reduction fisheries are sustainable. They may for instance simply have become increasingly over-exploited. These issues will be discussed in more detail in chapter 2.1.5.

Figure 2-2: Changing uses of fishmeal (based on data from Shepherd, 2011)

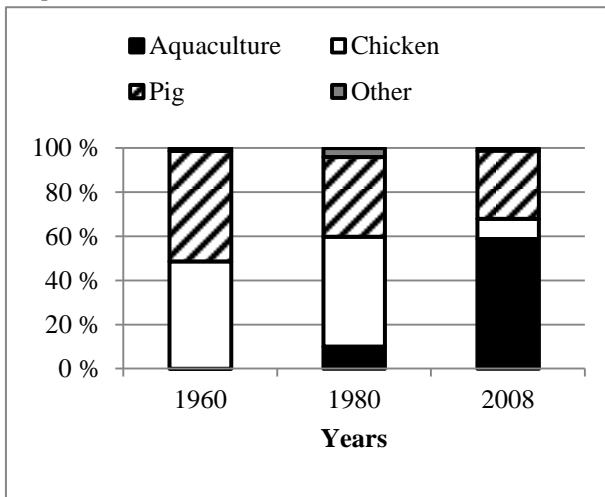
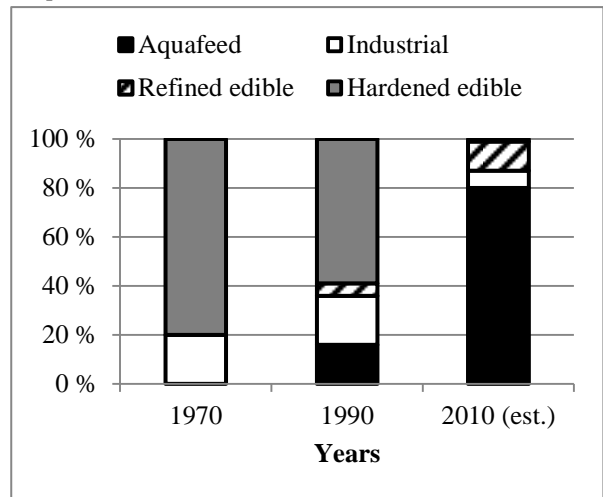
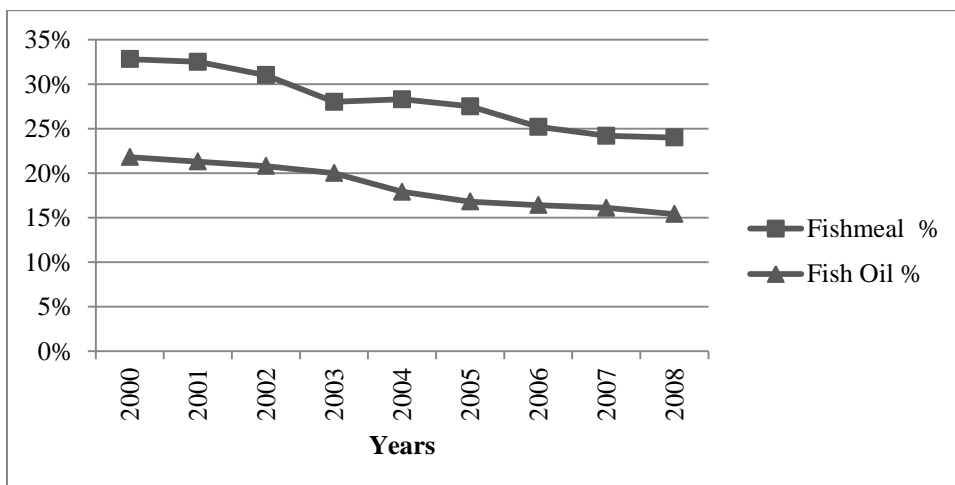


Figure 2-3: Changing uses of fish oil (based on data from Shepherd, 2011)



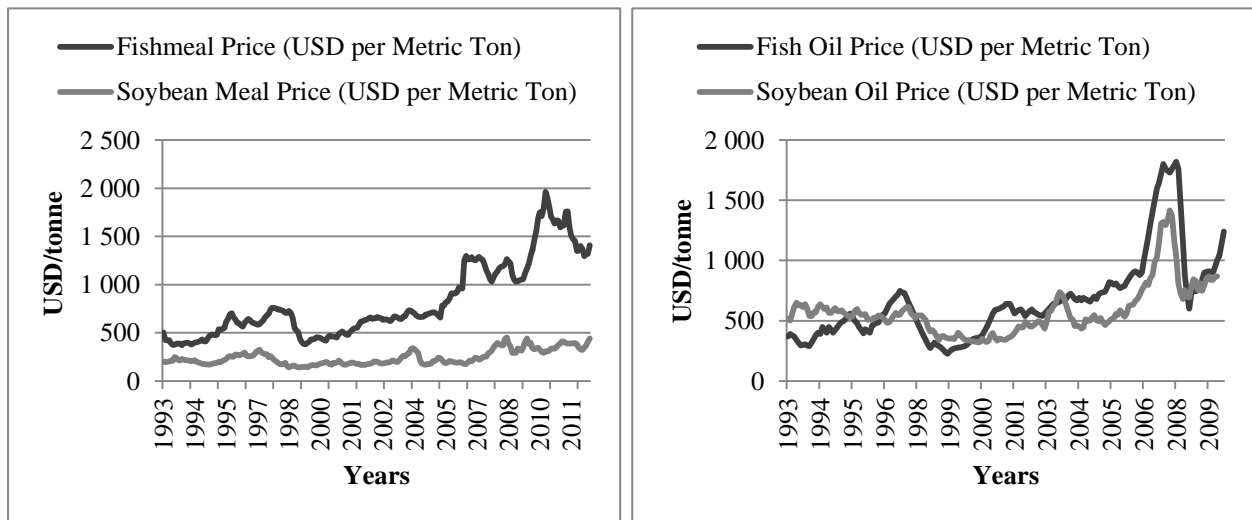
According to Tacon and Metian (2008, p. 148), the global average inclusion of fishmeal and fish oil in the salmonid diet is 30 % and 20 %, respectively. These numbers correspond well with those of FHL (2009), which states that the total inclusion of marine ingredients in the salmonid diet is around 50 %. In 2011 Skretting, a large Norwegian producer of fish feed, completed a full-scale commercial trial where the fishmeal and fish oil inclusion in the salmonid diet were as low as 15 % and 9 %, respectively, without affecting the quality of the finished product (Skretting, 2011).¹³ As we can see from Figure 2-4 below, the inclusion of fishmeal and fish oil in salmonid diets have declined steadily over the years. Recent surges in fishmeal prices in particular, but also for fish oil, as shown in Figure 2-5, gives credence that this trend will continue.

Figure 2-4: Percentage inclusion of fishmeal and fish oil in salmonid diets from 2000 to 2008 (based on data from Shepherd, 2010)



¹³ For comparison, the control group in this study ate conventional feed with a fishmeal level of 25 % and a fish oil content of 13 %.

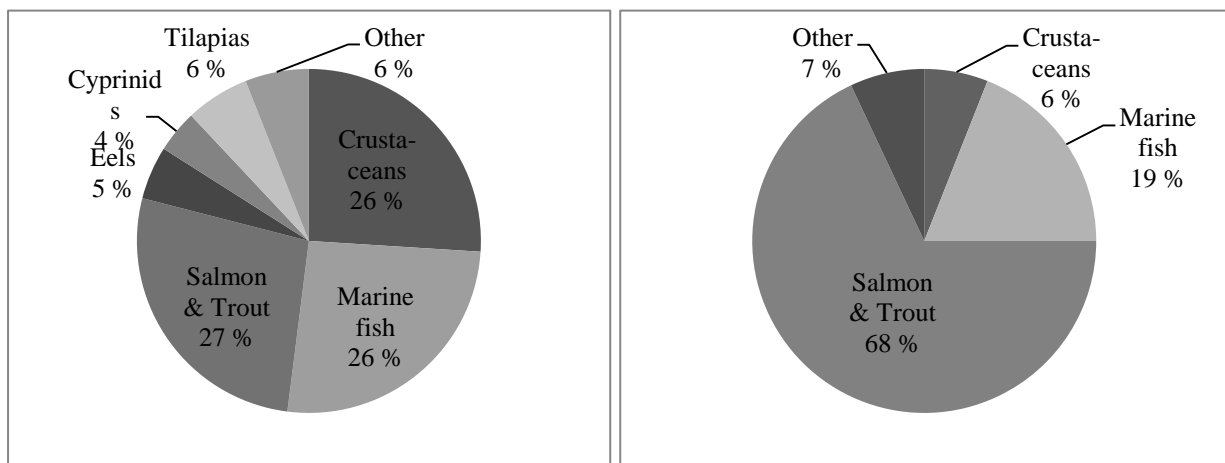
Figure 2-5: Fishmeal and soybean meal prices in Germany and the Netherlands (left), and fish oil and soybean oil prices in the Netherlands (right) (adapted from FAO, 2010a, pp. 62-63; IndexMundi, 2012b; 2012c; 2012d)



Tacon and Metian (2008, p. 155) operate with an average yield of fishmeal and fish oil from wet fish of 22.5 % and 5 %, respectively. Newer data from Jackson (2009b, p. 10) however claims that improved processing equipment has increased the yield of fishmeal to 24 %. For the rest of this thesis it is assumed that the yield of fishmeal and fish oil from wet fish is 24 % and 5 %, respectively, and that the inclusion of fishmeal and fish oil in the salmonid diet is 25 % and 15 %, respectively, in accordance with Figure 2-4.

Despite farmed salmonids account for around only 4 % of the world’s total aquaculture production yet make up almost 13 % of the production value, Figure 2-6 below shows how salmon and trout account for a large and disproportionate amount of fishmeal and especially fish oil.

Figure 2-6: Percentage of fish meal (left) and fish oil (right) used for different species in aquaculture production in 2009 (based on data from Shepherd, 2011)



2.1.3 FEED CONVERSION RATIO

The feed conversion ratio (FCR) measures the relationship between input and output in terms of how much feed is needed to produce one kg of meat/whole fish. Our definition is based on that of Schipp (2008), which focus “on the conversion of the whole wet weight of wild fish into the whole wet weight of farmed fish”, and of how much of a formulated diet it takes to do so (p. 6). The FCR varies from animal to animal and also across fish species. Different sources give different ratios. According to FAO (2010b, p. 17) the FCR for pork is 4 whereas the FCR for chicken is less than 2. For cattle it is around 8.

According to Aquamedia (2012) there is both a biological and economical approach to FCR. The economical FCR takes into account all the feed used, i.e. including the effects of feed loss and mortalities. The biological FCR considers only the net values. Whenever FCR is mentioned henceforth, unless otherwise stated, we will be referring to the economical FCR.¹⁴

As shown in Tacon and Metian (2008, p. 148), the FCR for farmed salmon varies globally between 1.00 to 1.60, with a global average of 1.25. Table 2-1 portrays the FCR range and FCR average for selected regions.

Table 2-1: FCR range and FCR average for farmed salmon in selected regions (based on data from Tacon & Metian, 2008, p. 148)

Region	FCR range	FCR average
Canada	1.20 – 1.40	1.30
Chile	1.20 – 1.40	1.30
Norway	1.00 – 1.40	1.20
World	1.00 – 1.60	1.25

Although the FCR between animals and fish are not directly comparable due to feed differences, the world average FCR of 1.25 still makes farmed salmon more efficient in terms of feed utilization than most farmed land animals. There are three reasons for the low FCR for farmed salmon, namely fish’s biology, the way fish live, and the high nutrient value in the fish feed itself.

While the global average FCR of farmed salmon is 1.25, wild salmon has a FCR of about 10 (Tom & Olin, 2010, p. 58). Under the assumption of a 10 % energy flow between trophic levels, this means in order for wild salmon to grow one unit it has to eat ten units of food (Naylor

¹⁴ In other texts also referred to as eFCR.

et al., 2000, p. 1,019). However, as it takes more than one kg of wild fish to produce one kg of fishmeal and fish oil, comparing FCRs for wild and farmed salmon have limited value, as they measure different things. Another approach to measure the impact from salmon farming on the reduction fisheries is needed.

2.1.4 FISH IN – FISH OUT RATIOS

Whereas the FCR simply measures how much fish feed is needed to produce one kg of farmed salmon, the fish in – fish out (FIFO) ratio measures how much wild fish it takes to do so. The FIFO ratio can be calculated in several ways, and the corresponding results vary. A widely cited approach has been that of Tacon and Metian (2008), which found that the FIFO ratio for farmed salmon was 4.9. However, their result has been criticized by the International Fishmeal and Fish Oil Organization (IFFO) for being based on unrealistic assumptions as well as not considering the fact that more and more of the world’s fishmeal and fish oil production come from trimmings and other fisheries’ by-products (Jackson, 2009b). According to IFFO (2006) more than 25 % of the world’s fishmeal production is now derived from these sources. Jackson (2009b, p. 9) did his own calculations based on the dataset of Tacon and Metian (2008), and ended up with a FIFO ratio of around 2.3, less than half of the findings from Tacon and Metian (2008).

Tacon and Metian (2008) calculated the FIFO for fishmeal and fish oil separately, and then used the highest value. Although both fishmeal and fish oil are extracted from the same fish stock, their yields are different. Unless the farmed fish in question eats an amount of fishmeal and fish oil which makes the two FIFO numbers exactly the same, Tacon and Metian’s (2008) method lead to excess supply of either fishmeal or fish oil. This is shown in the example below which examines the FIFO ratio for farmed salmon.

$$\text{FIFO}^{\text{Tacon \& Metian}} \text{ fishmeal} = ((\% \text{ fishmeal in feed}) * (\text{FCR})) / (\text{yield fishmeal})$$

$$\text{FIFO}^{\text{Tacon \& Metian}} \text{ fish oil} = ((\% \text{ fish oil in feed}) * (\text{FCR})) / (\text{yield fish oil})$$

Using the assumptions from Tacon and Metian (2008) the ratios become:

$$\text{FIFO}^{\text{Tacon \& Metian}} \text{ fishmeal} = (30\% * 1.25) / 22.5\% = 1.67$$

$$\text{FIFO}^{\text{Tacon \& Metian}} \text{ fish oil} = (20\% * 1.25) / 5\% = 5$$

The calculation above implies that in order to produce one kg of salmon, 5 kg of wild fish is needed to produce the necessary fish oil required for the feed. This can be verified because

$(5 \text{ kg} * 5\%) = (1.25 \text{ kg} * 20\%) = 0.25 \text{ kg}$ fish oil. However, 5 kg of wild fish gives $(5 \text{ kg} * 22.5\%) = 1.125 \text{ kg}$ fishmeal, while only $(1.25 \text{ kg} * 30\%) = 0.375 \text{ kg}$ fishmeal is needed. An excess supply of $(1.125 \text{ kg} - 0.375 \text{ kg}) = 0.75 \text{ kg}$ fishmeal is left. Schipp (2008) calculated a FIFO ratio in a similar way as Tacon and Metian (2008) but, in particular because he assumed a higher yield ratio for fish oil, arrived at a FIFO ratio of 3.6 (excluding the benefit of using fishmeal from trimmings and other fisheries' by-products).

Jackson (2009b) criticizes the approach by Tacon and Metian (2008) by arguing that the excess fishmeal can be used elsewhere and that it is not wasted as Tacon and Metian (2008) effectively assume. Other species in the aquaculture industry require different combinations of fishmeal and fish oil, and for many of them fishmeal is the constraining factor. Since the entire world production of fishmeal and fish oil is used, nothing is wasted the argument goes. Jackson (2009b) has therefore come up with his own approach to calculating the FIFO ratio, which looks at the combined usage of fishmeal and fish oil:

$$\text{FIFO}^{\text{Jackson}} = ((\% \text{ fishmeal in feed} + \% \text{ fish oil in feed}) / (\text{yield fishmeal} + \text{yield fish oil})) * \text{FCR}$$

With the assumptions from Tacon and Metian (2008) the ratio becomes:

$$\text{FIFO}^{\text{Jackson}} = ((30\% + 20\%) / (22.5\% + 5\%)) * 1.25 = 2.27$$

With the assumptions used in this thesis the ratio becomes even lower:

$$\text{FIFO}^{\text{Jackson}} = ((25\% + 15\%) / (24\% + 5\%)) * 1.25 = 1.72$$

Considering how roughly 25% of the current fishmeal production is derived from trimmings and other fisheries' by-products, the ratio is actually even lower. By using Jackson's (2009b) formula the ratio becomes:

$$\text{FIFO}^{\text{Jackson}} = (((75\% * 25\%) + 15\%) / (24\% + 5\%)) * 1.25 = 1.45$$

In order to make a more realistic comparison of the FCR between land based farm animals and farmed salmon, it is necessary to incorporate the FIFO ratio of farmed salmon into its FCR. In our fish feed research, we have never seen such a calculation, and this might therefore represent a new way of thinking from our side. The total inclusion of marine ingredients in the fish feed diet is $(25\% + 15\%) = 40\%$, which equals, as just calculated, to 1.45 kg of whole, wild fish. With an FCR of 1.25 the remaining 60 % of the fish feed diet amounts to $(60\% * 1.25) = 0.75 \text{ kg}$ other ingredients. When the FIFO ratio is incorporated into the FCR,

the new $\text{FCR}^{\text{ADJUSTED}}$ thus becomes: $(1.45 + 0.75) = 2.2$. This number is higher than the separate FCR and FIFO ratios, and is more representative than the ordinary FCR (of 1.25) when comparing FCR's between animals and fish. However, in terms of sustainability, the $\text{FCR}^{\text{ADJUSTED}}$ would inflate the concern because its value includes more than just fishmeal and fish oil. Hence, the FIFO ratio is still better than $\text{FCR}^{\text{ADJUSTED}}$ for measuring sustainability of the reduction fisheries. It is important to remember though that the $\text{FCR}^{\text{ADJUSTED}}$ only makes sense as long as the assumptions used in the calculation remain unchanged. If the total marine inclusion or the total marine yield changes, or the FCR, the FIFO ratio would change as well, which would then require a new calculation of the $\text{FCR}^{\text{ADJUSTED}}$.

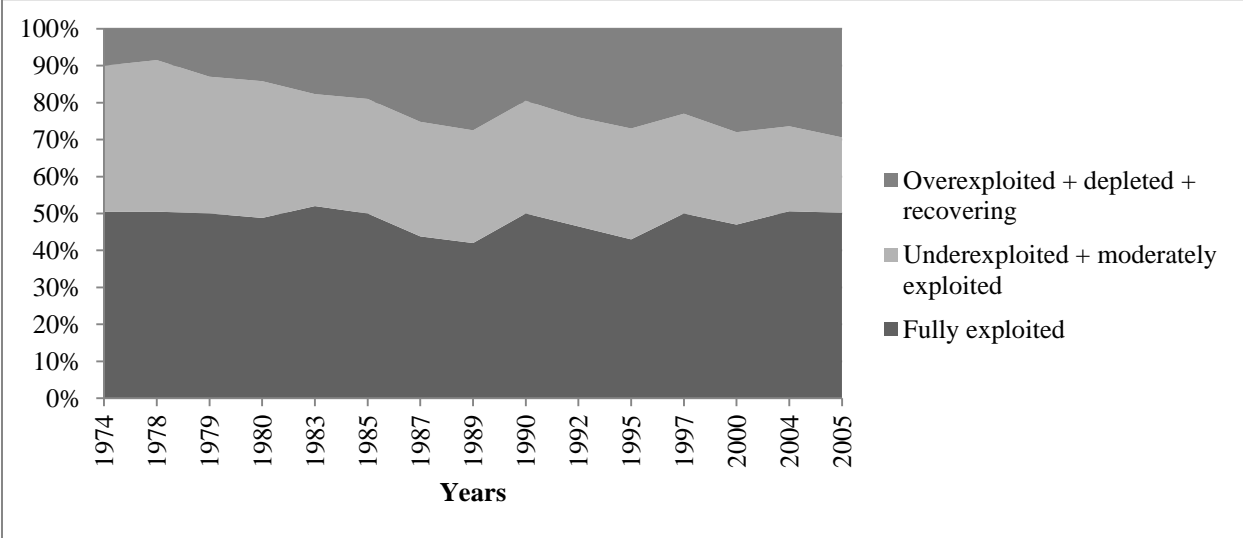
2.1.5 SUSTAINABILITY

Since the $\text{FCR}^{\text{ADJUSTED}}$ (of 2.2) for farmed salmon is lower than that of cattle and pigs especially, and in the case of the ordinary FCR (of 1.25), also for poultry, it could be argued that it is better for the environment to eat farmed salmon than for example cattle. But as long as fishmeal and fish oil makes up a significant part of the salmon diet the sustainability of the reduction fisheries need to be examined closely. This has to be done for each individual species. To do this analysis thoroughly is beyond the scope of this thesis, considering that fish feed is just one out of five context areas. Indeed, Pihlstrøm (2010) wrote a master thesis devoted entirely to this subject. For the purpose of our thesis, a more general overview is preferable, and hence Pihlstrøm's (2010) conclusions will have to suffice. The conclusion of Pihlstrøm (2010) was that the Norwegian salmon farming industry with regards to the inclusion of marine ingredients in the fish feed, was moderately sustainable. Lack of data was a problem for Pihlstrøm (2010), especially when determining the sustainability of Peruvian Anchoveta, which is one of the main reduction fisheries. Chamberlain (2011) however, found that Peru overall has better managed fisheries than Norway. Naylor et al. (2009) states that the sustainability of forage fisheries remains hotly contested, but that: "with appropriate economic and regulatory incentives, the transition toward alternative feedstuffs could accelerate, paving the way for a consensus that aquaculture is aiding the ocean, not depleting it" (p. 1). In this thesis we will look at the overall picture and trends, rather than establishing some kind of conclusion, as even the experts seem to disagree.

As seen in Figure 2-7 below the number of fully exploited fisheries has remained stable over the years, whereas the numbers of overexploited, depleted and recovering fisheries have risen considerably in the same period. The overall trend is that there seems to be increasing pres-

sure on the world’s fish stocks. This ought to call for application of the precautionary principle on quota settings. A closer monitoring of fish stocks as well as increased efforts in combating so-called illegal, unregulated and unreported (IUU) fishing, should also be considered.

Figure 2-7: Global trends in the state of the world’s fisheries since 1974 (based on data from FAO, 2009).



Two standards to help ensure sustainable fishing include a certificate from the MSC, and the RS standard from IFFO. Other standards/certificates also exist, but due to limitations the focus here will be on MSC and IFFO RS. The latter standard is from the fishmeal and fish oil producer’s own organization. It is a business-to-business “certification program that enables a compliant factory to demonstrate that it responsibly sources its raw material from well managed fisheries and responsibly converts that into pure and safe products” (Chamberlain, 2011, slide 22). The MSC standard is not the same as this, as it instead recognizes and rewards sustainable fishing (Chamberlain, 2011). There are also price differences among the two standards, with MSC being more expensive to acquire.

Wild fishing operations capture and kill a lot of non-targeted fish. This is known as by-catch. Although the majority of by-catch is marketable, and thus kept and sold, a lot of it is simply discarded.¹⁵ To the extent that by-catch is used to produce fishmeal and fish oil, doing so can discourage the adaptation of technologies designed to reduce by-catch. According to (FAO, 2011, p. 17) “Fisheries that generate excessive by-catch and discards are ultimately not sustainable, especially when there are no management practices for non-targeted species”. Due to lack of data regarding how much fishmeal and fish oil which is produced from by-catch it is

¹⁵ According to Delgado et al. (2003), around 20 million tonnes of by-catch from fish and other marine organisms are discarded every year.

hard to determine the seriousness of this issue. The same can be said about potential production of fishmeal and fish oil from by-catch from bottom trawling.

MSC- and IFFO RS-certification may help overcome potential problems related to by-catch and IUU fishing. However, it might take time before the standards are fully developed, recognized and implemented across the industries. With regards to IFFO RS, it was only launched in 2009 with the first factory becoming certified in the beginning of 2010 (Chamberlain, 2011). Currently more than 20 % of the world's production of fishmeal and fish oil is IFFO RS certified (Chamberlain, 2011).

World Wide Fund for Nature (WWF) is not convinced that the reduction fisheries are sustainable. WWF (2012a) claims that “all the most important species used for fish feed are already fully exploited or in decline – and besides very important in their eco-systems”. WWF (2012a) further states that the decline in Norwegian seabird populations is probably due to overfishing of Tobis, which is a reduction fishery in Norway. WWF (2012a) also claims that Norway has the biggest ecological footprint in the world regarding consumption of marine resources due to fish farming. They encourage the industry to refrain from using fishmeal and fish oil from species which are heavily exploited. In particular they request the industry to refrain from using Tobis, Norway pout and blue whiting. WWF (2012a) demand full traceability of all ingredients in the fish feed, but also encourage consumers to be active, by for instance asking for environmentally certified farmed fish.

2.1.6 FEED OR FOOD

According to IFFO (2006) fishmeal and fish oil are produced from small, oily and bony fish of which there is little or no demand for human consumption. While IFFO have cited an FAO article which states that only 10 % of forage fish has a market for direct human consumption, and even though a newer article from FAO (2011) admits that this number is probably still correct, critics of the fish farming industry claim that much of the forage fish used to produce fishmeal and fish oil could instead be used to feed people. According to FAO (2011) reduction fisheries have no impact in developed countries. But in regions with a poorer population and more undernourished people, forage fish can potentially represent a cheap source of protein. Indeed, Abila (2003, cited in FAO, 2011, p. 17) found evidence for that in some regions a proportion of the reduction fishery was simply not available for human consumption, but that, if it had been available, it would certainly be consumed. A problem in this regard though

is the poor quality of the forage fish when taken ashore, effectively reducing its food value. There would also be differences in local demand.

There are conflicting views on the potential of using more forage fish for direct human consumption. In relation to Chilean fisheries, Bórquez and Hernández (2009) maintain that there is a direct correlation between increased production of canned products from pelagic fish and reduction in fishmeal production. They did a case study on the potential of using jack mackerel from one specific region mainly for human consumption instead of for reduction. With an average FCR of 1.35 (their assumption) in Chilean salmon farming, it follows that 1,350 kg of feed are needed to produce one tonne of salmon. Since the average share of fishmeal in fish feed in Chile is around 30%, 1,350 kg of feed requires 405 kg fishmeal. In order to get 405 kg fishmeal, 1,687 kg jack mackerel is required. 1,687 kg jack mackerel yields 843 kg jack mackerel when head-on gutted (HOG). In comparison, each tonne of farmed salmon yields 850 kg HOG. From a food security point of view Bórquez and Hernández (2009) therefore make the conclusion that it does not make any difference whether jack mackerel or salmon is used for human consumption. But since the price of salmon is more than four times higher than jack mackerel, Bórquez and Hernández (2009) claim that salmon makes Chile better off at a macro-economic level. Farmed salmon is an expensive product mainly exported. Poor people can only afford to buy jack mackerel. According to Jackson (2009a) the Chilean government is trying to increase demand for jack mackerel, and, as Bórquez and Hernández (2009) point out, this demand has indeed risen in recent years. Chamberlain (2011) claims that the demand for direct human consumption of many species used for reduction purposes is rising. However, despite rising demand only 3 % (190,000 tonnes) of Peruvian anchovy went directly to human consumption in 2010 (Chamberlain, 2011). According to Bórquez and Hernández (2009), Chilean domestic demand for jack mackerel is low, and if jack mackerel were to be produced instead of salmon, the production would have to be exported. In other words, unless demand increases drastically, it would not really benefit the Chilean people in terms of food security.

2.1.7 RECAP

The low FCR of farmed salmon may indicate that it is better for the environment to eat farmed salmon rather than many farmed animals. However, the $FCR^{ADJUSTED}$ is better than the ordinary FCR to compare FCR's between animals and fish. The FIFO ratio is however more interesting to look at than both types of FCR in terms of sustainability. Although the FIFO

ratio for farmed salmon is low, this alone does not mean the reduction fisheries are sustainable. The concern regarding the sustainability of the reduction fisheries seems valid, and one issue in this regard is the uncertainty related to how much fishmeal and fish oil which is produced from by-catch (from bottom trawling). The MSC and IFFO RS standards are certification schemes which might help to show that a fishery is sustainable. The concern that much of the fish currently used for reduction should instead be used for direct human consumption (by the poor, thus giving them a cheap source of protein), is less worrisome than the sustainability concern. This is because although there might be a certain potential for increased direct human consumption, these markets are not yet mature.

2.2 SEA CAGES

The environment in a sea cage is essential for production results, the welfare and health of fish (Oppedal, 2011). Stressors (e.g. stocking density, net deformations, poor water quality and other important conditions) are potential threats to fish welfare and subsequently fish health, and they impose an allostatic load which in the short term will impair the physiological homeostasis of the fish and in the long term impact its wellbeing (Segner et al., 2012). Once the site is geographically located the cage-atmosphere is a result of factors such as; variations in environmental conditions, light conditions, water flow through and around the cages, fouling, biofouling, cage size and the fish's oxygen consumption (Oppedal, 2011).¹⁶

2.2.1 SITE SELECTION

Researchers (e.g. Johansson et al., 2007; Huguenin, 1997) argue that site selection is critical for optimal fish farming conditions, as the right locations are a great contributor of both fish welfare and production efficiency. Site selection also incorporates proper waste management (Miller & Semmens, 2002) and must be made on individual basis due to site characteristics. Fish farming sites are located in lakes bayous, ponds, rivers or oceans. To properly estimate the holding capacity of a site, Johansson et al. (2007), underlines the importance of understanding the physical, chemical and biological processes that affect water quality. “Because cages are immersed in the ambient environment, favorable physical, environmental and water quality conditions are imperative to success” (Huguenin, 1997, p. 172). “Farms in coastal are-

¹⁶ “Biofouling is simply how objects in water, e.g. ships’ hulls, instruments, nets on sea cages, etc., become subjected to accumulation of microorganisms, plants, algae or animals after a period of time (TNO Industrial Technology, 2005).

as typically have relatively homogenous water quality, are subject to a stronger and more variable current regime, and may experience wind-driven upwelling of cold water with lower oxygen saturation levels” (Oppedal, Dempster & Stien, 2011, p. 2).

In order to understand the oxygen conditions inside the cages one must also include other factors than site location, such as the fish’s oxygen consumption, stocking density, light conditions and temperature. Johansson et al. (2007, p. 281-282) also states the importance of developing site specific cage configurations in addition to management factors like; total allowed biomass and stocking density, to achieve optimal farming conditions and acceptable welfare standards. Turnbull et al. (2005, p. 129) also put words into the importance of obtaining information from a wide range of sources to understand the complex nature of welfare that are subjected to many physiological and behavioral aspects of an animal. As we can derive there are a mixed set of factors that need to be adjusted to the specific location of the fish farm sites. In other words, one set of configurations (e.g. stocking density, light conditions and cage design) specially attributed for one site can be disastrous for another location. This makes it more complicated as it stresses the requirements for enhanced research on specific site attributes (water currents caused by wind, tidal movements and fresh water runoff) that matches the configurations shaped by the fish farmers.

It is also said that the fish farm location has a major impact on the currents experienced, and commercial fish farms are under normal conditions exposed to currents up to 0.5 meter per second (Lader et al., 2008). However, the focus is also centered on locations that are exposed to currents as high as 1.5 meters per second during storms, and currents caused by tidal effects (low to medium currents).

2.2.2 FALLOWING

Fallowing (i.e. shutdown of fish farming at a site or in an area for a given time period) is done with the purpose to ease negative pressure on the surrounding environment caused by intensive fish farming. Thus, it is understood that the nature need to recover from time to time. “Sedimentary organic matter will accumulate over a period of time if removal by biochemical degradation and physical processes are less than the input from farming activities” (McGhie et al., 2000 p. 352). Furthermore, it is said that the accumulation rate is influenced by the physical conditions of a specific location where water currents are important. The study of McGhie et al. (2000) indicated that most of the accumulation was confined to an area right under the

sea cages, whereas waste indicators (e.g. feces and fish feed spoilage) surrounding the sea cages by 30 meters were still elevated compared to reference areas. Macleod, Moltschanivskyj and Crawford (2006) found that “Rate and extent of recovery were affected by farm location, initial impact of the sediments, and length of fallowing period” (p. 1,458). Thus, fallowing management need to be adapted to reflect site specific differences.

2.2.3 CAGE DESIGN

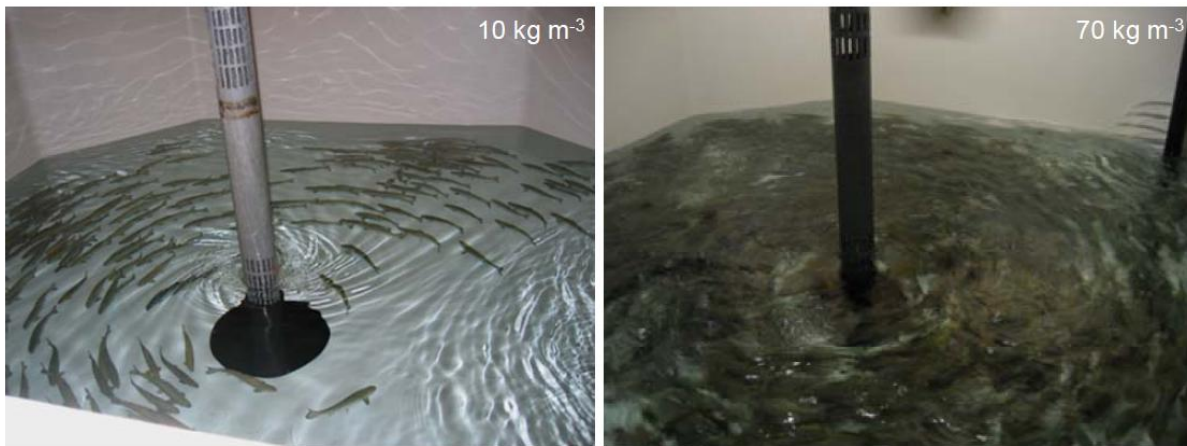
“Salmon are typically held in either square or rectangular sea-cages of 20–40 m sides, 20 to 35 m deep or circles of 90–157 m in circumference and up to 48 m deep. Cage volumes range from 20,000–80,000 m³. Square cages are typically clustered together in a steel platform with between 4–28 cages per site with little distance (2–4 m) between adjacent cages. Circular cages are arranged in mooring grids in single or double rows but with typically greater space between them (>20 m) than square cages” (Oppedal, Dempster & Stien, 2011, p. 2).

Oppedal, Dempster and Stien (2011) claim that fish’s “...movements are restricted by the volume set by the net and the surface, wherein they display their preferences and aversions” (p. 2). The same authors also proclaim that behavioral studies of caged salmon reveal that the fish rarely distribute themselves randomly in sea cages. Instead, their swimming depth and speed is a response to several environmental gradients.

2.2.4 STOCKING DENSITY

Picture 2-1 depicts the perception of two opposite stocking densities. As one can discover, a typical shoaling pattern can be recognized in the picture to the left. This kind of pattern is more difficult to recognize within the high density portrait, where the fish is constantly in physical contact with each other.

Picture 2-1: Experimental tanks from a stocking density experiment showing Atlantic salmon kept at two extreme densities: 10 kg/m³ and 70 kg/m³ (Sundh, 2009, p. 34).



In Norway, the most recent available data from the Directorate of Fisheries (2011d) state that close to 350 million individual salmon are currently held in Norwegian sea cages at any time. The stocking density is highly correlated with fish welfare and Oppedal, Dempster and Stien (2011, p. 2) mention that as much as 200,000 – 400,000 individuals can live together in the same cage. Countries like Norway however have set regulation for maximum densities, which are currently at 25 kg/m³ (Regelhjelp, 2008). Updated regulations from Norway are asserting that effective from 1. January 2013, the maximum threshold for number of fish held in each sea cage is 200,000 (Directorate of Fisheries, 2012c). Despite, the density can still vary as the cage size can differ.

The findings of Turnbull et al. (2005), confirms that there are numerous implications for salmon aquaculture and that the conditions of which farmed fish are cultured in do indeed influence their welfare. Stocking density has an important influence on welfare. However, Turnbull et al. (2005, p. 131) underlines that solely concentrating on stocking densities alone, when predicting or controlling welfare, is not sufficient. Hence, their findings suggest a turning point in terms of a non-linearity relationship between welfare and stocking density. They found that below a critical point of around 22 kg/m³, reducing density further does not reduce welfare.

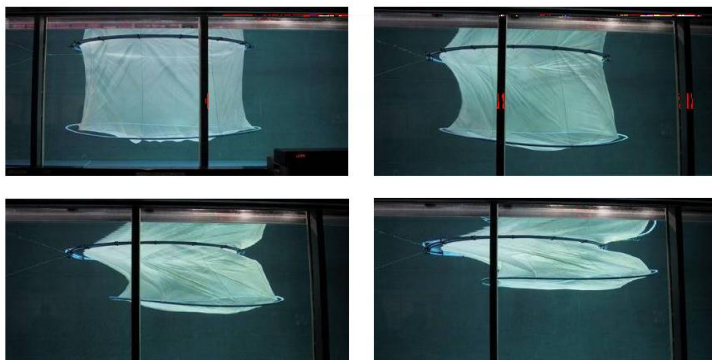
Organic salmon production has according to The Fish Site (2011a), a maximum allowance of 10 kg/m³. As stated by Turnbull et. al. (2005, p. 131) one must keep in mind the risks associated with manifesting a certain threshold of stocking density to ensure fish welfare due to other important site specific aspects (e.g. water currents causing net deformations). Hence, good welfare can then reconcile from high densities whereas other factors are aligned, and initially low densities are no guarantee of good welfare if for example severe net deformations occur.

Instead of having specific density thresholds, it is said that a range of acceptable densities can be efficient as long as the specific stock meets a set of other welfare criteria.

2.2.5 NET DEFORMATIONS

Net deformations (cf. Picture 2-2) reduce swimming volume and water exchange through the sea cage, and thus have considerable impact on fish welfare and production features of fish farms. Growth rates are also disturbed, which are especially critical when stress levels are high. Net deformations also reduce oxygen levels. These factors are correlated with stocking densities and thereby especially critical when densities are high. “In extreme cases, where nets have been severely deformed during events such as storms that generated strong currents $> 1 \text{ ms}^{-1}$, mass mortalities of up to 40 tonnes of fish in a single cage have occurred” (Steine, 2004, cited in Lader et al., 2008, p. 64). Lader et al. (2008) are concerned about two growing trends in the fish farming industry; “individual fish net cages are increasing in size and farms are being sited in more exposed areas where average currents and wave heights are greater” (p. 64). This concern is raised from the potential of greater net deformations, since larger nets have smaller “surface area to volume” ratios, in addition to reduced water exchange compared to smaller nets.

Picture 2-2: Visualization of net deformations (Sintef, 2009, p. 10)



“While a variety of net cage types have been developed, “gravity” nets, or those that retain their shape based on gravity and a series of weights, are the dominant net cage type in use worldwide” (Lader et al., 2008, p. 52). These nets are

equipped with floating devices on the surface and weights attached to the bottom of the cages for the purpose of keeping the original design measurements. These weights in total are said to often weigh between 1,000 and 3,000 kg. Although there have been research and testing on the implications flow strengths have on net deformations, Lader et al., (2008) assert that due to their construction, sea cages based upon the gravity principle deforms when they are subjected to horizontal water currents. Hence, both the overall shape of the net in addition to mesh configuration changes. Tests on two different fish farm sites by using depth and pressure sensors as well as acoustic current measurements, led by Lader et al. (2008), revealed

substantial net deformations caused by incoming currents of varying velocities. The corresponding volume reduction of sea cages could reach as high as 40 percent. "...a current velocity greater than $0,4 \text{ ms}^{-1}$ causing a 40 percent volume reduction at the time of harvest when stocking density of the cage was 36 kg/m^3 would have increased the density markedly to 60 kg/m^3 , well beyond optimal stocking density" (Lader et al. 2008, p. 64). Therefore, considerable volume changes have significant impact on fish welfare and act as a potential fish stress factor. "The extent of the change depends on current velocity, the original shape and construction of the net cage, the netting of which the net cage is made of, the extent of biofouling and the amount and placement of weights" (Lader et al., 2008, p. 53-54).

The publication of the work by Lader et al. (2008) on net cage deformations and volume deformations of salmon farms is in their own perception the first one ever made. As a result of their studies, they suggest that it should be developed a system to detect significant deformations which could thereby act as an "early warning" system for fish farm operators. The use of depth sensors on net panels that are most frequently exposed to currents could then give the operators real-time information on the presence of net deformations, and thereby act as an indicator for adjusting the weights of the gravity cages. This could also serve as an indicator of the optimal timing for net replacement if biofouling levels contribute significantly to deformation.

2.2.6 DISSOLVED OXYGEN

"Oxygen in seawater is supplied from two sources, photosynthesis of plants and dissolution of atmospheric oxygen" (Davis, 1975; Ross, 1995, cited in Johansson et al., 2006, p. 602). The survey of Johansson et al. (2006) describes temporal and spatial dynamics of dissolved oxygen, which is one of the key environmental factors influencing fish welfare and development. They claim that it is important to reflect the oxygen levels in sea cages upon other environmental factors (e.g. light, tidal currents, wind) leading to rather unpredictable scenarios. Davis (1975, cited in Johansson et al., 2006, p. 595) claims that hypoxia can occur during periods of high temperature and low water exchange.¹⁷ Hypoxia is said to be a significant stress factor.

Like most other aquatic animals, fish have the capacity to detect and actively avoid low oxygen levels. (...) there were several occasions on which oxygen values fell be-

¹⁷ "Hypoxia = Very low dissolved oxygen concentrations, generally $\leq 2 \text{ mg/l}$ " (ESA, 2008).

low 6,5 mg l⁻¹. Below this concentration, salmon have been shown to exhibit symptoms of oxygen distress (Johansson et al. 2006, p. 603).

2.2.7 TEMPERATURE

Some scholars (e.g. Wedemeyer, 1973; Barton & Schreck, 1987, cited in Johansson et al., 2009, p. 296) claim that rapidly fluctuating temperatures are seen as stressful to fish. However, other studies see similar temperature shifting patterns to have positive effects on growth (e.g. Brett, 1971; Spigarelli et al., 1983; Bevelhimer & Bennett, 2000, cited in Johansson, 2009, p. 296). The survey of Johansson et al. (2009) reveals that; "...individual swimming depth and body temperature is in part a response to available temperature interacting with stocking density and time of day, while some individual variation cannot be ascribed to the measured variables" (p. 296). Each fish has the opportunity to select their thermal environment as long as sea cages have a "pronounced thermal stratification".¹⁸ Furthermore, they claim that behavioral responses to thermal stratification are poorly documented. Hence, in their four months survey period, fish were stocked at two density levels; normal (5.6-14.5 kg/m³) and high (15.7-32.1 kg/m³). The findings of Johansson et al. (2009) revealed that there were large individual variations in swimming depth, and that stocking density influenced the average swimming depth by leading to competition for preferred thermal space in periods with unfavorable high temperature.

2.2.8 LIGHT

Oppedal, Dempster and Stien (2011, p. 11) states that there is a trade-off between light and temperature in sea cages when favored levels exist at different depths. It is said that temperature often dominates the light-temperature trade-off. The physiological benefits of maintaining a position in a preferred temperature range outweigh those associated with optimal light levels. It is also claimed that the underlying drivers regarding the trade-offs between thermo- and photoregulatory behavior does not differ in the presence of using artificial light. Artificial light is achieved either by manipulating the surface light levels or by submerging lights. The aim of applying artificial light is to manipulate the salmon's behavior. By manipulating the salmon's swimming behavior one can make it avoid suboptimal water layers, or increase cage volume utilization by reducing fish density in certain areas of the sea cage, with both factors helping to improve fish welfare (Juell & Fosseidengen, 2004, p. 270).

¹⁸ E.g. different temperature layers.

“Light conditions in salmon production cages are highly variable due to diel and seasonable variations in natural photoperiods and the rapid absorption of light in water” (Juell & Fosseidengen, 2004, p. 269). Normal behavior of salmon is swimming in a circular pattern during daytime whereas descending around dawn as a response to the fading light. Guthrie (1986, cited in Juell & Fosseidengen, 2004, p. 270) asserts that the fish eye rely mainly on the slow retinomotor response for adapting to changes in light levels.¹⁹ This differs from the mammalian eye figures that adopt to different light level by pupil diameter regulations. The use of artificial light thereby induces salmon to maintain the original swimming pattern when natural light fades at dusk (e.g. Korsøen et al. 2009, p. 374).

The use of artificial light in the fish farming industry is getting more common. Cornelisen (2011, p. 1) claims that the use of artificial lightening inhibits the salmon maturation rate (grisling) as a function of seasonal changes in the day/night cycle (photoperiod).²⁰ The most obvious benefits are reducing the risks of early maturation prior to harvest and increasing production. Benefits of increasing production efficiency is also fronted by Juell and Fosseidengen (2004, p. 270). Taranger (1993, cited in Endal et al. 2000, p. 338) states that one benefit of enhanced growth is shorter time to reach market size, and the ability to harvest before sexual maturation diminishes flesh quality and growth. The confirmation of how artificial light positively influences growth rates is also stated in earlier studies (e.g. Oppedal et al., 1997). By applying sub-surface lights during night time, Juell and Fosseidengen (2004) suggest benefits of more evenly distributed fish and decreasing fish densities near the surface.

2.2.9 SUBMERGENCE

Korsøen et al. (2009, p. 373) announce that submergence may solve several substantial operational challenges (e.g. storms leading to escaping or damaging installations, ice, algal and jellyfish blooms, salmon lice infestations, hypoxia, unsuitable temperatures, biofouling) that exist in surface-based fish farming.²¹ Dempster et al. (2009, p. 254) assert that submerged or semi-submerged sea cages have been successfully applied to several fish species (e.g. pacific threadfin, cobia, Atlantic cod, haddock). Despite salmonids are cultured solely in open surface cages submergence may still give benefits, especially in situations where surface-level conditions are suboptimal (e.g. high concentrations of algae and jellyfish, low oxygen levels) (e.g.

¹⁹ “The movement of the outer segments of retinal receptors relative to the pigment layer” (Juell & Fosseidengen, 2004, p. 270).

²⁰ “Removing changes in light as an environmental variable” (Cornelisen, 2011, p. 1).

²¹ Submergence: Access to surface is denied through lowering the sea cage and applying a top cover to the cage.

Dempster et al., 2009). Smith (1982, cited in Korsøen et al., 2009) clarifies the reason behind the challenges related to submergence in salmon farming as: “Salmonids, in particular, face challenges during submergence as they have a physostomous swim bladder which must be filled by gulping at the surface to maintain buoyancy” (p. 373).²² Thus there may be challenges due to negative buoyancy from forced submergence. On the other hand, Korsøen et al. (2009, p. 374) indicate that some tolerance of submergence must exist since salmonids can survive in locations with a thick ice surface for up to three months. Depth, pressure, duration and light conditions are set to be important factors in this regard. Therefore an understanding of submergence effects related to fish welfare is of great importance and Ryan (2004, cited in Korsøen et al., 2009, p. 374) states that a submergence level of 10 meter and more will in most cases force the fish away from unsuitable surface conditions, but at the same pose challenges to their buoyancy control. However, Dempster et al. (2009, p. 262) found that submergence for short periods (hours to several weeks) would not seriously affect production.

2.2.10 SEWAGE

Miller and Semmens (2002, p. 2) claim that water flow patterns are important factors in relation to waste management since appropriate flows minimize the fragmentation of fish feces, and will allow for rapid settling and concentration of the settleable solids. “This can be critical because a high percentage of nonfragmented feces can be quickly captured which will greatly reduce the dissolved organic waste” (Mathieu & Timmons, 1993, cited in Miller & Semmens, 2002, p. 2).

2.2.11 CLOSED CONTAINMENT SYSTEMS

This method involves enclosing fish on land-based farms or in floating containers. The focus on closed containments have so far mostly centered on the North American territory. The development of closed containment facilities is in an early phase, and financial concerns are the major constraints for further transforming the industry. The Columbia Basin Bulletin (2012) describes a pilot project to test raising farmed salmon in land-based tanks. The project confirms the financial concerns as the salmon raised in tanks are projected to cost about USD 9,000 per ton produced opposed to USD 2,000 per ton for salmon raised in ordinary sea cages.

²² “Buoyancy arises from the fact that fluid pressure increases with depth and from the fact that the increased pressure is exerted in all directions (...) so that there is an unbalanced upward force on the bottom of a submerged object” (HyperPhysics, 2000).

Other important concerns regarding closed containment facilities are, according to Boulet, Struthers and Gilbert (2010), that there will be greater energy requirements (e.g. land-based salmon farming requires large amounts of seawater to be pumped inland), that the management of waste becomes a greater issue, and that logistical concerns would result in large commercial scale operations, which in turn could impact fish welfare.

2.2.12 RECAP

Numerous challenges arise in relation to sea cages. One must recognize the factors discussed as highly interrelated, which means that one factor (e.g. stocking density) is likely to have impact on other factors (e.g. oxygen levels). Moreover, issues like stocking density will be an indirect consequence of net deformations that cause less available space in the sea cage. It has also been discussed how other factors such as temperature and light will affect the environment in the cage, and how artificial light can be used to manipulate fish's swimming behavior. More innovative methods involving submergence has been discussed as a possible method for managing operational difficulties. Closed containment facilities have also been discussed, but they are not currently viable alternatives due to their high extra costs due to increased energy and logistical requirements.

2.3 ESCAPING

Since wild Atlantic salmon only occur naturally in Northern Europe and the North-Eastern parts of North America, this naturally explains the great interest of Atlantic salmon escapes in these areas. Atlantic salmon is also farmed in British Columbia, Canada, and in Chile. In British Columbia there are wild Coho salmon populations, so salmon escapes are a big concern there as well. In Chile there are no wild salmon, and hence escapes are a lesser concern here. Concern in this regard should be understood in the context of how farmed salmon affect wild salmon. In addition, there will always be economic concerns as each escapee has a direct impact on the bottom line.

“Large-scale field experiments undertaken in Norway and Ireland showed highly reduced survival and lifetime success of farmed salmon” (McGinnity et al. 1997, 2003; Flemming et al. 2000, cited in Jensen et al., 2010a, p. 77). The field study of Hansen (2006) displayed that salmon appeared to be “homeless” when escaping during winter and did not return to the release site; instead they swam with the current where some examples involved recaptures as far as 2,000 km away. It is also said by Hansen (2006) that salmon which escape during autumn

has a lower survival rate than salmon escaping during winter or early spring. Life stage may also impact the survival rate. A survey of Hansen (2006) found that; “Fish released closer to maturation might have a higher probability of entering fresh water to spawn than fish released in the year before they mature, but relatively low recovery rates of these fish (<6%) suggest that significant numbers of them also died” (p. 1,215).

The debate around escapes is, as we experience from time to time, great especially among wild salmon protectors. They are afraid that the genes of the wild salmon population will be diluted due to interaction with escaped farmed salmon. The potential spread of diseases and pathogens are also big issues, with sea lice (cf. chapter 2.4) as one of the major culprits in this regard. With regards to economic consequences for the companies, Jensen et al. (2010a, p. 76) states that the reported escapes of salmon on average reach losses less than 0.2 % of the fish held in sea cages each year, and thus the relative direct economic consequence to the industry is small. The costs for fish farmers related to replacing damaged equipment, and recapturing costs are also minor, as Naylor et al. (2005, cited in Jensen et al., 2010a, p. 76) assert that insurance claims are likely to offset these costs. Hence, little economic incentives may therefore exist related to investing further time and resources to prevent escapes. Jensen et al. (2010a, p. 76) underline that the possibility of indirect costs associated with damaging the industry’s reputation are greater, as escape occurrences are often popular press material, and fuels environmental groups. The news may though only be proclaimed in the country where it takes place, leaving the export markets unscathed from media coverage unless picked up by overseas environmental groups. Consequently, there might be hard to stipulate this kind of indirect costs. On the other hand, escapes might lead to challenges related to industry expansion. “The extent to which this restricts the industry from expanding the number of sites it uses and the amount of fish it produces is immeasurable, but is likely to be significant, as the threats that escapes pose to wild populations are strong counterpoints in debates regarding industry expansion” (Naylor et al., 2005; Hindar et al., 2006, cited in Jensen et al., 2010a, p. 76).

2.3.1 GENETIC INTERACTION

Some researchers (e.g. Lund et al. 1991; Hansen et al. 1999; Fiske et al. 2001; Youngson et al. 2001; Carr & Whoriskey 2006; Hindar et al. 2006; Erkinaro et al. 2006, cited in Chittenden et al., 2011, p. 215-216) claims that escaped farmed salmon can make up 20-75 % of the resident “wild” population in some areas. “The reduction in the genetic differentiation of wild Atlantic salmon (...) due to genetic mixing with farmed escapes – in some cases reported as

high as 70 percent – may be driving some native spawning populations to extinction” (Hutchings 1991; Mork 1991; McGinnity et al. 2003; Ford & Meyers 2008, cited in Chittenden et al., 2011, p. 216).

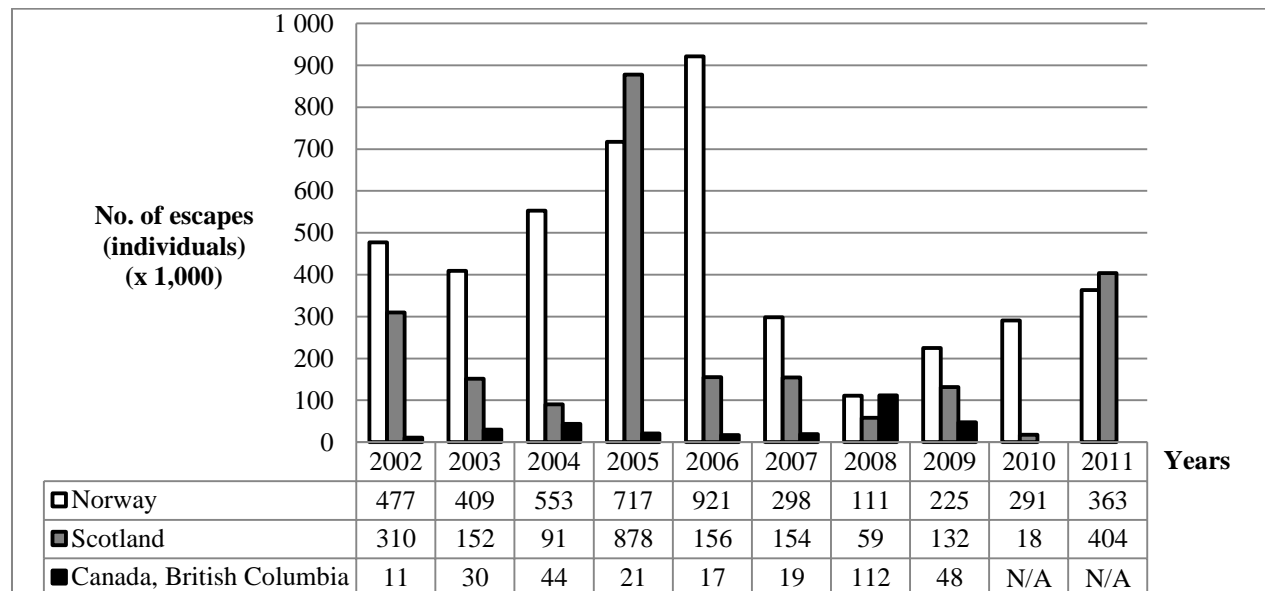
There is however, a rather diversified viewpoint on the effects of how gene mixing affects wild populations. “Farmed salmon differ genetically from wild populations due to founder effects, domestication selection, selection for economic traits and genetic drift” (Ferguson et al. 2007, cited in Jensen et al. 2010a, p. 77). In Norway for example, the farmed salmon is based on a collection of salmon from 40 rivers, and constitutes what Slinde (2011) asserts as an example of a “multicultural community”, whereas defenders of wild salmon claim the value of Aryan purity in each river. The origins of Norwegian cultured salmon are also stated by Glover et al. (2011) who says: “Multiple, partially isolated breeding populations were formed in the 1970s and has today gone through targeted breeding of approximately ten salmon generations” (p. 3). The salmon has existed for millions of years, and it has adapted to different strains with different genetic compositions. Slinde (2011) sees natural fault-migration of salmon as good as it contributes to genetic diversity. Glover et al. (2011, p. 3) declare wild salmon populations as more or less isolated reproductive, and that there are genetic differences between populations and their corresponding adaptations to their local environments. This explains why salmon largely migrate back to the rivers of their origin to spawn. Glover et al. (2011) claims experience from fish release studies suggest that the biological consequences of cross breeding is generally negative, but stresses the need for more studies. Ferguson et al. (2007, cited in Jensen et al. 2010a, p. 77) confirm the potential of genetic alteration of native populations, reduced local adaptation and negatively affected population viability and character, when farmed salmon interbreed with wild stocks.

2.3.2 ESCAPE FREQUENCY

Like Jensen et al. (2010a, p. 72) emphasize, Norway has the most comprehensive record of escapes of Atlantic salmon in the world. Figure 2-8 below is a compilation of data from the following sources: Directorate of Fisheries (2012d); The Scottish Government (2012); Province of British Columbia (2011); Aquaculture Statistics (2010). It depicts official escape statistics of Atlantic salmon from 2002-2011 from Norwegian, Canadian and Scottish governmental sources. With regards to Canada, it only shows escapes from British Columbia. However, that region had close to 70 percent of the total Canadian salmon aquaculture production from 2006-2010, as of information from Aquaculture Statistics (2010). Due to lack of a com-

plete Chilean statistical data set, Chilean escapes are excluded from the figure.²³ Like Thorstad et al. (2008, p. 28) emphasizes, there are no monitoring programs in place in Chile to follow up escapes of salmon.

Figure 2-8: Escape statistics (number of individuals in thousands) of Atlantic Salmon from 2002-2011 (based on data from the Directorate of Fisheries, 2012d; The Scottish Government, 2012; Province of British Columbia, 2011; Aquaculture Statistics, 2010)



Since Figure 2-8 rely solely on officially reported statistics there are, as Jensen et al. (2010a, p. 73) proclaims, uncertainties related to the credibility of the statistics, as not all escape incidents are reported or detected. Discussions exist related to whether smaller, larger or less detectable events contribute the most. A study by Sægrov and Urdal (2006, cited in Hindar & Diserud, 2007, p. 9), assumes that from 1998-2004, the actual number of escaped farmed salmon in Norway on average was 2.4 million per year, which means an non-reporting of about 71-88 %. Earlier studies (e.g. Lund, 1998, cited in Hindar & Diserud, 2007, p. 9) support these findings as it concluded there was a non-reporting of 50 %. Also other surveys (e.g. Baarøy et al., 2004; Skilbrei & Wennevik, 2006, cited in Chittenden et al., 2011) proclaim that the actual number of escapes is difficult to ascertain and that it is probably much higher than the number reported. As stated by Fiske et al. (2006, cited in Hindar & Diserud, 2007, p. 9) this may be an indication of certain challenges related to normal activities.

Despite uncertainty related to the storm “Berit”, which occurred in Norway late November 2011, it is stipulated by the Directorate of Fisheries (2012e) that about 1/3 (equivalent of

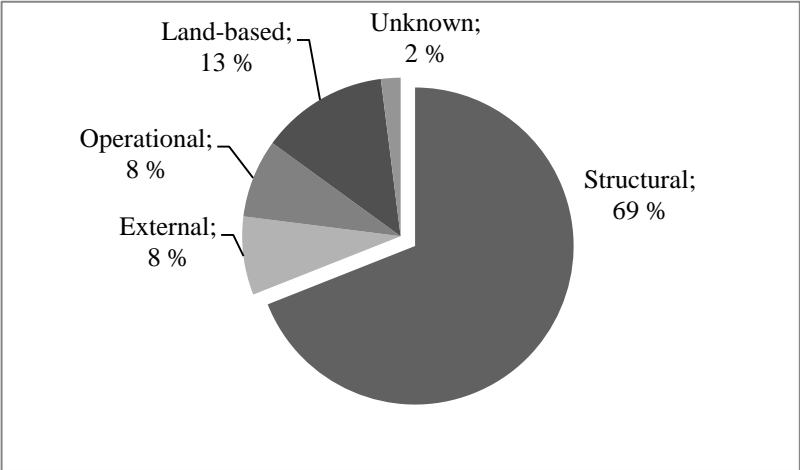
²³ When we reviewed the Subsecretaria de Pesca (2012) website, which is the official Chilean Undersecretariat for Fisheries, we could not find any data related to escapes.

about 120,000 individuals) of the escapes on Norwegian sea territory in 2011 were related to it. In spite of significant escape numbers linked to catastrophic events, Fiske et al. (2006, cited in Hindar & Diserud, 2007, p. 9) found a better correlation between the amount of farmed salmon in cages and the proportion of escaped farmed salmon in rivers of the same county, than there was between reported escape numbers and the ratio of farmed salmon in local stocks.

2.3.3 CAUSES

Jensen et al. (2010a, p. 74) have studied causes related to escapes from 2006-2009, based on data they got from the Directorate of Fisheries, and the results of their findings are shown in Figure 2-9 below.

Figure 2-9: Causes of escapes (adapted from Jensen et al., 2010a)²⁴



The statistics reveal that escapes caused by equipment based structural failures (mostly holes in the nets) explain close to 70 % of all escape incidents. “Structural failures may be generated by severe environmental forcing in strong winds, waves and

currents, which may occur in combination with component fatigue or human error in the way farm installations have been installed or operated” (Jensen, 2006, cited in Jensen et al., 2010a, p. 74). The study also reveals that operational errors cause escapes more frequently, but that the numbers of escapes each time is fewer. Earlier studies in Canada of Whoriskey (2001) also indicate that escapes results mainly from inevitable human errors and when severe events like storms is exceeding the engineering capacity of the equipment used. Because structural failures are found to explain most escape incidents, Jensen et al. (2010a, p. 75-76) give an overview of the three main causes of structural failures leading to escapes. First, mooring failure is emphasized, as when one mooring line brakes, the loads on the remaining lines may exceed, leading to a sequence of diminishing structural strength. Second, the breakdown and

²⁴ The numbers are mere approximations, as the source material did not provide exact numbers.

sinking of steel-floor used to walk around the sea cages can tear down the nets. The third main cause is abrasion and tearing of nets. Holes in the nets are mainly caused by collisions with boats, biting by predators, flotsam floating in the sea, or due to cage handling procedures. Lader et al. (2008, cited in Jensen et al., 2010a, p. 76) argue for the current trend in Norway to be that fish farms are moving into areas with stronger and steadier currents, with the purpose being to increase water quality. Greater forces on the nets increase the probability of net deformations (cf. chapter 2.2.5) leading to structural failures followed by holes in the net. Jensen et al. (2010a, p. 76) stresses that net failure with a subsequent formation of a hole is the dominant factor causing escapes in Norwegian aquaculture, explaining about 2/3 of the incidents.

2.3.4 PRE ESCAPE STEPS

In addition to organize for more precautionary steps to reduce the risks of structural failures, there are other methods that can be done in advance to improve the problems related to escapes. Physical tagging is widely used for domesticated animals such as cattle and sheep. However, Glover (2010) asserts considerable logistical, animal welfare and economic issues that challenge the feasibility of applying physically tagging to all farmed fish. Glover (2010, p. 3) claims that physical tagging offers some advantages over other methods such as a DNA approach. “In addition, coded wire tags have been used extensively for identification of fish in the wild” (Brennan et al., 2007; Bumgarner et al., 2009, cited in Glover, 2010, p. 3). Hence, Glover (2010) asserts that these tagging systems provide identification that could in theory be adapted to mark all cultivated fish. The survey of Baarøy et al. (2004, p. 29-30) on the other hand, assert the need for welfare considerations, as different tagging systems (e.g. external physical markers in combination with removal of body parts as part of the tagging process) can cause significant additional stress and discomfort for the fish. Skaala et al. (2004, cited in Glover, 2010, p. 2) demonstrated the ability to accurately identify farmed salmon to the strain of origin, known as the DNA stand-by method. By using this method the exact fish farm responsible for the escape can be identified.

As emphasized by Baarøy et al. (2004, p. 26), it is important to consider what kind of information that is not derived from a tagging system. Such systems cannot describe any causes related to the escape nor quantify the number of escapees, and it will therefore still be necessary to clarify facts surrounding the escape. “To be able to estimate the actual number of escaped fish, one must also conduct research at the plant” (Baarøy et al., 2004, p. 26). On the

other hand, Baarøy et al. (2004) claims tagging to be reliable in the sense of locality identification, as a tool for quick reactions.

An alternative approach, yet not demonstrated on a commercial scale, is the ideas of using acoustic conditioning to recapture/recall escaped salmon. Tlusty et al. (2008) found throughout their seven month experiment that salmon could be trained in a short period of time to return to specific locations in response to an acoustic tone. When conditioning to a 250 Hz acoustic tone during feeding, as much as 85 percent of the stock were responding by day seven. To assess retention of conditioning, Tlusty et al. (2008) exposed fish to a single tone without feeding reinforcement every one, two or four weeks whereas the salmon continued to respond for a seven month period with no significant decrease.

Among other alternatives, Thorstad et al. (2008) highlights sterilization of salmon as having a positive effect on reducing direct genetic effects of farmed salmon on wild salmon populations, but it is unlikely to greatly reduce threats from the transmission of diseases and parasites. “Use of triploid (e.g. sterile) salmon in commercial farming would require research and development to determine optimum rearing conditions and boost triploid resistance” (Thorstad et al., 2008, p. 8).

As a critical note towards the literature – since most escape incidents are caused by structural failures, more focus ought to be on improving the equipment used. However, the focus areas covered in much of the literature are on the other herein-mentioned factors (tagging, DNA, etc.).

2.3.5 POST ESCAPE SOLUTIONS

Skilbrei and Jørgensen (2010, p. 107) claim that little effort has been put forward to compare the efficiency among different fishing gears and the development of methods and strategies for recapturing escaped fish. The literature highlights three methods for recapturing escaped fish; (1) gill netting, (2) surface trawling and (3) bag-net fishery. In their Norwegian survey, Skilbrei and Jørgensen (2010) found surface trawling to be unsuccessful, whereas gill netting proved to be an efficient method of recapture. This is supported by a Canadian survey by Morton and Volpe (2002) and in a Chilean study performed by Soto, Jara and Moreno (2001). Chittenden et al. (2011) found bag-nets to be effective for recapturing escaped farmed salmon when the circumstances allowed immediate implementation after an escape scene.

2.3.6 STEPS SUGGESTED BY NGO'S

As opponents around the world believe farmed salmon harms wild salmon stocks there is a wide variety of solutions suggested implemented for purposes of protecting the wild salmon. The following is a list of demands from the subsequent wild salmon protectors: Norwegian Salmon Rivers (2012); Save our salmon (2007); Bellona (2009); Redd Villaksen (2012); WWF (2006).

- Escapes should be classified as unlawful and there should be a more severe punishment system.
- There should be a compulsory tagging system of farmed fish to ease identification when escapes occur.
- The need of sterile farmed salmon.
- Further research must be done on the application of enclosed sea cages or land based farming facilities.
- Exclusion of the largest sea cages as these are correlated with higher escape numbers if escaping first takes place.
- Authorities must enhance the surveillance of escaped fish and their mixing with spawning wild salmon.
- Increased technical standards for sea cage construction, e.g. double barrier drainage, mesh holes' size in relation to fish size.
- Fish farmers to pay for recapturing escapees.
- More coordination with insurance agents.

2.3.7 OTHER STEPS

To quantify the prevalence of escaped salmon in rivers, Glover et al. (2011, p. 27) stress the need for a large scale screening of rivers using SNP-markers (further described by Karlsson et al. 2011, cited in Glover et al. 2011, p. 27) and for the purpose of detecting changes in genetic structure, both in time and space, by the use of microsatellite-markers (further defined by Ellis et al. 2011, cited in Glover et al. 2011, p. 27).

Jensen et al. (2010a, pp. 80-81) round up their work by recommending a five step strategy, which is based on the Norwegian experience of dealing with the escape problem, to be implemented by policy-makers. Jensen et al. (2010a, pp. 80-81) claim many of the steps are al-

ready in place in Norway and that they can be directly transferred to industries in other countries. The five steps are:

1. Establish mandatory reporting of all escape incidents.
2. Establish a mechanism to analyze and learn from the mandatory reporting.
3. Conduct a mandatory, rapid and technical assessment to determine the causes of escape incidents involving more than 10,000 fish.
4. Introduce a technical standard for sea cage aquaculture equipment, coupled with an independent mechanism to enforce the standard.
5. Conduct a mandatory training of fish farm staff in escape-critical operations and techniques.

Recently, as stated in chapter 2.2.4, the Directorate of Fisheries in Norway has in their efforts to prevent escapes and the spread of lice, put in a new regulation effective from 1. January 2013 limiting the maximum number of individuals per sea cage to 200,000. Director Geir Andreassen of The Norwegian Seafood Federation (FHL) claim the new regulation is a step backward, because it will require a considerable increase in space and make it impossible to carry out production in the current operating zones (The Fish Site, 2011b). In Norway, the Directorate of Fisheries has also, effective from 1. January 2012 implemented the updated NYTEK (2011) regulation, which is about technical standards of installations.

In addition, a Norwegian cooperation including IMR and the Norwegian Veterinary Institute has recently developed a report calculating the environmental implications caused by escaped farmed fish (Taranger et al., 2012). The report aligns the effects of genetic interactions as well as lice infestations. Moreover, it describes two sets of indicators; warning and verification. “The warning indicators is said to identify the risk of adverse environmental impacts at an early stage, while the verification of indicators can be used to determine if environmental conditions are within certain political declared limits of acceptable impact” (Norwegian Veterinary Institute, 2012). It is further stated, that for each of the two indicators it should be developed steps to be implemented if calculated threshold values are exceeded.

2.3.8 RECAP

Norway has the highest record of Atlantic salmon escapes for the time period 2002-2011, followed by Scotland and Canada. Chile does not seem to have an official record of escapes. In Norway in particular there are concerns that escaped farmed salmon may have a negative ge-

netic impact on wild salmon populations. Among the causes related to escapes, structural failures explain around 70 % of them. There has been discussed some pre escape steps as well as post escape solutions in addition to concerns surrounding structural failures. Of the pre steps, tagging and DNA systems among others have been discussed. Of the post solutions, different recapturing methods have been mentioned. Different steps aimed at reducing the severity of the escape problem, such as suggestions from NGOs and governmental regulations have also been discussed.

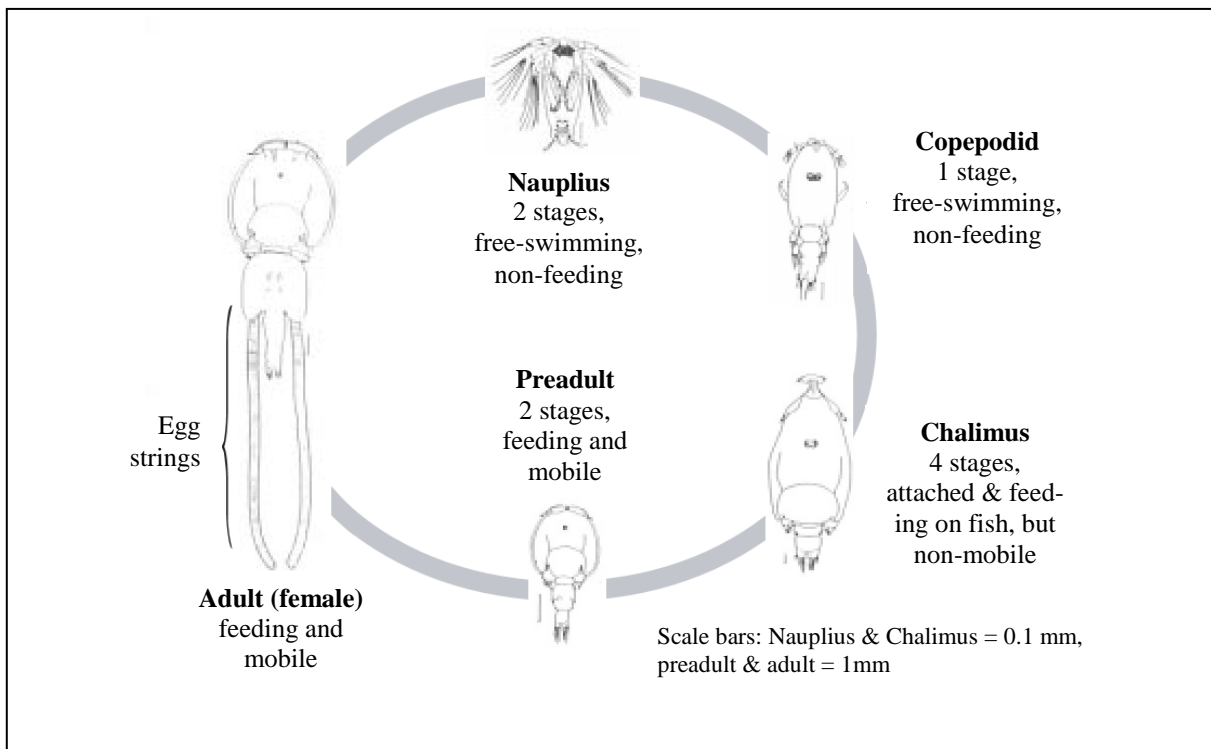
2.4 SEA LICE

2.4.1 CHARACTERISTICS AND PHYSIOLOGY OF SALMON LICE

The most important type of sea lice with regards to salmon farming is *Lepeophtheirus salmonis*, which is a salmon louse that feed and live on salmon and other salmonid fish. Although the focus in this thesis is on the salmon louse, the two terms sea louse and louse will also be used to refer to it.

The salmon louse has a life cycle involving 10 stages: three stages where it mostly floats around freely, four stages where it is attached to its host and immobile, and three stages where it is attached to its host and mobile. The 10 stages are explained briefly below (Otterå et al., 2004, p. 28; Taranger et al., 2011, p. 10; Watershed Watch Salmon Society, 2004, p. 10), and shown in Figure 2-10. After hatching from the egg, the salmon louse goes through two nauplius stages where it floats around like plankton with the ocean currents. At the end of the nauplius stages it emerges as a copepodid, and it is only at this stage it can attach itself to a fish. The copepodid has limited ability to move on its own, but can to a certain degree adjust its position vertically as well as respond when it senses a fish approaching. Once attached to a fish it will remain attached and immobile in four subsequent chalimus stages. After this the louse enters the pre-adult stages where it is able to move around on the fish body. It moves from the back of the fish to the head and the gills before it finally becomes an adult and the female starts laying eggs. The whole life cycle for female sea lice is approximately 50 days at 10° C (Otterå et al., 2004, p. 29). The size of salmon lice varies from less than 0.1 mm for the copepodid to more than 1 cm for the adult female.

Figure 2-10: The life cycle of the salmon louse (*Lepeophtheirus salmonis*) (Watershed Watch Salmon Society, 2004, p. 10)



Salmon lice are ectoparasites that attach themselves to the outside of salmon and other salmonid fish, more precisely the skin, fins and gills. They feed on the mucous, blood and skin of their host, whose problems increase significantly when the salmon louse enter the last three stages (Taranger et al., 2011, p. 10). Sea lice can harm its host by causing serious fin damage, skin erosion, constant bleeding, and deep open wounds. This can in turn increase the stress level of the fish and weaken its immune systems making it more prone to diseases and other parasites (Watershed Watch Salmon Society, 2004). The more sea lice on a fish, the greater these problems will be. Studies referred in Otterå et al. (2004, p. 34) have indeed shown that the cortisol level (stress) of fish increased even in the four chalimus stages (which are less problematic than the last three stages). Studies have also shown that the different species of salmon have different susceptibility to sea lice, with pink salmon being the most vulnerable and Atlantic salmon having mid-range susceptibility (Watershed Watch Salmon Society, 2004). Furthermore, since salmon lice are natural parasites it is common to find them on wild salmon. But whereas adult salmon can cope with several lice without being affected, juvenile salmon on their way to the sea are much more vulnerable. “As few as 5 lice may seriously harm a juvenile Atlantic salmon of 15 grams or less, while 11 or more can kill it” (Watershed Watch Salmon Society, 2004), and for the smaller and more susceptible pink salmon, as little as two lice may be enough to kill it. In a risk assessment done by Taranger et al. (2010) it was

concluded that just 1-3 lice may negatively affect a smolt of 10-15 grams which recently migrated to sea.

An important characteristic about sea lice is that they only thrive in sea water. When adult salmon return to their birth rivers to spawn, the lice will eventually fall off and die. The exact time this takes is not fully known, but according to Watershed Watch Salmon Society (2004) one study found the time to be three weeks. The point to remember is that the emigrating salmon smolts have traditionally faced few lice on their way to the sea. The fact that a large portion of the adult wild salmon population is usually far out at sea when the juveniles reach the ocean may have historically helped to shelter the smolts further (Drisdelle, 2007).

2.4.2 THE EFFECTS OF SEA LICE FROM FISH FARMS UPON WILD SALMON POPULATIONS

With decline in wild salmon populations and fewer wild salmon returning to spawn (Otterå et al., 2004) many have been concerned about the future of wild salmon. Coupled with the growth in salmon farming this has caused concern as to what extent sea lice from fish farms affect wild salmon populations. Numerous studies have addressed this issue, and there are varied conclusions (Liu, Sumaila & Volpe, 2011). Some say that salmon farms lead to increased levels of sea lice in surrounding waters. They argue that this will lead to serious infection of juvenile wild salmon, which in turn results in higher mortality rates and a reduced wild salmon stock. Others argue that sea lice are natural parasites and that other factors, like ocean conditions, are more important because these populations fluctuate widely on their own (Liu, Sumaila & Volpe, 2011). Summaries of various studies and their differing conclusions are given in the paragraphs below.

The Hardanger fjord is one of the most intensive fish farming areas in Norway, and at the same time home to many wild salmon populations. Otterå et al.'s (2004) report about salmonid aquaculture in the Hardanger fjord and its effects on wild salmonid populations concluded that wild salmon and sea trout populations had been in decline in recent years, and assumed that salmon lice was one of the two main threats to the wild salmonid populations (the other threat was the genetic impact from escaped farmed salmon). However, since the conclusion was based on assumptions, it is not scientifically valid. Taranger et al. (2011) published an updated report assessing environmental risks due to Norwegian fish farming. It was considered that there was a "medium to high probability that the environmental effects of fish farming were in violation with the goals in the sustainability strategy along the Norwegian coast

from Rogaland to Finnmark” (Taranger et al., 2011, p. 3). Taranger et al. (2011) reiterated their colleagues previous conclusions that pressure from sea lice infection (and the genetic impact from escaped farmed salmon) were the two most alarming factors.

Since farmed salmon are typically kept in open net cages with little or no barriers to the surrounding environment, it is easy for naturally occurring sea lice to enter the net cages. The high density of salmon in the net cages ensures that the lice can easily complete their life cycle and rapidly reproduce. Female sea lice lay strings of eggs, with each string containing between 200–500 hundred eggs, and may be able to brood up to six times in her life cycle. In an experimental study done by Otterå et al. (2004) with comparable temperature conditions to those of the Hardanger fjord in April/May, a single female sea louse may produce several strings of egg within a month with each strings of egg containing an average of 250 eggs (conservative assumption from Otterå et al., 2004). Based on this and other assumptions, Otterå et al. (2004, p. 10) estimated sea lice production in April from salmon farms in the Hardanger fjord every year for 1997 – 2002 excluding 1998. Since 2000, estimated production for April was 4 to 6 billion larvae. A study by Lien (2003, cited in Otterå et al., 2004, p. 11) found that the real numbers should be around three times higher, as the previous methods were inaccurate and consistently produced underestimates. WWF (2000) claims that sea lice production in the Hardangerfjord, which they say has the highest density of fish farms in the world, is probably several ten thousand times higher in winter and spring than what would be natural. It has been calculated that the copepodid can survive without a host for around 15 days at 10° C (150 degree days) (Taranger et al., 2011, p. 10). Under optimal conditions Asplin et al. (2004, cited in Taranger et al., 2011, p. 10) found that within a 10-day period the sea lice can be transported up to 80–100 km. In short, Taranger et al. (2011) view sea lice as highly reproductive and infective, with a good chance of finding a host.

Salmon farming may magnify an already existing sea lice problem. Butler (2002, cited in Liu, Sumaila & Volpe, 2011, p. 1747) and Gargan et al. (2002, cited in Liu, Sumaila & Volpe, 2011, p. 1747) found that the collapse of sea trout populations along the Scottish coast line was caused by heavy sea lice infestation. A newer study by Urquhart et al. (2010, cited in van Nes et al., 2011) found no such evidence however. Other studies have also found no evidence suggesting that sea lice from salmon farming are the cause for the decline in wild salmon populations. The dramatic reduction in the wild pink salmon population in the Broughton Archipelago of Western Canada in 2002 serves as a good example (Science Daily, 2010). In 2002, only three percent of the expected numbers of salmon returned to spawn. Exposure to

sea lice from farmed Atlantic salmon was thought to be the cause, as more than 90% of juvenile pink salmon had been found to be infected with sea lice the previous year. The study by Marty, Saksida and Quinn II (2010) examining fish farming data 10–20 years back and data for pink salmon 60 years back found no such purported correlation however and subsequently refuted this claim. Marty, Saksida & Quinn II (2010) argued that;

...the number of pink salmon returning to spawn in the fall predicts the number of female sea lice on farm fish the next spring, which, in turn, accounts for 98% of the annual variability in the prevalence of sea lice on outmigrating wild juvenile salmon (p. 22,599).

Marty, Saksida and Quinn (2010) calls for the need to include medical analysis in future fish decline studies as laboratory tests indicated that many of the sickness symptoms found on wild pink salmon, such as bleeding at the base of the fins, could not stem from salmon louse, but from other sources. Lastly, Marty, Saksida and Quinn II (2010) also based their conclusion on how data from 17 salmon farms from 2000-2009 showed that the relative variation in salmon lice populations varied much more than the relative variation in farmed salmon populations. While the highest estimate of the total salmon lice population was 180 times higher than the lowest estimate, the highest number of total salmon was just 2.3 times higher than the lowest number. Hence, in Marty, Saksida and Quinn II's (2010) eyes, since the prevalence of sea lice on farmed fish was independent of the number of farmed fish, this means that the fluctuation in salmon lice populations depend upon other factors.

Even though Marty, Saksida and Quinn II (2010) did not manage to find a significant relationship between sea lice and the decline in salmon populations, they did however, as quoted, find a positive correlation between the number of sea lice in fish farms and the number of sea lice on out-migrating smolt. Since even a few sea lice can harm juvenile salmon significantly, the results from this study may simply be interpreted to how more research needs to be done. Just because it is hard to find a correlation between increased numbers of sea lice from salmon farming and the decline in wild salmon populations does not mean a lack of relationship.

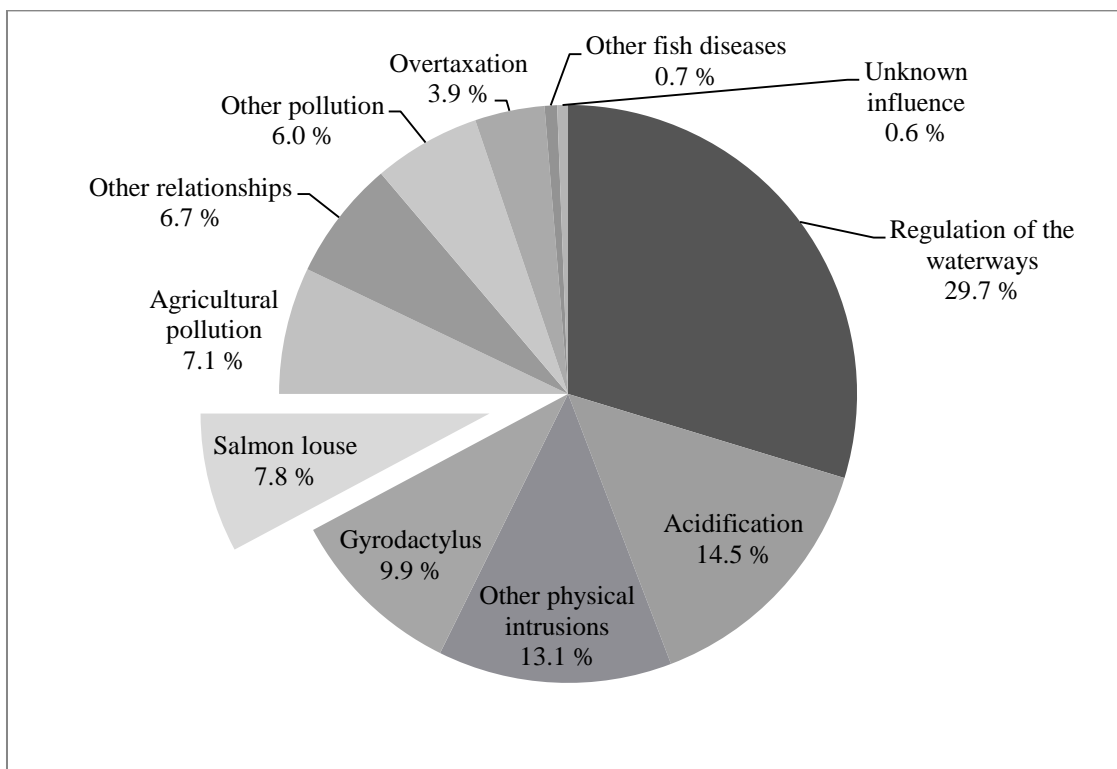
Other studies cited in van Nes et al. (2011) have found correlation between reduction in wild salmon populations and the establishment of fish farms, but have failed to document causal relations. The work of van Nes et al. (2011) is worth mentioning more. They evaluated the factual basis regarding the effect of salmon louse from farmed salmon on wild salmon. They found that salmon populations on both sides of the North Atlantic have shown the same de-

velopment trend, even in areas with no fish farming at all. While most fish farming sites are in the northern parts, the wild population there was found to be stable. For the southern parts, with little fish farming, the populations were found to be in decline. Van Nes et al. (2011) mention climate change and natural cycles in sea temperature as plausible reasons for this, and claims there is increasing documentation that living conditions at sea best can explain such a widespread geographical correlation. Van Nes et al. (2011) find the probability that these trends could be the result of increased quantities of salmon lice from fish farms to be virtually non-existent. On the other hand, the same authors also claim that it is:

...well documented that the prevalence of salmon lice in coastal waters (within immediate proximity of fish farms) is periodically largely increased, which in turn expose emigrating smolt for a greater infection pressure than what it probably would be without fish farms present (van Nes et al., 2011, pp. 1-2).

With regards to the conditions in Norway, van Nes et al. (2011) found that salmon louse is only the 5th most important influence factor decisive for the status of salmon waterways in Norway at the national level, as portrayed in Figure 2-11 below.

Figure 2-11: Overview over influence factors / relationships decisive for the status of salmon waterways in Norway at the national level (based on data from van Nes et al., 2011, p. 38).



At the regional level however, van Nes et al. (2011) found that salmon louse was the most important influence factor in Hordaland. As previously mentioned, the Hardanger fjord is one of the most intensive fish farming areas in Norway, so this is not so surprising.

Lastly, Jonsson et al. (2006, cited in van Nes et al. 2011, p. 23), states how salmon louse should perhaps more rightly be called sea trout louse. This is because the sea trout lives in fjords and waters close to the coast all year around and thus can ensure production of salmon louse at all times.

Norwegian regulations stipulates that if there are more than 0.5 sexually mature female sea lice, or 3 mobile sea lice, per fish in average, treatment has to be initiated within 14 days, and Bellona (2012) points out that as the scope of salmon farming grows so too will the number of sea lice. Therefore, in order to reduce the growth of sea lice and decrease its pressure on wild salmon, the 0.5 limit would have to be continually lowered to compensate for the increased numbers of fish. Bellona (2012) feels this is unlikely to happen. According to WWF (2012b), salmon lice is foremost a problem for wild salmon, not for farmed salmon.

To summarize, although there might not exist any scientific casual relations (yet) regarding the potential negative effect from salmon louse from fish farms on wild salmon populations, it seems reasonable to believe and it is certainly possible that such a relationship do exist. Hence, a precautionary principle ought to be followed while more research is being done, and this represents our stance. In addition, since the number of sea lice on fish farms apparently influence the number of sea lice on wild salmon populations (out-migrating smolt), it is reasonable to assume that a negative relationship is probable. Due to the vast number of farmed fish in sea cages even a small number of sea lice per farmed fish will produce a lot more sea lice than what is natural. Coupled with the knowledge of how vulnerable juvenile salmon is to salmon lice it therefore seems reasonable to conclude that sea lice is indeed a threat to wild salmon.

2.4.3 COMBATING SEA LICE NATURALLY – WRASSE

One natural method to fight sea lice is with wrasse, which is a “cleaner” fish eating sea lice. According to Solheim (2011), Ballan wrasse would be most efficient to use. The Ballan wrasse is the largest in the wrasse family and can grow up to 50-60 cm. long, and live as long as 25 years (Gofishing, 2012). Solheim (2011) explains that a total of 2-5 % of Ballan wrasse as a fraction of the total salmon population in the net cage is needed to keep it free from lice.

A salmon farm with 100,000 salmon would then need 2,000-5,000 Ballan wrasse. As this supply currently comes from wild catch, Nofima has, together with leading players in the industry, initiated a large-scale project to look into the possibilities of Ballan wrasse farming (Solheim, 2011). More than 10 million wrasse were captured in 2010 (Institute of Marine Research, 2011a). Very few wrasse will survive a production cycle though – many wrasse escape through small holes in the nets, some are eaten by the salmon (and brown trout) themselves, yet others get sick and die. According to the Institute of Marine Research (2011a, p. 2) “the use of wrasse is a consumption – and in an order of magnitude which is not ethical responsible”.

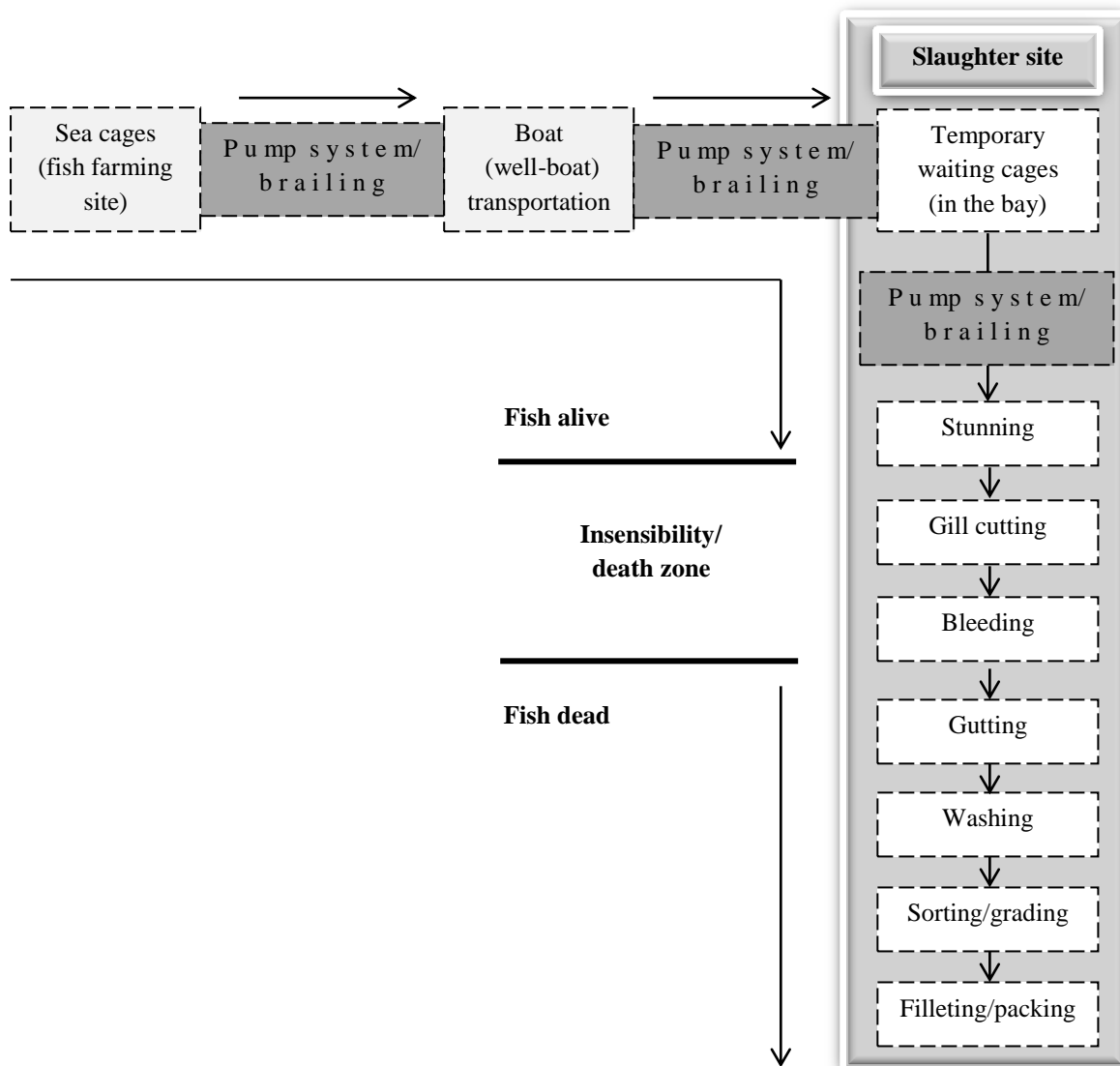
2.4.4 RECAP

As already summarized, salmon lice is likely a threat to wild salmon, but the extent of it can be debated. Using wrasse represents a natural way to combat sea lice. There might be some fish welfare issues and sustainability challenges related to the use of wrasse. At the moment IMR does not yet have a clear answer on the sustainability issue, as they are still gathering information (Institute of Marine Research, 2011a). But wrasse farming may solve the sustainability issue in the future.

2.5 THE SLAUGHTER PROCESS

“Ethical stunning and harvest methods for fish require; instantaneous death, or immediate loss of consciousness which lasts until the fish is bled, or if the anesthesia is slow, fish must not experience pain, fear or significant discomfort until they lose consciousness” (FHF, 2009, p. 5). According to the European Food Safety Authority, EFSA (2004) the most common slaughter method in the EU in general (i.e. for both fish and land based animals) is cutting major blood vessels in the neck or thorax in order to achieve rapid blood loss. The cuts for obtaining rapid blood loss involve considerable tissue damage in areas supplied by pain receptors. Rapid decrease in blood pressure led by blood loss is readily detected by the conscious animal where fear and panic is provoked. According to the EFSA (2004), fish has the highest time frequency between being cut through a major blood vessel until insensibility occurs, where more than 15 minutes is not unusual. In comparison, sheep takes up to 20 seconds, 25 seconds for pigs, 2 minutes for cattle and 2 ½ minutes for poultry. The typical slaughter process for farmed salmon is portrayed in Figure 2-12.

Figure 2-12: Typical slaughter process



“All processing of live salmon (crowding, brailing, pumping, cooling, etc.) leads to the risk of poor welfare” (Midling et al., 2008, p. 1). Exhaustion from repeated physical stress manifested by low muscle pH, draining of the swimming bladder and emptying of the salmon's energy stores is at high risk in this regard. Traditional harvest logistics causes salmon (which are more or less fatigued) to go into rigor mortis after a short time (5-10 hours)” (Midling et al., 2008, p. 1)²⁵. Long pre-rigor time is seen as a goal for the salm-

²⁵ Rigor mortis is the process which transforms muscles to flesh and this process significantly influences flesh quality and durability/freshness. Rigor mortis can take up to 1 ½ days for fish, and may make further processing difficult because of muscle stiffness. When the fish loses its stiffness (subsequent of rigor mortis) further processing can be done. Pre-rigor is the time between death and rigor mortis, and is shorter when the fish is exposed to stress factors. Processing within the pre-rigor time is possible and perceived as good in terms of fillet quality. In addition, pre-rigor filleting will enable shorter delivering time to the customer. The shorter the pre-rigor time is, the more difficult is pre-rigor filleting because there will be less time for processing (logistical constraints) (Mejdell et al., 2006; Balevik & Slinde, 2004).

on industry. Hence, it is in the financial interests of governments, the industry and their customers to process the fish in a careful manner before being slaughtered (Midling et al., 2007).

The quality of the fillet is also greatly correlated with the slaughter process and Roth, Birkeland and Oyarzum (2009) concludes that; "...the quality of the salmon is influenced in the following order: (1) stunning method, (2) pre slaughter conditions, (3) filleting method, (4) processing by salting and smoking" (p. 355). "Processing the fillets further by salting and smoking leveled out any effect caused by stunning, pre slaughter conditions or filleting method, although some attributes of the fresh product could be traced after smoking" (Roth, Birkeland & Oyarzum, 2009, p. 355).

2.5.1 WELL-BOAT

Gatica et al. (2010) emphasize the fact that a stocking density on well-boats as high as 107.8 kg/m³ implies significant impact on the fish's cortisol levels, which can be used to measure its stress. This was confirmed when a significant drop in cortisol concentrations was detected after unloading the fish to waiting cages with a much lower stocking density.

2.5.2 PUMP SYSTEMS

Brydges et al. (2009), claim that salmonids are generally very sensitive to handling. A Chilean study of Gatica et al. (2010) found the pumping from waiting cages to the slaughterhouse as the most stressful stage within the slaughter process. "In general, siphon pumps (mammoth) are gentler than vacuum pumps and double pumps are considered gentler than single pumps" (Mejdell et al., 2009, p. 56).²⁶ Other important aspects such as the inner pipe surface is vital since sharp flanges and poor designing of joints can cause lacerated fins. Also bends on pipelines are crucial since sharp bends can lead to sores and bruising of the fish's muscles. Mejdell et al. (2009, p. 56) emphasize that bends and pipes must not be too acute and 90° angles should be avoided. In addition the number of pipe-meters should be kept low as pipe dimensions are important for the oxygen content of the water.

Roth, Birkeland and Oyarzum (2009) found that the pumping process was among the most important aspects of reducing fillet quality, therefore the pumping process should be minimized. This corresponds with the findings of Gatica et al. (2010) asserting that the last han-

²⁶ The density of mammoth pumps is about half of that of a vacuum pump, where the latter operates at around 200 kg/m³ (Midling et al., 2008, p. 8).

dling procedure (i.e. pumping from waiting cages to the slaughter house) is the most stressful of the stages studied.

2.5.3 BRAILING

Lines and Spence (2012) disputes that very high densities of fish occur inside the brail for short periods and state brails can contain anything from a few kilograms to several hundred kilograms. The two kinds of brailing systems; wet or dry, differ in terms of fish welfare. The water is not held in the brail when dry systems are used, often leading to fish hazards like; crushing, bruising, puncture and abrasion injuries caused by contact with other fish or the net. These dangers occur less frequently in wet brailing where water and fish together are lifted. Also threats associated with brailing exist when fish often fall and hit other fish or fall from too high levels into water or solid surface. “Dry brails are frequently used by tradition and for operational convenience” (Lines & Spence, 2012, p. 157).

2.5.4 WAITING CAGES PRIOR TO SLAUGHTER

“Crowding density and the time the fish are kept crowded, has great importance for the welfare of fish” (Mejdell et al., 2009, p. 55). Due to preparation for slaughter, waiting cages becomes harvest cages and it is commonly done by crowding.²⁷ The oxygen saturation is critical for fish welfare and the problem is increasing for higher temperatures. Hence, the time frequency is critical, and long lasting crowding leads to exhaustion and it is also said to reduce product quality. “The location and the design of the pumping system also affect how much fish needs to be crowded” (Mejdell et al., 2009, p. 55). According to Midling et al. (2008, p. 6) there have in general been performed little or no public research on crowding and brailing of farmed fish, and the industry has developed their own procedures and techniques for discharge, and different types of pump systems. Five levels are highlighted in Table 2-2 by Mejdell et al. (2009, p. 56) in relation to fish welfare from crowding.

²⁷ Crowding: By waiting-cage shrinking.

Table 2-2: Levels of fish welfare from crowding (adapted from Mejdell et al., 2009, p. 56)

Level 1 (Target)	Level 2 (Good)	Level 3 (Undesirable)	Level 4 (Unacceptable)	Level 5 (Extreme crowding)
The fish are swimming calmly, but not necessarily in the same direction, no dorsal fins are breaking the surface and no white sides are visible.	There is normal swimming activity close to pump intake, few dorsal fins breaking the surface and no white sides visible.	There is anxious behavior with frantic swimming in different directions, more than 20 dorsal fins breaking the surface and some white sides visible most of the time.	There is extremely high activity with haphazard swimming, surface panting and declining activity as fish become exhausted. Many dorsal fins and white sides are visible everywhere and it is impossible to maintain an even pumping rate.	The fish are exhausted and will die if they are not given more room. Many fish are floating on the side.

2.5.5 METHODS OF FARMED FISH STUNNING

When evaluating the subsequent stunning methods, one must keep in mind the risk of generalizing the evaluation upon the different methods. One must see the whole sequence as one operation (cf. Figure 2-12). This is because the treatment of the fish, the general physical and environmental conditions prior to stunning differ from site to site. Pumping systems, waiting cages and crowding are essential parts of fish welfare prior to stunning. In order to assess fish welfare in the slaughter process it is therefore important to see all handling of live fish within the context of Figure 2-12. The three most commonly discussed stunning methods in the fish farming industry are; percussive, electrical, and carbon dioxide.

2.5.5.1 PERCUSSIVE STUNNING

“If you let wriggling fish be sluiced in a queue (...) and gave each a quick and sturdy blow on the head, the animals would probably get a brain injury so powerful that they would not notice the subsequent bleeding” (Børresen, 2000, p. 36). Percussive stunning can be achieved with applying a single hammer strike to the head (Roth, Slinde & Robb, 2007, p. 192). Percussive stunning machines work by making the fish unconscious by giving them a concussion and brain hemorrhage (Mejdell et al., 2009, p. 15).

2.5.5.1.1 ADVANTAGES

Percussive stunning machines are perceived as an acceptable stunning method as it both promotes welfare considerations and efficiency (Mejdell, et al., 2009; Hjeltnes et al. 2010; Roth, Slinde & Robb, 2007; Benson, 2004; Lambooij et al., 2010). Insensibility occurs instantane-

ously and does not injure the fillet, and the system is perceived to work very well when the fish have uniform size, normal behavioral response and when the mechanical machine technique works (Mejdell et al., 2009). Fish that are hit successfully will generally die of stroke (Hjeltnes et al., 2010; Mejdell et al., 2009). According to Midling et al. (2008, p. 28) the specifications of the system indicates that there is a successful rate of 98 % for immediate insensibility followed by a good bleeding process. Equally, the arguments of Hjeltnes et al. (2010) assert that a proper adjusted machine will kill or stun 98-100 % of the fish.

2.5.5.1.2 CRITICAL AREAS

As with other machines, malfunctions or improper use leads to risks, and in this case the focus is on increasing risk of causing pain or fear and the need for re-stunning. Time between an unsuccessful automated first stroke and the second is said to be critical as the fish may suffer from severe injury caused by error.²⁸ If fish is hit imperfectly and regain consciousness at a time when their gill arches are cut, this may cause wriggling in the bleeding process (Mejdell et al., 2009). These thoughts are also supported by EFSA (2004) stating miss-hits as a potential disadvantage of percussive stunning, leading to poor welfare.

It is also said that large variations between species, and also physiological status diversity, are critical in terms of effectiveness. “Sexually mature salmonids can tolerate more than similarly large non-sexually mature salmonids” (Mejdell et al. 2009, p. 9). A proper stroke force is then necessary to achieve the balance between a too soft one; with the risk of regaining consciousness too soon, or a too hard one; with the consequence of out-blown eyes and jaw fracture (see e.g. Lambooij et al., 2010; Roth, Slinde & Robb, 2007). The use of different bolt heaviness in relation to the bar pressure is of significant importance in achieving the right force (see e.g. Mejdell et al., 2009; Roth, Slinde & Robb, 2007).²⁹

2.5.5.2 ELECTRICAL STUNNING

Electrical stunning is widely used in relation to slaughter of terrestrial animals like; pigs, sheep, goats, turkeys and broilers (Compassion in world farming, 2010). This is explained to be done by adding a sufficient amount of electricity that passes the brain and cause the nerve

²⁸ Backup stroke done either manually by a wooden or polypropylene priest or by an extra percussive stunning device.

²⁹ “Effective anesthesia is achieved by adding the maximum amount of energy to the brain within the shortest possible time. Impact energy depends on the bolt weight and speed, but the bolt speed when stroke occurs has more importance than the mass (...)” (Mejdell et al., 2009, p. 9).

cells to activate and depolarize, and stocks of neurotransmitters to be depleted. “The nerve system is thus “empty” or “shorted” and not able to receive, process or transmit information” (Midling et al., 2007, p. 9). Hence, the process is explained to “short circuit” the brain and make the animal unconscious. However, the consciousness is only disrupted for a while if proper amount of voltage, frequency and duration is combined, and therefore immediate bleeding is necessary to ensure the fish will not regain consciousness shadowed by poor animal welfare (Midling, et al., 2007; Hjeltnes et al., 2010). The voltage used can vary due to different fish sizes from approximately 20-110 volt (Mejdell et al., 2009; Midling et al., 2007).

Electrical shock is perceived as unpleasant or painful to both humans and animals. Wotton (1996, cited in Mejdell et al. 2009, p. 8) manifests that it takes approximately 0,15 seconds from a peripheral nerve cell is stimulated to the impulse reaches the brain, which is required for the perception ability to be perceived as conscious. With this in mind, the ideal loss of consciousness should be triggered quickly. “... modern electrical stunning equipment is based on exposing the whole fish to an electrical current” (FHF, 2009 p. 6), when an electrified metal pole touches the side of the fish. Systems have been developed for stunning fish in or out of water (dry stunning), whereas the literature presents the dry stunning method as the most frequently used.

2.5.5.2.1 ADVANTAGES

The system handles all sizes of farmed fish and are less dependent to pretreatment during earlier stages, and Mejdell et al., (2009, p. 15) argue that the system is good in terms of adjustments and that maintenance is fairly easy. Hence, there is a higher probability that all fish are stunned if proper voltages are used. EFSA (2004) states this to be an effective method of stunning and highlights the great efficiency rate of fish to be stunned as an advantage.

2.5.5.2.2 CRITICAL AREAS

Midling et al. (2007, p. 9) claims that exposure to electric fields leads to both primary and secondary stress responses which in turn lead to a shorter period before rigor mortis occurs than if the fish are slaughtered by a stroke to the head. To ensure that the electricity passes the brain at once, Mejdell et al. (2009, p. 53) emphasize the importance that the fish’s head should be in contact with energized equipment at the moment when the fish is subjected to power. Thus, there are challenges related to getting the salmonids to enter in the right direc-

tion (head first), since sideways or backwards entering will increase the probability of slaughter injuries which in turn can lead to poor fish welfare. Since the machines take all sizes, problems occur when the small or medium sized fish have too much space, and Hjeltnes et al. (2010) is claiming that fish entering backwards is subjected to a painful electric shock.

Since fish can regain consciousness after an electric stunning the right amount of voltage applied is essential. Mejdell et al. (2009, p. 58) indicates that lack of cleaning can increase the system resistance leading to reduced amounts of electricity passing through. Since this form of stunning is reversible, risks are associated with fish regaining consciousness before or in the process of gill arches being cut or in the bleeding process (Hjeltnes et al., 2010).

A survey by Roth, Birkeland and Oyarzun (2009) revealed that electrical stunning has a negative impact on fillet quality and the duration of the electrical current must be minimized. It is not unusual that pre rigor time is less than six hours, leading to darker and redder flesh than post rigor filleted fillets. Similar findings are presented by Midling et al. (2008) claiming a reduced pre rigor time of 40-50 percent when using electrical stunning.

2.5.5.3 CARBON DIOXIDE STUNNING

With regards to the industrial use of carbon dioxide for salmon stunning, gas is traditionally used in high concentrations in small carbon dioxide anesthesia tanks. The gas has also been used in lower concentrations in combination with chilling tanks and Hjeltnes et al. (2010, p. 9) underlines that in both cases, it takes 2-4 minutes before the fish are immobilized.

In the past, the Norwegian government among others incorporated farmed fish under animal welfare regulations assuming that fish have pain perception. Therefore, it was implemented regulations that farmed fish should be stunned with CO₂ before slaughter and Børresen (2000) comments;

We know that fish are equipped with a chemical sensory apparatus on the body surface, which far surpasses the human. When CO₂ rises in the environment, the fish tries to escape at any cost. For all we know, the rising carbonic acid content of the water feels almost like swimming and breathing in hydrochloric acid. Since the fish is trapped, it tries to jump over the edge of the tub. Therefore, we discover “boiling water” of frantic fish in the five or six minutes it takes before they lose consciousness and are agonized to silence (p. 35).

Hjeltnes et al. (2010) state this stunning method causes the fish to show extreme flight behavior before it is immobilized. The same concluding remarks are found in the recent work of Erikson (2011), stating; “carbon dioxide (regardless of concentration) stunning imposed stress, compromised welfare and did not render (...) salmon unconsciousness” (p. 374). Earlier findings also support this perception and Benson (2004) claims the lack of immediate consciousness loss generates stress responses in addition to high risk of fish not being unconscious when gills are cut. It is also claimed that it is difficult to ensure sufficient exposure, and that it is problematic to control the usage in commercial scales. The same year as Benson (2004) made his conclusions, EFSA (2004) also put forward statements telling no advantages whatsoever regarding CO₂ as part of the fish slaughter process, and that it leads to high risks of fish being processed before loss of consciousness.

An example of a governmental act in revisiting earlier regulations and adding new thoughts with the purpose of defeating poor slaughter methods like carbon dioxide stunning can be taken from Norway, with the Minister of Fisheries and Coastal Affairs, Lisbeth Berg-Hansen, stating:

It has long been a goal to phase out CO₂ as a stunning method on salmon slaughterhouses to improve fish welfare. Progress in technology has now progressed beyond what we see as better options. The ban on CO₂ stunning will therefore be applied on 1. July 2012 (Ministry of Fisheries and Coastal Affairs, 2011).

No recent research has shown any positive aspects of using CO₂ as a stunning method for salmon farming. According to Erikson (2011) this also applies for other gases such as nitrogen. Of the tested methods tested, Erikson (2011, p. 374) have found that the only one fulfilling their criteria of fish welfare and low stress was the use of the anesthetic isoeugenol.³⁰

2.5.6 ALTERNATIVE SLAUGHTER PROCESS

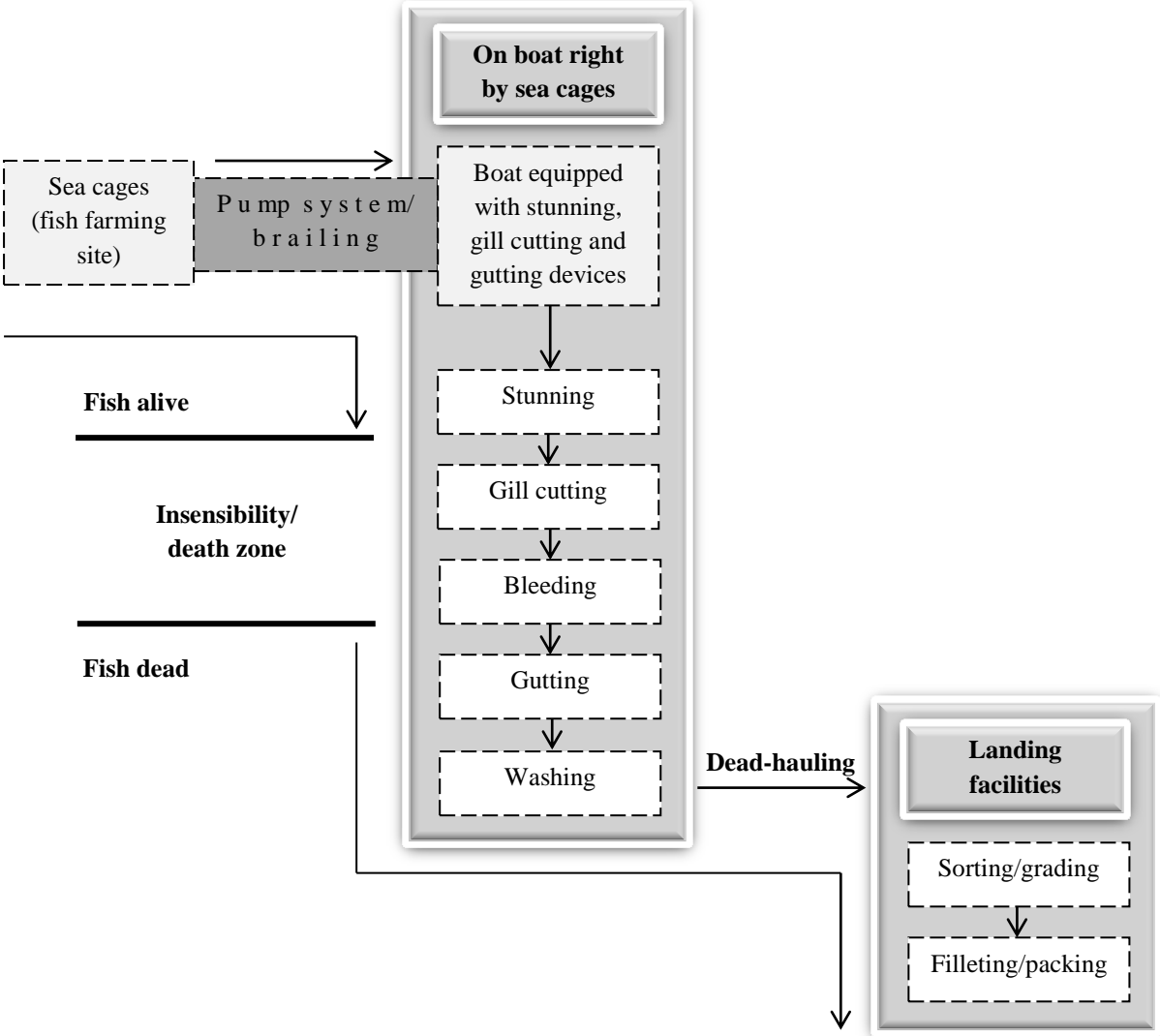
The ordinary logistics of the slaughter process presented in Figure 2-12 has potential negative impacts associated with the steps prior to stunning (e.g. well-boat, several pump systems, waiting cages and crowding). Midling et al. (2008) suggest positive results from an alternative

³⁰ The different stunning methods tested; isoeugenol, nitrogen and three levels of carbon dioxide (Erikson, 2011).

approach redesigning the whole chain of activities from the ordinary slaughter process; dead-haul.³¹

Instead of transporting living fish from the sea cages to the slaughter site (as presented in Figure 2-12) we can derive less transportation and waiting time for the fish from Figure 2-13. The idea is that the stunning- and slaughter process take place on a boat specially equipped for that purpose, right by the sea cage. Hence, transportation of living fish, unnecessary pumping/brailing and the need for waiting cages are then eliminated.

Figure 2-13: Alternative slaughter process



³¹ Slaughter of farmed salmon on boat, directly from the sea cages. The dead fish is then transported on the boat to landing facilities for further processing.

2.5.6.1 ADVANTAGES

Midling et al. (2008) found several advantages with this method. Among the advantages were elimination of problems related to transport fatalities caused by high sea temperatures and weak fish. The method is also found to have greater efficiency in terms of loading factor, since the boat transport to landing facilities can be done with a 5-6 times higher density. It is possible to deliver completely chilled fish to the landing facilities. Also, when salmon is harvested gently and directly from sea cages, the pre-rigor time is said to be about 30 hours, which is regarded as good in terms of further processing and for fillet quality (Midling et al., 2008).

Compared to regular slaughtering processes, the fish will in this method live in its natural sea cage environment until slaughtered. A recent study done by the Norwegian research organization Nofima showed that unnecessary delays in crowding, typical for waiting cages (as in Figure 2-12) prior to slaughter, have large impacts on the quality of the fillet (Hægermark, 2012). Three groups were tested; without crowding, 20 minutes of crowding and approximately 20 hours of crowding before slaughter. The different tests had huge impact on quality measures such as durability, bacterial growth and the development of undesired taste and odor. Also, the time until rigor mortis occurred was affected and scientist Turid Mørkøre underlines; “In our study, both short and long time crowding accelerated the time of rigor mortis but it was the long time crowding that gave quality problems and three days shortened durability” (Hægermark, 2012). It was said however, that crowding of fish had no negative impact on fillet color, firmness and drip loss during storage. The Institute of Marine Research (2011b) claimed the intensity of drip loss, i.e. fluid seeping out of the fillet, depends on how fast rigor occurs. It is further said that drip loss reduces the juiciness of the muscle. And as mentioned, fish stress influence rigor time. “Slaughterhouses that do filleting can with current methods do filleting before rigor mortis occurs (pre rigor), but fish that are exported un-filleted will go through rigor mortis during transportation” (Institute of Marine Research, 2011b).³²

2.5.6.2 CRITICAL AREAS

Although this system is found to be more expensive, the focus seems to revolve around hygienic factors. One concern is the hygiene factor related to the pumping of dead fish, but in the report of Midling et al. (2008) however, it is stated that the Norwegian Food Safety Au-

³² Un-filleted salmon is normally sold as HOG; head-on gutted.

thority is positive to this method as long as the collecting and processing of waste (e.g. blood water) is properly done. Also factors such as how efficient the slaughter processes are on a boat compared to well-equipped landing facilities are among the issues discussed.

2.5.7 RECAP

As we have discovered, a lot of considerations must be added to the value chain when considering the slaughter process. Among the evaluated stunning methods (i.e. percussive, electric and CO₂) there are major concerns related to the CO₂ method, which is soon to be banned in Norway. When considering the slaughter process, one must also keep track of the stages prior to stunning, where pumping, brailing, crowding and waiting cages have been discussed. The pumping process is generally perceived as the most stressful stage in this regard. We have also looked at an alternative slaughter process involving slaughtering at boat right by the sea cage. This has interesting efficiency and fish welfare implications, including effects on rigor, which affects flesh quality, since longer pre-rigor times are desirable. However, there might be some hygiene factors connected to the alternative method.

3 LITERATURE REVIEW

3.1 THE ART OF SOLVING THE RIGHT PROBLEMS

Just like a well put problem is half solved, the solution of a problem depends heavily on its definition. It should be unnecessary to state the importance of framing problems correctly. Yet, many companies fail to do exactly this. Instead, they end up solving the wrong problems correctly.

3.1.1 THE FOUR STEPS OF THE PROBLEM-SOLVING PROCESS

According to Mitroff (1998, p. 10), the process of problem-solving consists of four steps: (1) To acknowledge or recognize the existence of a problem. (2) To formulate the problem. This can be done in two ways; either wisely and correctly or unwisely and incorrectly. (3) To derive a solution. This can also be done in two ways; either competently and correctly or incompetently and incorrectly. (4) Implementing the solution. Since a problem (solution) can either be formulated (solved) correctly or incorrectly, it follows that there are four possible combinations of steps two and three. This is shown in Table 3-1 below:

Table 3-1: The interaction between defining a problem and deriving at the solution (adapted from Mitroff, 1998, p. 11)

	Step 3: Deriving at the solution	
Step 2: Defining the problem	Correctly	Incorrectly
Correctly	Wise and competent	Wise and incompetent
Incorrectly	Unwise and competent	Unwise and incompetent

If an organization solves the right problem correctly it is called wise and competent, an organization solving the right problem incorrectly is called wise and incompetent, an organization that solves the wrong problem incorrectly is called unwise and incompetent, and lastly, an organization that solves the wrong problem correctly is called unwise and competent. Sadly, according to Mitroff (1998), many companies end up in this last category. With reference to statistical type I and type II errors, Mitroff (1998, p. 15) calls this a type III or E3 error. However, due to the nature of E3 a more correct name would be a type 0 error, since, as contrary to type I and II errors, it manifests at the very beginning of the problem-solving process. It is

therefore a much more important type of error. What good are your results if you are working on the wrong problem?

According to Mitroff (1998, p. 20) there are five basic categories of solving the wrong problem precisely, i.e. committing an E3. They are: (1) picking the wrong stakeholders, (2) selecting a set of options which is too narrow, (3) phrasing a problem incorrectly, (4) setting the boundaries/scope of a problem too narrowly, and (5) failing to think systematically. These five categories are closely related to each other, and an E3 may be due to several of them at once. Mitroff (1998, p. 21) likewise lists five strategies to counter the five basic categories of E3. They are basically doing the opposite of the five basic categories leading to E3s. In short they are: (1) picking the right stakeholders, (2) expand your options: never accept a single definition of a problem, (3) never formulate or examine important problems solely in human or technical terms, (4) do not draw the boundaries of an important problem too narrowly, and (5) always locate and examine the broader system in which every important problem is situated.

When organizations decide to pursue a certain goal and believe that something (call it x) is the best way to do it, all other problems will often be seen as inferior (Mitroff, 1998). This view can be interpreted as to how the goal justifies the means. Such thinking can quickly lead to E3s, as seemingly different problems can be interrelated at a more holistic level. This can be related to what Mitroff (1998) calls system age thinking, which he claims dawned upon us sometime in the 1950s. While machine age thinking, the old dogma, is characterized by reductionism, system age thinking is characterized by everything being linked together and being interdependent. The complex relationship between events in the system age, i.e. for example how every event in the world has the potential to become local news, requires a more holistic approach to problem- formulation and solving. Mitroff (1998) claims that many companies still operate as if they are living in the machine age.

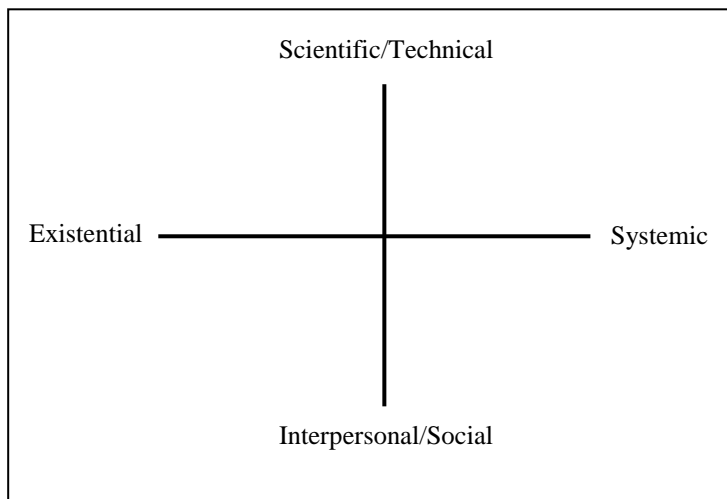
3.1.2 THE FOUR PERSPECTIVES ON EVERY PROBLEM

According to Mitroff (1998) our perspectives are determined by our education, profession, belief systems, personality, personal background, etc. Furthermore, the formulation of a problem depends on the language we use, and our perspectives influence our language. And yet people who speak the same language may still speak very differently, for instance by using different jargon. The formulation of a problem depend on the perspectives of those who for-

mulate them. Also, since the solution to a problem is highly dependent on how the problem is stated, the formulation itself becomes indispensable. To ensure that a problem will be formulated properly requires diverse and creative thinking. A small group of different people is likely to do this better than a large group of likeminded people, as the latter group might end up just validating each other's opinions.

Figure 3-1 below shows four perspectives which, according to Mitroff (1998, pp. 59-60), can be applied on any problem. Even though some perspectives may be more important than others in different situations, there is a grave danger of committing E3s when there is excessive focus on just one of the dimensions.

Figure 3-1: The four perspectives that can be applied to any problem (adapted from Mitroff, 1998, p. 59)



The scientific/technical perspective covers everything which has to do with numbers, graphs, equations, scientific laws, etc. A company only seeking profit maximization would fall entirely in under this perspective. Furthermore, the scientific/technical perspective often dominates the other perspectives (Mitroff, 1998). *The existential (or spiritual) perspective* concerns some of the most basic issues of the human condition, namely those of meaning and purpose. Ethical and moral values are included in this perspective. This perspective frequently resides in the background. *The interpersonal/social perspective* examines feelings, emotions and interpersonal relationships between people. Psychological and social concerns belong in this perspective. *The systemic perspective* takes a look at the more widespread, societal ramifications of the problem, for example at the regional, national or international level. This perspective takes a closer look at the greater context of the problem and how it affects the society we live in.

According to Mitroff (1998) each perspective in Figure 3-1 can be related to a person's underlying personality. In other words this means that some people are naturally inclined to focus more on a certain perspective. Although Mitroff (1998) links the four perspectives to the four basic Jungian personality types, the main point to remember here is simply that different personality types give rise to different types of e3s, but that together they can secure a holistic view.

As previously stated, the scientific/technical perspective (often in reality: economical considerations) often seems to dominate the other perspectives. Mitroff (1998) found that many companies that included an ethical (existential, interpersonal/social) perspective in their business approach ended up doing so purely by chance. One reason these companies had not formally incorporated the ethical perspective into their business practice may be due to the fact that organizations, within a management perspective, are often thought of in pure technical terms. Emotional, ethical and spiritual impulses are generally excluded from the literature of systems and organizations (Mitroff, 1998).

A typical clash of perspectives would be that of the scientific/technical (economic) one versus the ethical one. While responsibility for something can perhaps easily be denied or effectively argued against from a technical perspective, it is likely to be much harder, depending on which theory is being used, to do so from an ethical perspective. Utilitarianism (cf. chapter 3.3.8) might be used to increase the ethics threshold, as Mitroff (1998) calls it, i.e. increase the tolerance level for something. This is because utilitarianism will not justify corrective action until cost exceeds benefits. Kantian ethics (cf. chapter 3.3.7) on the other hand will certainly reduce the ethics threshold to a minimum. From a Kantian perspective even the smallest transgression is likely to be unacceptable. Furthermore, there is a difference between explicit and implicit assumptions. When organizations formulate or answer a problem, they often make implicit ethical assumptions. It is therefore important to carefully scrutinize every problem formulation for its implicit ethics threshold, and examine how the formulation and the solution change depending on whether the ethics threshold is made high or low.

3.2 CSR

3.2.1 THE ROLE OF CSR

The social commitment of organizations has existed for a long time, just under other terminologies than what we today regards as CSR. The literature, on the other hand, depicts a ra-

ther diversified view about important areas of responsibility and its underlying motivators. Midttun, Gautesen and Gjøølberg (2006, p. 369) proclaims large West-European and North-American multinational companies find necessity in developing CSR initiatives to obey the social expectations fronted by sophisticated interest groups which get media's attention. Other approaches developed in the CSR debate discuss the role of the government. Besley and Ghatak (2007) confront the representation of a public good through either CSR, the government or through charity. The purpose is to discover if profit seeking firms can contribute to public goods provisions in a better manner. The debate illustrates two major differences between government provisioning versus CSR. Besley and Ghatak (2007, p. 1,659) point out, firstly, that CSR is voluntary, and secondly, that most regulation concerning curtailment of a public bad applies to all businesses, even the ones that have services to customers that are careless. Luetkenhorst (2004) on the other hand, argues that the CSR debate reflects a wide range of motives and mechanisms that goes far beyond this, and;

...range from defensive attempts at avoiding financial losses and protecting image and reputation, to proactive cost-benefit calculus that factor in financial gains from productivity improvements (...) and ultimately, CSR as the core of a company's corporate strategy where CSR itself becomes the basis for brand equity and the driver of organizational learning, innovation and technology management (p. 158).

In line with this assumption there are similarities to be discovered with the pyramidal approach led by Bach and Reid (1991, cited in Nordhaug, 2011), where five stages determines the level of CSR commitment. In the lowest level, *Amoral* (1), the attitude to CSR is that "it's ethical as long as we don't get caught", and ", if caught, such costs are seen as nothing more than the cost of doing business. The *Legalistic* (2) approach seeks to obey laws and regulations, and for multinational companies this also applies to local laws in the countries they operate. *Responsive* (3) enterprises have the conception that there might be advantages to have a responsible business practice that goes beyond laws and regulations. Although not fully organizationally integrated, *emerging ethical* (4) companies establish ethical objectives (e.g. ethical codes, statements, manuals, internal routines) driven by a strong ethical aspiration. At the highest level, (5) *Ethical*, corporations' moral actions are fully integrated and its values carried out through every business unit and among its employees, and ethical conduct is seen as conducive to profitability.

Several definitions of CSR have emerged as a consequence of the ongoing development, and Morsing and Perrini's (2009) definition is that CSR arises when companies endeavour to engage in socially responsible behavior. This definition provides guidance for an organization's perspectives since CSR then extends beyond the company's "four walls". The Commission of the European communities (2001) believes most CSR definitions focus on firms' integration of social and environmental concerns in addition to an interaction with their stakeholders on a voluntary basis. Hence, the companies' should not just live up to meet legal expectations, but have a behavior that goes beyond.

Porter and Kramer (2006) indicate that CSR issues are included in corporate strategic choices with respect to a dependent relationship between business and society. CSR can be viewed in the company's own interest if the motivation is for creating a competitive advantage that provides the greatest shared values. No entity may be involved in solving all problems in society or bear the cost of doing it. Instead, each company can select issues that are the closest linked to their field of business. Other social agendas can be left to companies in other industries, NGOs or public institutions that are better equipped to solve them. "The essential test that should guide CSR is not whether a cause is worthy but whether it presents an opportunity to create shared value – that is, a meaningful benefit for society that is also valuable to the business" (Porter & Kramer, 2006, p. 8). In relation to this Dahle (2010) makes the distinction between strategic and genuine CSR, and criticizes the former approach for being too focused on only doing that which also benefit the company, i.e. neglecting the cases where good should be done for good's own sake.

Examples from the EU and other western countries may serve as valuable insights for CSR involvement. Midttun, Gautesen and Gjølberg (2006, pp. 376-377) discuss "The Nordic model", where it appears that the public sector has taken care of many of the concerns included in CSR issues. Kvåle (2007, p. 2) formulates the Nordic welfare model towards a partnership between the state and the private sector, which can help explain the reasons behind success factors of economic growth. Midttun, Gautesen and Gjølberg (2006, p. 373-377) point out that the Nordic countries overall score high when it comes to socio-political models and that they rank among the best on indices such as FTSE4, Global 100, the DSJE index in addition to rankings made by "The world business council for sustainable development".

It should also be stressed the extent to which the government wants to cooperate with the companies in relation to regulation enforcement. Whether governmental regulations are pref-

erable to CSR will largely depend on whether organizations' stakeholders should take part in monitoring (through their response patterns) or whether monitoring should be done via the political agenda (at a higher level). Besley and Ghatak (2007) raise the question whether CSR is feasible and desirable. Furthermore they place CSR in a context of consumers' preferences of public goods/bads as part of a corporate profit maximizing strategy in cases where the latter creates external effects.

The conclusion of Besley and Ghatak (2007, p. 1,660) indicates that CSR is no "miracle cure" for the challenges associated with private provisions of public goods and businesses that actively implement CSR will create public goods at the exact same level as regular voluntary contributions. The challenges that are often cited in connection with volunteering are "free-riders". The question may be whether it is up to the governments to deal with the controlling and that companies then may choose to ignore the external effects they are creating. The discussion can therefore go in the direction of considering ideology more than just looking at empirical evidence, and the distinction can be interpreted between whether the government should have a small or big impact. Both alternatives can be efficient if exercised right, so this is not about which mechanisms that might work, but rather the underlying ideological reasons. The argument must however be reevaluated in cases where the government performs imperfect and Besley and Ghatak (2007) questions whether CSR may therefore be a reaction to government's bias or as a result of poor monitoring.

The debate can in a way go in the direction that it is all well and good that the government should set guidelines for corporate external effects. The question may concern how far the CSR issue really extends beyond the government's role and that it thus should form an integral part of corporate governance matters apart from just enforcing established laws. In this regard Midttun, Gautesen and Gjølborg (2006) mention how the extensive regulations and policies in some Western countries have a dampening effect on CSR possibilities.

3.2.2 STAKEHOLDER THEORY

In the CSR development, the awareness and meaning of stakeholder policies has had an increasing impact on management strategies. Among different scholars the opinions and the degree of stakeholder importance vary significantly and Fassin (2009, p. 113) states that few management topics have generated more debate in recent decades. The prospects of Freeman (1984) are regarded as a milestone in terms of modern views on stakeholders as a necessity of

the existence and affluence for business participants. Although his work on the field of stakeholder approach has been revised over the years, the original framework of Freeman (1984) was an achievement to highlight the scope of a company's responsibility for its internal and external surroundings. In contrast, well recognized researchers such as Milton Friedman have completely shaded the importance of businesses' surrounding interests where the only goal is the preservation of the owners' wealth. As the 1976 Nobel Prize Winner states: "There is only one and only one social responsibility of business – to use its resources and engage in activities designed to increase its profits as long as it stays within the rules of the game, which is to say, engages in open and free competition without deception and fraud" (Freidman, 1970). From this assumption the managers are obliged to maximizing shareholder value. The role of leaders is to be put in the context of only living up to legal constraints. The pressure is laid on the shoulders of the legal authorities to make regulations that are designed to carry out preferred actions by business participants. In this sense, all external effects are to be put aside and the need for CSR in this context is seen as irrelevant. Jensen (2010b) argues that "...stakeholder theory should not be viewed as a legitimate contender to value maximization because it fails to provide a complete specification of the corporate purpose or objective function" (p. 32). Value maximization provides managers with a single objective, but as Jensen (2010b, p. 32-33) argues, stakeholder theory leads managers to serve "many masters", all ending up being shortchanged. In this sense, the need for a classification system (e.g. Freeman, 1984; Mitchell, Agle & Wood, 1997; Fassin, 2009; Falck & Heblich, 2007) where managers can make stakeholder priorities is thought to be a necessity for an efficient stakeholder approach. This dimension seems apart from the approach of Jensen (2010b) claiming the importance of managers having just one mission; a single valued objective function – value maximization, and who says that "companies embracing stakeholder theory will experience managerial confusion, conflict, inefficiency, and perhaps even competitive failure" (p. 33). The assertion of Falck and Heblich (2007) can serve as a valuable opposite in this regard claiming that management can use CSR to combine the interests of both stakeholders and shareholders. "In attempting to solve the win-win puzzle, management needs to answer the question of which stakeholders should be considered and, correspondingly, how much is at stake" (Falck & Heblich, 2007, p. 250).

Fassin (2009, p. 122) makes a triangular interaction between stakeholders, stakewatchers (mainly pressure groups) and stakekeepers (largely regulators). "This view better reflects the distinct activities of stakeholders in one of the three groups: the stakeholder who holds a

stake, the stakeholder who watches the stake and the stakeholder who keeps the stake” (Fassin 2009, p. 128). Hence, the distinguishing between a broad vs. narrow stakeholder approach makes an important implication on firms’ considerations with regards to stakeholder attitudes. Freeman (1984) argues that a narrow view only includes those who are seen as necessary for the company’s existence, while a broad definition should include virtually anything that is affiliated with the company’s actions. The broader definition recognizes the statement: “A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization’s objectives” (Freeman 1984, p. 46). A problem with a broader definition is, according to Orts and Strudler (2002, p. 219), that it is likely to give rise to contradictory interests which it might be hard to reconcile.

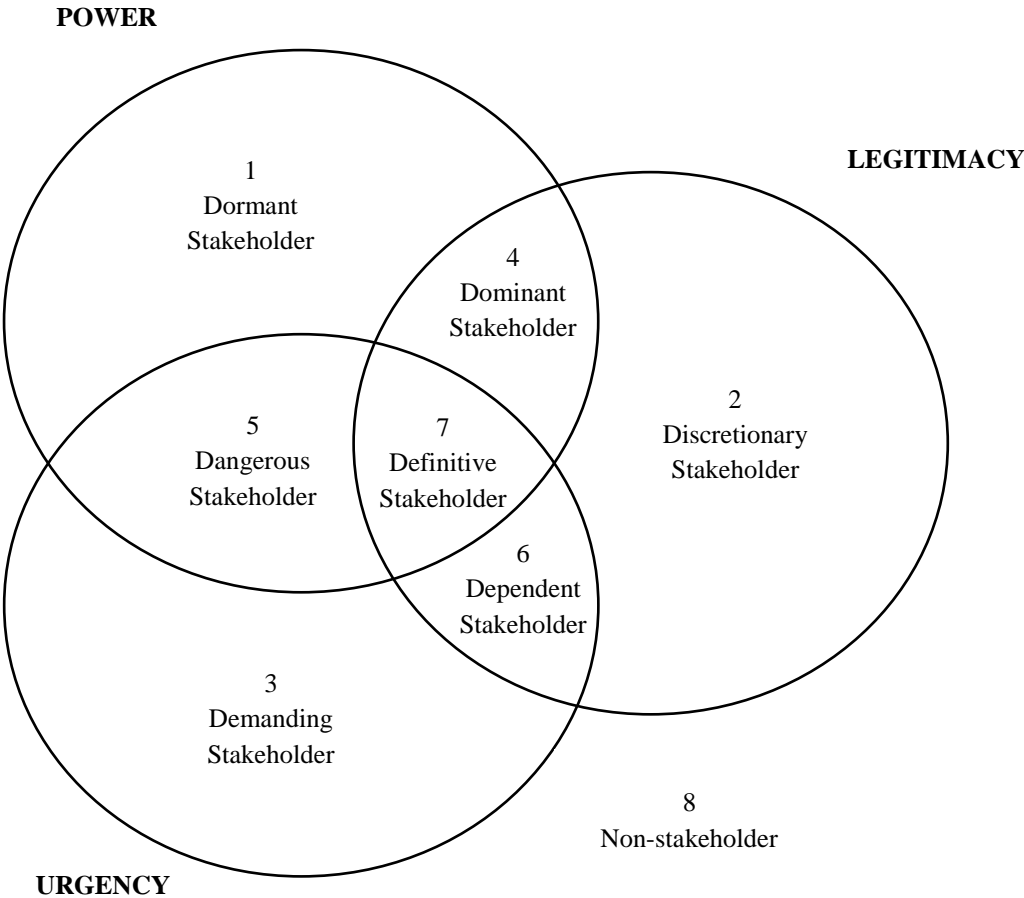
Mitchell, Agle and Wood (1997) identify stakeholders and their salience on the fundament of their power, legitimacy and urgency. Salience is at its highest when all three foundations exist. Mitroff (1998, pp. 37-40) divide stakeholders into their stance (e.g. hero, powerful, enemy) and functional role (e.g. legal expert, regulator, competitor, stockholders).³³ Salancik and Pfeffer (1974, cited in Mitchell, Agle & Wood, 1997, p. 865) define *power* as the ability to put the outcomes they desire into life. Other scholars such as Etzioni (1964, cited in Mitchell, Agle & Wood, 1997, p. 865) prefer to categorize the resource that is used to exercise power, e.g. “coercive power” which includes physical attributes like force, violence or restraint, “utilitarian power” based on material or financial resources and at last the “normative power” that focuses on symbolic resources. Symbolic resources often exclude factors that are physical or give material rewards, and are instead concentrated on elements such as prestige and esteem or other social symbols. *Legitimacy* can be defined as: “A generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (Suchman 1995, cited in Mitchell, Agle & Wood, 1997, p. 866). Although this definition might be seen as wide and thereby challenging to put into real business scenarios, researchers find it constructive for the purpose of identifying stakeholder approaches. “This definition implies that legitimacy is a desirable social good, that is something larger and more shared than a mere self-perception, and that it may be defined and negotiated differently at various levels of social organizations” (Mitchell, Agle & Wood 1997, p. 867). Among academics, *urgency* can be stressed when both time sensitivity and criticality are present. This means that a stakeholder claims immediate action and the occurrence is critical to the stakeholder. Mitchell, Agle and Wood (1997) define urgency

³³ A stockholder is just one important class of stakeholders.

as “the degree to which stakeholder claims call for immediate attention” (p. 867). A stakeholder will according to Mitroff (1998) often take (have) several stances (functional roles) simultaneously. Mitroff (1998) also claims organizations discriminate against their stakeholders. Through implicit, taken-for-granted assumptions they narrow down a list of stakeholders to arrive at their “stakeholder pool”. Stakeholders are then separated into two categories; those who are relevant (powerful) and those who are irrelevant (weak). The views of those powerful stakeholders who share views with that of the organization are used to justify whatever action the organization see fit. These stakeholders will give strong support to the organization’s actions. Other stakeholders, including those who give strong opposition, are ignored.

The following section discusses the seven categories behind what Mitchell, Agle and Wood (1997) named the: “Stakeholder Typology: One, Two or three Attributes Present”, which is visualized through Figure 3-2.

Figure 3-2: Stakeholder Typology: One, Two, or Three Attributes Present (adapted from Mitchell, Agle & Wood, 1997, p. 874)



3.2.2.1 LATENT STAKEHOLDERS

Dormant (1) stakeholders have usually little interaction with the organization but holds power and abilities for confronting the company in public. Since *discretionary* (2) stakeholders have the lack of both power and urgency the need for managers' attention is low. The fact that they carry legitimacy may create the need for attention if their thoughts are observed and adopted by more demanding stakeholders. *Demanding* (3) stakeholders can be perceived as annoying, but their lack of importance reduces their priority.

3.2.2.2 EXPECTANT STAKEHOLDERS

Stakeholders denoted *dominant* (4) have the ability to influence the organization but creates no immediate need for attention. The underlying uncertainty of whether they will follow up their interests or not puts them on the "watch list" for managers. *Dangerous* (5) stakeholders might be recognized by a violent and intimidating attitude. They often use coercive power as compensation for lack of legitimacy. Academics often add activist groups, strikes, employee sabotage and terrorist activities to this group. The characterization of *dependent* (6) stakeholders lies within its name, as they depend on others to front their claims or interests. This category of stakeholders must often rely on the encouragement of more powerful stakeholders or even goodwill from corporations' leaders. Starik (1993, cited in Mitchell, Agle & Wood, 1997, p. 877) gives examples of such stakeholders as local residents, marine mammals, birds and the natural environment.

3.2.2.3 DEFINITIVE STAKEHOLDERS

Definitive (7) stakeholders contain all the vital elements to be considered at the highest priority level, as described by the expression salience. If the claims from stakeholders that already have power and legitimacy becomes urgent, a manager's attention requires sudden priority to them. The most common occurrence is likely to be the movement of a dominant stakeholder into the "definitive" category (Mitchell, Agle & Wood, 1997, p. 878).

3.2.3 STRATEGIC CSR

Asymmetric information may lead to difficulties in revealing true motivators behind organizations' CSR efforts which makes it harder to check for egoistic or social incentives. "Managers may perceive that many external stakeholders view CSR activity more favorably if it is divorced from any discussion of the bottom line" (McWilliams, Siegel & Wright, 2006, p. 9).

“Although CEOs and government leaders insist in public that CSR projects create value for the firm, privately they admit that they do not know if CSR pays off” (Husted & Allen, 2007, p. 594). Often, companies scatters fuzzy words in their annual reports and McWilliams, Siegel and Wright (2006, p. 9) argues that the lack of candid information makes it harder to find true motivations behind CSR, whether it (the motivation) is for private or social benefit. Husted and Allen (2007, p. 606) argues that visibility is an essential part of creating value from CSR projects, but they further claim the dangers for “green wash” arises when CSR may be managed for visibility (reputation) in the absence of compliance. It is also said that multinational enterprises often are good at implementing a good looking CSR program while they continue the same old practices. Challenges that arise in terms of value creation undertaken from CSR are highly dependent on the degree of implementation-knowledge into the business processes, and Husted and Allen (2007, p. 607) argue that CSR will remain a necessity and often an uncomfortable burden only with the purpose of satisfying NGOs and for avoiding negative publicity.

Perspectives on CSR implementation by Porter and Kramer (2006) give ideas for making CSR-integration of companies and society a spearhead for future wealth, gaining both. Every business participant can create competitive advantage through detecting a set of societal challenges they are best equipped to solve. Despite an enormous amount of possibilities for contributing, only a handful of them are “real opportunities”, which really makes a difference. Organizations should identify their “highest aces” for the degree of influencing based on their core activities. It is when these activities interrelate with society at most the opportunity for shared value between business and society arises. This is the heart behind the ideas presented by Porter and Kramer (2006), where CSR in a strategic context creates opportunities for significant social influences while the preservation of business benefits is still present. Reinhart (1999) claims certain requirements must be met if engagement in social or environmental activities also will increase expected firm value: “(1) Where the possibility for strategic interaction with competitors exists; (2) Where opportunities exists to differentiate products; (3) Where principal-agent problems within the firm give rise to unexploited cost savings (a “free lunch”) and hence to the possibility of cost reduction within the firm” (p. 11). Reinhart (1999, p. 11) emphasizes that neither the three need to be mutually exclusive and there may be circumstances where two or all of them apply simultaneously.

The ideas and models presented by Porter (1985; 1990) create the fundament of what Porter and Kramer (2006, pp. 5-8) present as the framework for discovering interdependence be-

tween a company and society; “Mapping Social Opportunities”. In the interaction between an “inside-out” view (i.e. mapping the social impact of the value chain) and the “outside-in” perspective (i.e. social influences on competitiveness), companies can focus on CSR activities that has the greatest potential for maximizing shared value. Both inventive value chain improvements and social attributes implemented in a competitive manner are important for creating economic and social value, but as Porter and Kramer (2006, p. 11) stress; the impact is even greater if they interrelate. Value chain activities can be performed in ways that are strengthening the social dimension of context, and equally, investments in a competitive context have potential for reducing constraints on value chain activities (Porter & Kramer, 2006).

Firms’ activities are essential and Bhattacharyya (2010, p. 84) claims that any discussion regarding CSR initiatives should be “action oriented” and the discussion of strategic CSR should focus on the real strategic activities of an organization. These activities must have some traits that differ from non-strategic activities. For this matter we can discover parallels to the “inside-out” view of Porter and Kramer (2006), and Husted and Allen (2007, p. 606) find arguments for sufficient firm-value-creation by focusing on even just one strategy variable. To realize which of the activities that really creates value is thus essential. It is said that companies can add value by reducing costs, create product differentiation, and by stimulating customers to change their purchase-patterns according to what the different companies do. Furthermore, “CSR is an opportunity to re-configure the competitive landscape as well as to develop distinctive and dynamic resources and capabilities” (Husted & Allen, 2007, p. 605). The dynamics of consumer preferences and the business environment can change, which will give the business participants an opportunity to make their contribution aligned with Porter and Kramer’s (2006) ideas for “outside-in” perception. In order to enhance knowledge about the degree of social issues that affect a company, Porter and Kramer (2006, pp. 8-12) distinguish between; (1) generic social issues, (2) value chain social impacts and (3) social dimensions of competitive context. This is shown in Figure 3-3 below.

Figure 3-3: Involvement in society: A strategic approach (adapted from Porter & Kramer, 2006, p. 9)

Generic Social Impacts	Value Chain Social Impacts	Social Dimensions of Competitive Context
<p>Good citizenship</p> <p>Responsive CSR</p>	<p>Mitigate harm from value chain activities</p> <p>Transform value chain activities to benefit society while reinforcing strategy</p>	<p>Strategic philanthropy that leverages capabilities to improve salient areas of competitive context</p> <p>Strategic CSR</p>

Despite generic social issues may be important to society, they are not significantly affected by corporate actions or truly affect companies' competitiveness in longer perspectives. As a result of a firm's ordinary business activity, the second level deals with social effects as a result of a company's value chain and thus have significant potential for impact on social issues. The last category deals with the social dimensions in a competitive context, and Porter and Kramer (2006) explain what they are, namely; "Social issues in the external environment that significantly affect the underlying drivers of a company's competitiveness in the locations where it operates" (p. 8). Due to diversity of different businesses and sectors the approaches to the framework will differ. What makes a huge social dimension of competitive context in one company may just be a generic insignificant social issue for another. Therefore, companies need to individually identify and prioritize their social issues based upon the three categories. Much of the same viewpoint is shared in the concluding remarks of Reinhardt (1999), expressing that there is no "one-size-fits-all" policy, which instead needs to be linked to the economic fundamentals considering; "...the structure of the industry in which the business operates, its position within that structure, and its organizational capabilities" (p. 18).

As we can derive, there is an opportunity cost associated with the resource allocation of performing CSR and the literature holds diversified proposals of whether there are trade-offs involved. Jensen (2010b) for example, has a rather fixed viewpoint that profits and social performance cannot go hand-in-hand, claiming that "It is logically impossible to maximize in more than one dimension at the same time unless the dimensions are monotone transformations of one another" (p. 34). Researchers such as Reinhardt (1999) argue for more of a risk management mechanism in terms of voluntary provisions of public goods. Here it said that some companies will succeed in creating opportunities for voluntary operations while

others will not. In this sense, the link upon the framework of Porter and Kramer (2006) is relevant for enterprises in order to sort out which key areas have the greatest potential for creating significant social influences, while still gaining a strategic competitive advantage that captures firm-profits.

3.3 ETHICS

3.3.1 MORAL ECONOMIC MAN

According to the Economic Man concept an agent's actions are purely motivated out of maximizing self-interest. Numerous studies, referred to in Zsolnai (2007), have shown that this notion is invalid. According to Zsolnai (2007), overwhelming empirical evidence shows that people not only care about their material payoffs, but also consider the interests of others, as well as caring about their own reputation and self-conception. Moreover, people care about fairness and may be willing to sacrifice own utility in order to punish others. The concept of Moral Economic Man takes these aspects into consideration.

Based on the findings mentioned above, Zsolnai (2007, p.53) has devised a framework outlining determinants of ethical behavior. Whether an agent chooses to act ethically or not can be seen as depending on two major factors, namely: (1) The moral character of the agent, and (2) the relative cost of ethical behavior. "Moral character refers to the strength of the moral beliefs and commitments of the agents" (Zsolnai, 2007, p. 53). In order to keep the framework simple, moral character is classified as either strong or weak. The relative cost of ethical behavior is determined by comparing the transaction cost and opportunity loss of acting ethically versus acting unethically. This cost is classified as either high or low. An agent with a strong moral character and a low relative cost of ethical behavior can be expected to act ethically. An agent with a weak moral character and a high relative cost of ethical behavior can be expected to act unethically. The framework is summarized in Table 3-2:

Table 3-2: Determinants of ethical behavior (based on the work of Zsolnai, 2007, p. 53)

Moral character (strong/weak)	Relative cost of ethical behavior (high/low)	Corresponding behavior (ethical/unethical)
Strong	Low	Ethical
Weak	High	Unethical
Strong	High	?
Weak	Weak	?

The corresponding behavior of the last two combinations in Table 3-2 is unknown. It is impossible to predict which factor will outweigh the other. However, the focus of the framework is the first two combinations. Furthermore, although the term “an agent” might best refer to individual behavior; it can be argued that a company is nothing more than the sum of its individuals. In light of that the framework may also be applied on companies.

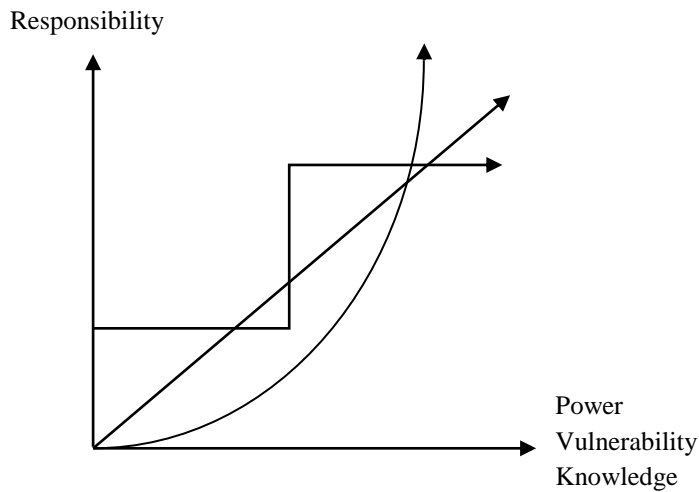
Zsolnai (2007, p. 55) makes four assumptions of what might affect moral behavior. They are: (1) That a stronger collective belief in ethical norms among the agents will lead to more ethical behavior. (2) That a stronger pro-social orientation among the agents will lead to more ethical behavior. (3) That a higher social cost of transgression (i.e. a bigger fine or a longer jail-time) will lead to more ethical behavior. (4) That greater transparency and accountability of the actions of the agents will lead to more ethical behavior.

3.3.2 THE RESPONSIBILITY GRAPH

Figure 3-4 depicts the relationship between responsibility on the vertical axis and any another dimension such as knowledge, power or vulnerability on the horizontal axis. The rationale of Figure 3-4 is that since an agent’s actions may affect other beings and/or the environment around him he has to carry a certain degree of responsibility. Whether the relationship is linear, exponential or step-wise, i.e. increasing drastically as a certain threshold is reached, is not essential. The main point is simply to establish that a relationship exists, and that the agent has a moral obligation to heed it.

With power and knowledge on the horizontal axis it might be possible for an agent to downplay their responsibility by equally downplaying or voluntarily reducing their own power/knowledge. Putting vulnerability on the axis ensures that focus will remain on the status of the beings and/or the environment affected, because this status is given and independent of whatever the agent might say or do.

Figure 3-4: The Responsibility Graph (based on Ims, 2011)



3.3.3 MORAL DISENGAGEMENT THEORY

From time to time corporations act unethically, but not necessarily breaking the law, in opposition to cultural and social values and norms of conduct. In such situations employees and corporations may use moral disengagement strategies to convince the public that they are not really responsible, or at least less responsible than public sentiments would suggest.

According to Bandura, Caprara and Zsolnai (2007), “transgressive conduct is regulated by two sets of sanctions, social and personal. Social sanctions are rooted in the fear of external punishment; self-sanctions operate through self-condemning reactions to one’s misconduct” (p. 153). When people adopt moral standards, they adhere to them voluntarily - no laws or regulations are needed. The mechanisms of moral disengagement enable people to act against their better judgment, and at the same time feel less guilty about it. Bandura, Caprara and Zsolnai (2007, pp. 153-155) have identified eight different moral disengagement strategies. They are:

1) *Moral justification:*

Moral justification means that the agent justifies his behavior by rationalizing and making up excuses for why his actions are just. If the agents can convince himself of his righteousness, acting unethically becomes (much) easier.

2) *Euphemistic labeling:*

Euphemistic labeling is a strategy where the agent conceals and distorts his true intent and/or tries to manipulate public opinion by masking (labeling) his intentions or ac-

tions, possibly even trying to glorify them, in a way which is in clear conflict with reality. The agent tries to hide behind an illusory façade, and, if successful, may even gain (some) recognition.

3) *Advantageous comparison:*

An agent may use advantageous comparison to contrast his behavior in a favorable light. This can be done in numerous ways, for example; by saying that the alternative was worse; by “lending” credibility from institutions which already have a good reputation, and then claim there is no inherent difference between your actions and those of the other institution.

4) *Displacement of responsibility:*

This means that the agent tries to renounce his responsibility by blaming others and claiming he is not “the real agent”. An example of this would be a person claiming he was simply following orders and doing his job in a difficult position, and that because his superiors have assumed full responsibility, he cannot be blamed.

5) *Diffusion of responsibility:*

This happens when the agent just plays a minor part of a whole, and where his behavior may seem innocent or negligible in isolation. In such situations it may be hard to pin down individual responsibility. If the agents do not understand or have full overview of the whole situation, it will be harder or even unreasonable to expect them to accept responsibility. This strategy can be seen in relation to the many-hands dilemma, which occurs when/because “corporate responsibility cannot be traced back to the sum of individual responsibilities” (Bandura, Caprara & Zsolnai, 2007, p. 4).

6) *Disregarding or distorting the consequences:*

Another way of trying to renounce one’s responsibility is by disregarding or distorting the consequences. It is hard to take responsibility for that which one does not acknowledge, or convinces oneself does not exist or is not as bad as everyone else think.

7) *Dehumanization:*

If one accepts that all humans have certain rights and deserve certain considerations, then what about that which is not human? Do they deserve to be treated by the same standards? By dehumanizing one’s victims, the agent may try to outstrip them of their rights, feelings, hopes and concerns. It is easier to disregard responsibility for something/someone if you do not think them worthy.

8) *Attribution of blame:*

Attribution of blame involves blaming others and claiming to be a victim oneself. An agent may claim he had no choice, and that he was forced to act the way he did by unfortunate, uncontrollable circumstances.

A company may use several moral disengagement strategies simultaneously, depending on the situation they are in.

3.3.4 THE RESPONSIBILITY TRIANGLE

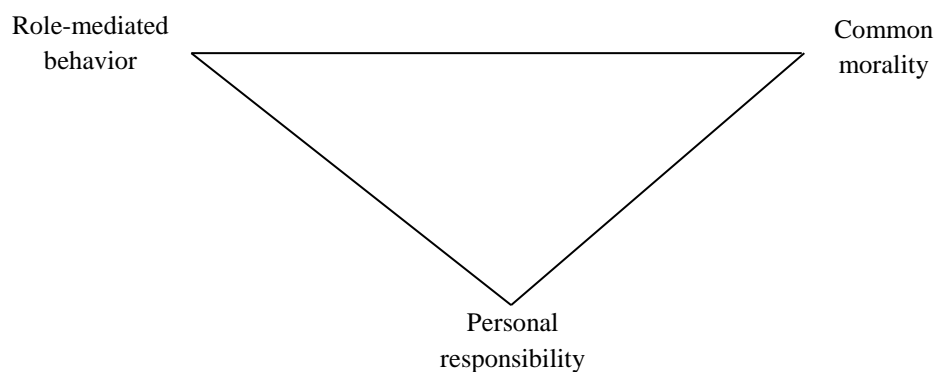
In relation to management control, Jørgensen and Pedersen (2011) distinguish between the two concepts of (1) organizing for control and/or motivation, and (2) organizing for responsibility. The organizing for control approach is based on appeals to extrinsic motivation. Here employees are given distinct roles outlining their tasks and responsibilities. Then the management monitors the employees to ensure their performance. Incentives in the form of possible rewards, and sanctions are used as tools to align the employee's behavior with the interests of the organization. According to Jørgensen and Pedersen (2011, p. 110) this traditional approach has been criticized from both an expediency and ethical point of view.

Organizing for responsibility is a new perspective trying to remedy the weaknesses of the traditional view. It recognizes the threat and danger of extrinsic motivation possibly displacing intrinsic motivation (the crowding-out effect), and seeks to strengthen intrinsic motivation. It highlights personal responsibility. But what is responsibility? According to Bovens (1998, cited in Jørgensen & Pedersen, 2011, pp. 113-114) there are five forms of responsibility, namely; (1) responsibility as a cause (casual responsibility), (2) responsibility as accountability (moral responsibility), (3) responsibility as capacity, (4) responsibility as a task and (5) responsibility as virtue.

Responsibility as capacity and virtue are intra-individual, i.e. relate to the person itself. Responsibility as a cause, as accountability and as task are extra-individual, i.e. relate "to the conditions, context or situation within which the individual acts, or to the outcomes of the individual's choices and actions" (Jørgensen & Pedersen, 2011, p. 114). "The extra-individual forms of responsibility are prevalent in the literature on organization and management" (Jørgensen & Pedersen, 2011, p. 114), and are basically what underlies the organizing for performance approach, through its focus on extrinsic motivation.

Because of the separation of intra- and extra-individual responsibility it follows that an employee who responsibly fulfills his job duties may actually do so against his personal values and sense of responsibility. This potential conflict of interests can be better understood through what Ims (2006, cited in Jørgensen & Pedersen, 2011) calls the Responsibility Triangle (Figure 3-5). The Responsibility Triangle is a framework dealing with three types of responsible action derived from; (1) role-mediated behavior, (2) common morality and (3) personal responsibility, and how these types interact with each other.

Figure 3-5: The Responsibility Triangle (adapted from Ims, 2006, cited in Jørgensen & Pedersen, 2011, p. 117)



Role-mediated behavior is likened to professional responsibility, and is closely related to responsibility as task. As the wording implies, one has a responsibility to carry out the tasks associated with one's role. Role-mediated behavior is thus a form of extra-individual responsibility. Ims (2006, cited in Jørgensen & Pedersen, 2011), argues how professional responsibility is a shallow form of responsibility in tension with both common morality and personal responsibility. *Common morality* represents a "snapshot" of the current dominating values and norms within a given society or community. Common morality is therefore also a form of extra-individual responsibility. Only *personal responsibility* deals with the intra-individual form of responsibility. According to Ims (2006, cited in Jørgensen & Pedersen, 2011, p. 116), this is the most important source of responsibility and "involves the deeply anchored values, attitudes, feelings and beliefs from which the individual's sense of responsibility springs". Therefore, ideally, role-mediated behavior should be based upon personal responsibility. When this is not the case, organizations may use several moral disengagement strategies (e.g. Bandura, Caprara & Zsolnai, 2007) to renounce or diminish one's sense of responsibility.

From the interpretation of the responsibility triangle by Ims (2006, cited in Jørgensen & Pedersen, 2011) one perceives that there is a dynamic and two-way interaction among all lines

in the triangle. Just as one's personal responsibility may influence the way one carries out one's professional responsibility, it is also reasonable to expect that one's role-mediated behavior might change one's notion of personal responsibility, at least given enough time, since man is habitual. Likewise, since common morality is what gives rise to laws and regulations, as well as the dominant public opinion, it should be clear that it (common morality) has a great potential in setting the stage for, as well as in disciplining (sanctioning) role-mediated (company) behavior. However, just like role-mediated behavior influences personal responsibility, so too does it change common morality, which, after all, is nothing more than the aggregated sum of individual morality. Since common morality represents a "snapshot" of the current conceptions of right and wrong, good and bad, wise and unwise, it will play a major role in determining personal responsibility. However, strong and influential individuals may quickly change common morality. In this way, all three types of responsible action may change over time.

From the discussion of the responsibility triangle (Jørgensen & Pedersen, 2011; Ims, 2006, cited in Jørgensen & Pedersen, 2011), it is understood that personal responsibility is wider than professional responsibility because whereas the latter type confines the employee to primarily deal with maximizing shareholder wealth, the former type allows the employee to consider all stakeholders. The organizing for performance approach can thus be linked to the stakeholder perspective. As seen from the Responsibility Triangle, there are three types of responsible action, and they all operate simultaneously. It is not possible to renounce one's personal responsibility.

3.3.5 GAME THEORY AND ENVIRONMENTAL CRISES

Game theory is a branch of decision-making theory that deals with decision-making strategies when two or more decision-makers (players) confront each other. In a typical game there are only two players. If the players are companies, they may both seek profit maximization, but perhaps through different means. In other situations the players might have differing or even opposite goals. A player's decisions (or lack of) will usually affect the outcome of both players, and so each player try to anticipate what the other will do and then (re)act the best possible way. All the players are assumed to behave rationally and motivated by self-interest. Depending on assumptions and the conditions of the game, game theory can be used to predict the player's behavior and the outcome of the game. The various combinations of possible payoffs are usually displayed in a payoff matrix.

If a company is responsible for an environmental crisis, the two active players can typically be the company responsible and a regulatory agency acting on behalf of the government (Neves & Sanyal, 1990). The general public can be viewed as an inactive player which, although unable to act on its own, can still influence the game. The public can influence the game by affecting payoffs through boycotts, demonstrations, public outcry, etc. In a game such as the one just depicted, the company may try to minimize its costs of clean-up, while the regulator agency will act on constraints such as budget, respond to public pressure, job safety, etc.

Depending on the severity and nature of the crisis, its consequences may decline, remain constant or increase with time. The same can be said about the costs of a company clean-up or a potential fine. Such costs depend on factors such as whether public scrutiny remains over time, and whether the company and the agency will have to spend resources battling each other in court, etc. Because the players will consider the cost of action now versus the cost of action in the future, it may be preferable for both players to defer. The game may then extend over several periods. Because the cost to the public and the environment itself are not fully incorporated into the players' calculations, the public and the environment might be worse off. The matrix in Table 3-3 is an example outlining how the active players' cost patterns affect the outcome of the game.

Table 3-3: Game theory and environmental crises (adapted from Neves & Sanyal, 1990, p. 209)

		G o v e r n m e n t a g e n c y		
		Rising	Constant	Declining
P l a y e r s	Rising	Early cooperative restoration	Company acts promptly	Company acts promptly
	Constant	Agency is forced to intervene	Indifferent	Company reacts; late restoration
	Declining	Agency is forced to intervene	Company protracts; late resolution	Late or no restoration

3.3.6 ECONOMISM

Huehn (2008) makes a distinction between economics and management; while economics is about the efficient use of resources where effectiveness acts as a constraint, management on the other hand should be about effectiveness with efficiency as the constraint. The economization of management refers in this context to how managers become increasingly concerned with efficiency rather than effectiveness (Huehn, 2008). Due to the mistake of reductionism

policy makers fixated on economic efficiency erroneously assign quantifiable values (usually monetary) to that which either has no market price or has its own intrinsic value which cannot be quantified (Haubrich & Wolff, 2006). Adam Smith (1979, cited in Haubrich & Wolff, 2006, p. 13), through his example of the “water-diamond paradox”, differentiates between the terms “value in use” and “value in exchange”.³⁴ Krutilla (1967, cited in Haubrich & Wolff, 2006, p. 12) claims how nature in addition can have what is deemed “existence value”.³⁵ Haubrich and Wolff (2006) establish a crucial link between these three value types, stating: “economic valuations impose a unitary standard (usually money) on the valuation and comparison of goods and thus subordinate both existence value and use value to the new standard of exchange value” (p. 22). By dissecting “the hardcore hypotheses of economics” (Huehn, 2008, p. 825) eventually makes the conclusion that economism is an unethical ideology. Freeman et al. (2004, cited in Huehn, 2008) says: “Maximizing shareholder value is not a value-neutral theory and contains vast ideological content” (p. 828).

From the literature we thus understand economism to be how efficiency displaces effectiveness as a goal in practical management. Such a development can be related to the phenomenon of “commodification”, as first coined by Marx (1964, cited in Haubrich & Wolff, 2006).

3.3.7 DEONTOLOGICAL ETHICS

Kant’s deontological approach is according to Painter-Morland (2008); “typically described in terms of two basic moral maxims, which he believed to be of such a self evidently reasonable nature that it would secure the acquiescence of all reasonable individuals” (p. 57).

...the first maxim states that a moral decision must always be put to the so-called “universalization test”: Act only on that maxim through which you can at the same time will that it should become a universal law. (...) Kant’s second maxim is formulated as follows: Act in such a way that you always treat humanity, whether in your own person or in the person of any other, never simply as a means to an end, but always at the same time as an end (Painter-Morland, 2008, p. 57-58).

³⁴ Value in use is the utility value of an object, whereas value in exchange is similar to the purchasing power of the object to acquire other goods. The water-diamond paradox is how that which has a high use value (like water) often has a low exchange value, and how that which has a high exchange value (like diamonds) often has a low use value (Smith, 1979, cited in Haubrich & Wolff, 2006, p. 13).

³⁵ Existence value is for example the inherent, unquantifiable value related to preserving the survival of a species (Krutilla, 1967, cited in Haubrich & Wolff, 2006, p. 12).

The first maxim is also known as the categorical imperative. As we can understand from the two maxims, deontological ethics has a non-consequentialist approach. With regards to the second maxim, Vetlesen (2007) says that “this is concerned around our common humanity, about everyone’s duty to safeguard and protect the inviolable intrinsic value (“Würde”) which according to Kant is present in every human person” (Vetlesen, 2007, pp. 21-22).

3.3.8 UTILITARIANISM

Utilitarianism is a moral principle focusing on the results, or consequences of the actions done, and thus a form of consequentialism where the notion of “utility” or usefulness is essential. Utilitarianism is mainly influenced by the thoughts of John Stuart Mill (1806-1873) and Jeremy Bentham (1748-1832). Bentham took the maxim “the best action is the one which secures the greatest happiness to as many as possible” (Magee, 1999, p. 183), and developed this into a moral philosophy which argued that the moral value of an action should entirely be considered from its consequences. Utilitarianism is also known as the greatest happiness principle, telling that morally correct actions are those which create the greatest happiness to the greatest numbers (Magee, 1999, p. 183).

“Utilitarian reasoning allows business practitioners to justify rationally some of the harmful consequences of their actions by simply out-balancing it with other perceived benefits” (Painter-Morland, 2008, p. 53). An example of a real business scenario problem is given by Painter-Morland (2008, p. 53-54) with regards to misrepresentation in financial reporting. Here managers can justify manipulations of financial statements in the sense that it will protect the broader interests (e.g. employees, shareholders), and as long as they later reconcile the reality of the financials linked to their public representations no one needs to suffer. Hence, there is danger of making lying acceptable and even as something good. As a consequence of utilitarianism, stakeholders might sometimes be perceived as no more than faceless abstract entities in manager’s problem analyses.

As understood, what would be considered unethical or immoral from most ethical perspectives could easily be considered ethical or moral from a utilitarian point of view, as long as total utility (welfare) increased. In that way utilitarianism is a flexible ethical theory.

4 FRAME OF REFERENCE

Although ecology and ichthyology are given as separate chapters, some aspects overlap between the chapters. Ecology and ichthyology can be closely related at some areas. For example, a non-anthropocentric approach to environmental ethics (cf. chapter 4.1.6) will have implications for how one perceives fish. Hence, there is a thin borderline between the two chapters.

4.1 ECOLOGY

The origins of the word ecology can be divided into the Greek words *oikos* (i.e. “household”) and *logos* (i.e. “knowledge”). Ecology ranges from individuals to the ecosystem, and Semb-Johansson (1993, p. 15) refer to a hierarchical scheme that increases in complexity; a new step is based upon the previous and simpler one. A typical four step starts out with (1) the *individual*, or an organism, The next step contains (2) the *population*, encompassing individuals of the same species living in the same area. What ecologists refer to as (3) *society* is different from what we usually refer to as society. Society in ecological terminologies contains all the different populations in a specific location. If these specific locations also include the physical-chemical (e.g. sun, clouds, rain) environment in addition to the ecological community, we have (4) an *ecosystem*. Every step is dependent on another (Semb-Johansson, 1993, p. 17).

4.1.1 “CHREMATISTIKE” OR “OIKONOMIA”?

“To Aristotle, there can be too much or too little of nearly everything; too much or too little sunshine for a plant, too much of too little food for an animal, and also, there can be too much or too little wealth for a person” (Dierksmeier & Pirson, 2009, p. 421). In accordance to Aristotle, everything rests on the discrepancy between the two polar divergent orientations of economic pursuits; *oikonomia* and *chrematistike*. Dierksmeier and Pirson (2009) state that this “... is what makes or breaks the individual well-being, the wealth of households, and the welfare of the state” (p. 424). Gaining inspiration from origins of economic philosophy can serve as important contributors understanding ongoing challenges in modern business.

Originated by the word *chrematistikos* (*chremat* – money, gr.), the definitions of *chrematistike* (or chrematistics) within political economy revolves around the management of property and wealth in order to maximize the short-term monetary market value for owners (e.g. own

income, corporate profit or a nation's national income). As Dierksmeier and Pirson (2009) delineate; "Aristotle was fully aware (...) that if one's only goal is to make as much money as possible, a reasonable clear-cut code of conduct can be derived from this premise. (...) To outline a theory of such behavior was precisely what sound economic was *not* about" (p. 418). Instead of easing the process of deriving theories of pure money-making Aristotle fronted the opposite. "His predominant interest (...) was with what rightfully should be considered economics (*oikonomia*): the concern for morally adequate individual and public household management" (Dierksmeier & Pirson, 2009, p. 418). *Oikonomia* derives from *oikos*; "house" and *nomos*; "law", thereby "a house law". From then it can be defined as administration and management of a household for the purpose of increasing the utility value for all members. Bomann-Larsen (1993, p. 192) asserts that very much of the input within the field economy in modern educational institutions seems to lie much closer to chrematistike than *oikonomia*, and therefore we have a world full of chrematistiks and a great lack of economists. Bomann-Larsen (1993) distinguishes between three major differences of chrematistike and *oikonomia*; (1) "short-term vs. long-term (sustainable perspective), (2) ownership-oriented vs. public-oriented (the global perspective) and (3) exchange value vs. utility value (demand-oriented production)" (p. 192). Hence, Aristotle's separation of *Oikonomia* and Chrematistike has many similarities to economism (cf. chapter 3.3.6).

4.1.2 MORE OF EVERYTHING

Eriksen (2001) describes the challenges of exponential growth. You can do three things well simultaneously, or even six things appropriate. Some can even do twelve things acceptable concurrently. But when they get the thirteenth task, they suddenly do thirteen things bad. This is the transition of quantity into quality. Eriksen (2001) affirms that steady growth can take place for quite a while with no dramatic consequences, but suddenly when growth rises to a threshold the system flips into something else. Challenges related to exponential growth patterns, as stated by Eriksen (2001), revolve around how more activities will be increasingly cramped into the same time period. Eriksen (2001) asserts the results of this as; "more and more information, consumption, movement and activity to be pushed into the time you have available, that is relatively constant. (...) When it (i.e. the exponential curve) goes straight into the air, time has ceased to exist" (p. 131). It is obvious that such a growth cannot continue indefinitely.

4.1.3 CONSUMER CAPITALISM AND RESPONSIBILITY

Vetlesen (2009) claims that “consumer capitalism” is within the process of dooming the world. Vetlesen (2009) discusses how human lifestyle changes can be reconciled with liberal values of freedom and individualism, and argues that nature already is bursting upon the upper limits in terms of human consumption. The revolution in natural sciences, from teleological to mechanistic, has managed people and their businesses to expand over the last few hundred years. As a result Vetlesen (2009) asserts that where nature before appeared almighty, wild and untamed, sovereign and independent, it now portrays fragmentary, species by species, resource for resource, subjected to our technology-driven intervention for fulfillment of our needs. Our needs are increasingly changeable and elastic; endless expansive. Furthermore, Vetlesen (2009) discusses how nature has traditionally been superior to man, but that it has today become inferior. The uniqueness of nature, independent and unshaped by human practices; *dominant and obvious*, has become rare and exotic; *threatened and worthy*. The superior and inferior have switched seats. Balance gives way for unbalance. “The power-ratio between natural- and human capital is reversed, causing irreversible and self-reinforcing, yet today barely demonstrable consequences” (Vetlesen, 2009). Humans are what nature needs protection from, in order to remain something different than us, not shaped by us. Yet ironically, Vetlesen (2009) asserts that only humans are able to give this kind of protection. Today’s technology enables us to exploit the natural resources on a scale that involves overutilization; or *overkill*. Hence arises the need for a separate ethical and independent technology-driven limit to what we should harvest from nature. Despite Vetlesen (2009) sees such a need as both research-based and politically correct, he sees major challenges in achieving it, with the reason being that the average consumer has no existential attachment to the problem; it evokes no motivational emotional resonance. Moreover, he points to examples as; “we eat chicken like never before without knowing how it is produced, and bilberries for dessert which are duly plastic wrapped and comes from Chile”. The fact that e.g. bilberries has a long journey is not the main argument, Vetlesen (2009) asserts, but rather the fact that we do not have any experience with processes that take place prior to our perception of the products in the store-shelves. The perception of nature for the majority of us has become abstract because all our everyday needs are covered through high-tech commercial solutions.

Carrigan and Attalla (2001) refer to studies asserting that consumers are interested in ethical behavior beyond those issues that have direct impact on them. But although consumers are getting more sophisticated, Carrigan and Attalla (2001) conclude that this does not necessarily

mean that their purchase patterns favor ethical companies and punish unethical firms. This is backed up by arguments such as that price, value, quality and brand familiarity result in consumers to buy products for personal rather than societal reasons. “Perhaps it is not that consumers do not care, but rather they care more about price, quality and value than corporate ethics” (Boulstridge & Carrigan, 2000; Ulrich & Sarasin, 1995, cited in Carrigan & Attalla, 2001, p. 566). It is thus suggested that difficulties arise when the additional burden of having to trade off ethical information alongside with other factors (e.g. price and quality) becomes too much to deal with for the customers. Moreover, one need to recognize the challenges of inconvenience that may arise, when Cattigan and Attalla (2001) suggest that ethical purchasing will only take place if there are no cost to the consumers (e.g. no added price). On the other hand, Carrigan and Attalla (2001) found a change in consumer patterns if corporate unethical behavior negatively affected the consumer. Cattigan and Attalla (2001) also makes it clear that consumers have little specific knowledge about individual firms and instead perceive ethics on a macro basis in terms of “general” business offenses. Then, in the absence of any clear ethical differentiation among companies, the consumers have limited sources as a basis of their judgments. Thus, the need to more easily be able to compare and contrast ethical behavior of business participants arises. If consumers were better informed on who are performing ethically and not, it may encourage them to exercise greater discrimination when making their purchases. Sproles et al. (1978, cited in Cattigan & Attalla, 2001, p. 571) argue that efficient decision making requires fully informed consumers and although they are informed to some extent on ethical matters they are still not fully informed. In this sense, media is suggested to be the source most people receive their ethical information from, and hence arises the need for ethical companies to communicate more widely their socially responsible behavior.

To go back to Vetlesen (2009), he emphasizes the importance of how we perceive something determines how we deal with it, i.e. for instance whether we accept or reject it consciously or passively. All in all, coupled with the understanding of Cattigan and Attalla (2001) it can be perceived from Vetlsen (2009) that commercial capitalist-driven paternalism may make us immune to criticism of our consumer patterns.

4.1.4 ANTHROPOCENTRIC ENVIRONMENTAL ETHICS

The word anthropocentric derives from the Greek words *anthropos*, which means human and *kentron*, which means centre point (Nyeng, 2011, p. 233). Within environmental ethics the

terminology “intrinsic value” is essential, and rests upon the perception that there is a decisive distinction between humans and nature. From an anthropocentric viewpoint one could say that only humans can be attributed intrinsic value and thereby possess a status which gives moral protection from exploitation (Nyeng, 2011, p. 289). This can be perceived as a somewhat dualistic perspective that does not take into account that humans depend upon nature for other purposes than as a raw material for human consumption. The interpretation can be viewed in the context framed by the modern industrialized society, where the distinction between man and nature enabled humans to subjugate earth.

Stybe (1980) asserts the dualistic approach of René Descartes (1596-1650), distinguishing reality between the two substances; matter and spirit. Moreover, the human body was governed by the laws of nature, but unlike animals, humans were according to Descartes equipped with a spiritual soul. In Descartes opinion, animals were unfree because they lived like machines, understood as they were only performing what their body commanded. Then, freedom is man’s ability to not following his natural instincts, and because of a spiritual soul humans can rise above nature and make free choices.

4.1.5 REIGN NATURE OR MANAGE IT?

We can find evidence in 1st Genesis upon the assumption that man is set to rule nature: Then God said: “Let us make mankind in our image, in our likeness, so that they may rule over the fish in the sea and the birds in the sky, over the livestock and all the wild animals, and over all the creatures that move along the ground” (Genesis 1, 26).

Magee (1999, p. 74) highlights Francis Bacon as among the first ones to recognize that scientific knowledge could give humans power over nature. Science could thus be used to promote human interests and prosperity to an extent it was difficult to imagine. Parallels can be drawn upon Genesis 1, 26 as humans are set to rule over nature, and in this sense Bacon envisaged man to rule over and command a supposedly inexhaustible nature. This was to be done through a systematic approach through observations and by collecting reliable data. In other words, knowledge means power.

4.1.6 NON-ANTHROPOCENTRIC ENVIRONMENTAL ETHICS

Compared to anthropocentric ethics, a non-anthropocentric ethical approach tells us that nature and animals also possess intrinsic value (Nyeng, 2011, p. 233), and thus also are to be

provided with moral shelter.³⁶ However, Nyeng (2011, p. 233) says such an ethical approach may still have room for a classification of higher and lower beings, according to the level of their consciousness. In other words, the interests of some beings may be perceived more “worthy” than others.

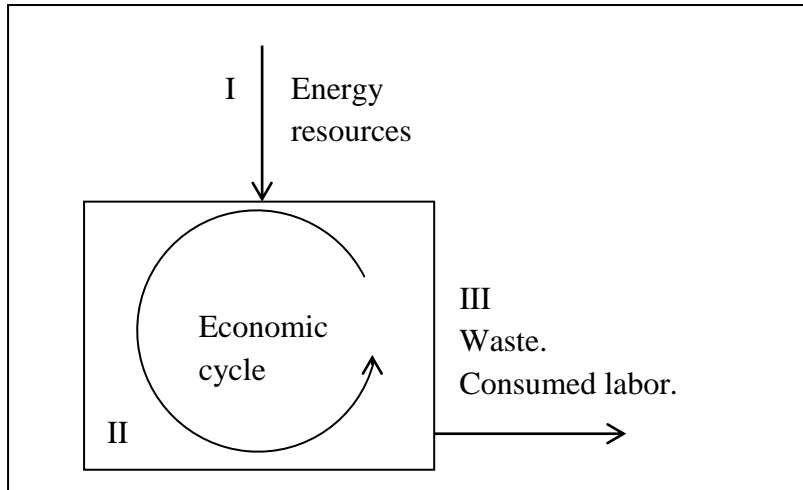
Arne Næss defends the belief that the absolute distinction between man and nature cannot be sustained. Man is part of nature, and nature is part of man. Næss (1976) argues for a holistic view on nature that requires nature to possess an equal and balanced intrinsic ethical value. In this context he finds reason for a certain self-fulfillment to elucidate the relationship between humans and the entire environment we attend. Here, human self-fulfillment also depends on recognition of the overall context we are part of. Human’s traditional desire-oriented self-fulfillment depends on the welfare of all of our surroundings. The self is therefore a part of a larger community, where the contradiction between what is one’s self and not is less decisive. We can also draw parallels of non-anthropocentric environmental ethics to animal ethics, where it is argued for animal’s inherent value, and, like Næss (1976) states, the importance of not inflicting other living beings unnecessary suffering.

4.1.7 DEEP ECOLOGY

According to deep ecology all living beings have unalterable value, with the same right to live (Nyeng, 2011, p. 231). Furthermore, humanity is just a small part of nature. The intrinsic value of all living beings is independent of whatever instrumental utility they might provide in covering human needs. Another keyword in deep ecology is interdependence. With regards to interdependence, Figure 4-1 illustrates an important concept in deep ecology, namely that of the difference between closed and open systems. While all economical systems in principle are open because they rely on external inputs and produce external output, many economic systems takes the external factors for granted, and thus operate as if they were closed (Skønberg, 1975, p. 95). A system ignoring the external affects might not be sustainable in the long run. Deep ecology is holistic in the sense that, from the perspective of Figure 4-1, there needs to be a balance between what happens in the economic cycle and the external input and output. Maximizing the processes within the economic cycle should not be undertaken before balance is achieved by first considering the external constraints. In our understanding of Skønberg (1975), arriving at this true, fully open system is an important part in deep ecology.

³⁶ Hence we can understand that “intrinsic value” in this sense is closely related to what was called “existence value” in the discussion related to economism (cf. chapter 3.3.6).

Figure 4-1: The relationship between deep ecology and open and closed systems (adapted from Skønberg, 1975, p. 95)



Interconnectedness is an important point in deep ecology. This can relate to how people identify with their surroundings. Næss (1976, p. 275) exemplifies degrees of identification through a person who discover an injured butterfly vs. an injured blood-leech. The person might feel pain as if the person was identical with the butterfly, while on the other hand he or she displays pleasure seeing the “disgusting” blood-leech. Hence, we can then find identification with the butterfly and lack of identification with the blood-leech. The degree of interaction is important because the butterfly’s beauty is perceived and admired but rarely anything more. From the literature we understand deep ecology to be identifying with all of nature and appreciate its inner qualities rather than measuring its worth in terms of their instrumental value.

Næss (1976, p. 267) states that all beings have intrinsic value on the basis of simply being alive. Næss’ (1976) deep ecology goes further than the non-anthropocentric environmental ethics approach when it comes to value perception, as Næss (1976) rejects the notion that some beings may have more worth than others. “The right of life for self-expression is universal and cannot be quantified” (Næss, 1976, p. 266). Furthermore, Næss (1976) raises concerns that man’s intervention into nature is excessive and destructive.

4.1.8 SUSTAINABLE DEVELOPMENT

Bomann-Larsen (1993, p. 201-202) expresses the need for a deeper ecological understanding of traditional environmental economic thinking. Traditional environmental economic thinking is characterized using cost-benefit analyses based upon the simple premise that the rational approach of making economic choices is to compare the benefits and costs of alternative actions, often measured by examining the willingness to pay. Bomann-Larsen (1993) raises two fundamental objections against the traditional environmental economic thinking;

First, people far away, especially unborn relatives, are not included in the group who get the opportunity to describe how much they value environment. (...) Second, this thinking is anthropocentric, where nature is only added value to the extent it is perceived as useful to humans (p. 202).

Hence, a sustainable economy presupposes a profound holistic ecological understanding anchored in an ecocentric and biocentric fundament. This is to be understood in relation to the non-anthropocentric perspectives where intrinsic value is completely independent of the usefulness to humans.

On the contrary, the principle; sustainable development, led by the Brundtland Commission, includes future generations interest, stating; “Sustainable development is development that meets the need of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987). Despite the inclusion of future generations, this definition requires that we hold an absolute knowledge and can predict the future needs. While the definition still provides a basis for designing a specific economic policy, Bomann-Larsen (1993, p. 202) emphasizes lack of a holistic approach as it has a clear anthropocentric approach. This because it outlines the value of the environment related to human benefit. However, the definition does not define human benefit in an economic perspective as the traditional environmental economics approach does. In this sense we can draw lines back to the willingness to pay and relate it to an estimation of how much the future generations’ will value the environment. Bomann-Larsen (1993) claims it just simply recognizes that the unborn generations probably want to protect the environment and the ones living now therefore have an obligation to give them the opportunity to enjoy and appreciate it. Pleasure should be understood in a broader context beyond mere resource exploitation, as pleasure and joy can also come from nature’s diversity and beauty. With the perception that sustainable development involves no environmental capacity-reduction over time, it is in line with the following idea stated of Bomann-Larsen (1993); “We do not inherit earth from our parents, we borrow it from our children” (p. 202).

4.1.9 TRAGEDY OF THE COMMONS

The tragedy of the commons raises important considerations within the intersection between economic actions and natural resources. “When economic actors act solely with their own interests in mind, they are in many situations in danger of creating an overall result which is

less publicly rational, including for themselves, than what had been the case if they somehow had coordinated their actions” (Nyeng, 2011, p. 236). The ideas of Hardin (1968) portray the tragedy of the commons when claiming self-interest will lead to disaster for the group as a whole.

The tragedy of the commons contradicts e.g. the proposals of Adam Smith (1723-1790), where economic decisions to a greater extent should be left in the hands of individual citizens and separate businesses. The idea of Smith (1776) is to utilize each individual’s own interest as the economic drive force and then enable the wealth of nations to grow faster and in a more efficient manner than by political control. Then the following question arises: How can we ensure that people behave in a manner that lead to society’s best interests? Challenges arise when the “invisible hand” of Smith (1776) does not work properly, when the actions of the private actors are not in the societies’ best interests. “What we are talking about is situations where the individual rationality results in collective irrationality” (Nyeng, 2011, p. 236). Thus, the need of some kind of public regulative arises to prevent depletion of natural capital, as no technological inventions can solve it if it first happens. In this sense, Hardin (1968) claims state control as the only solution.

4.2 ICHTHYOLOGY

“The fact that fish are cold-blooded, lives in a human foreign element, in our perspective has a divergent and quite weird body shape, with rigid, staring eyes and a gaping, expressionless face, makes it difficult for us to perceive them from “within”, from the fish’s own world” (Børresen, 2007, p. 9). Almost nothing in the fish’s appearance and behavior can be a social trigger for people, and because of the fish’ low “Bambi-factor” (also reinforced by schooling when the amount enhances the problem), Børresen (2007, p. 57) claims individual meetings with “mutual greeting” are practically excluded between fish and people.

To be able to have clear thoughts about each and one of us’ wonders about encounters between people and fish (e.g. like general fish lovers, wildlife advocates, anglers and fish-gourmets, those who have aquarium in the living room, or work in the fishing industry and do research), Børresen (2007, p. 11) claims the necessity of having a true and realistic idea of what fish are in addition to understanding the human role in the relationship. Questions often look like: “What does the fish think and feel?”; “Is the little fish brain really sufficient for mental processes?” From these questions a range of dogmas has arose, or what Børresen

(2007) tags anthropocentric dogmas of fish, that must be critically evaluated from an ichthyocentric (*ichthÿs*, gr. for fish) viewpoint; further stating:

If we take into account that fish has had several hundred million years to develop a biochemistry and physiology specially designed for temperature conditions in the water, and also has a very rich and varied sensory device tailored to the environment in which each fish species live in, we must therefore be open for fish to have as much “awareness” and “thoughts” as land based animals. (...) And nature, which is always rationally constructed, would never have developed fish’s varied senses if the fish brain could not translate all the information into action useful for the animal. The fish must perform actions in accordance with previous experiences i.e. the fish has a need to remember, learn, assess, and think. (...)... according to researchers working with the fish brain, it is more than adequate enough for “cognitive activity” (p. 9; 65).

Børresen (2007, p. 12) states that the scientific methods and knowledge have changed dramatically in recent decades, where huge gaps have ascended from Descartes’ view of animals as soulless machines compared to today’s pioneers with new scientific methodology, combining evolutionary thinking and objective facts with physical technology. Since Descartes’ disciples hold tight to the perception that humans are alone among spiritual qualities, they have learned to create distance by e.g. providing animals with numbers instead of names. This is part of the process in creating distance, aimed at keeping the emotional switch OFF in situations where it should be kept ON in order to trigger physical empathy. Related to the impression that fish certainly appears to have a wide range of exciting and hitherto unknown abilities, Børresen (2007) raises the questions: “Why haven’t we seen and understood this before? What is it about humans that make it so difficult to perceive strange creatures the way they are? We lack neither intelligence nor perception abilities” (p. 23). Since many have struggled with this problem for years, Børresen (2007, p. 23) relate this difficulty to humans innate instincts and emotions.

4.2.1 PREDATOR NON-EMOTIONALITY

Behavioral theorist, Eibl-Eibesfeldt (1971, cited in Børresen, 2007, p. 37) talks about “turning off” compassion/empathy with one’s opponent. Thus, one can see the center for “*predator non-emotionality*” in the hypothalamus as a kind of master-switch that turns off all social

emotions during the hunt, and turns them back on afterwards.³⁷ When the switch is in OFF-position, an otherwise thoughtful man, without blinking, shoots a moose or a grouse, cooks lobster, or is unconcerned fighting for an hour with a huge salmon on the hook. Like Børresen (2007, p. 37), we can draw an analogy to Arne Næss, that like all other animals and humans, had a social switch in the common brain hypothalamus. He had his switch ON when he with great passion studied the movements of small fish in the stream, but was unable to turn it OFF when he sat in the boat with fishing lures. It repelled him to kill fish, but at the grocery store he bought a can of meatballs. In this situation, the predator non-emotionality came to his aid because there was a long time since his dinner of the day had been a cow and a pig. He did not think of his indirect role of the animal's death, and as Børresen (2007) states; "until afterwards, when he became a philosopher" (p. 111).

Then the dilemma of whether or not to become a vegetarian, and thus allow other beings to live on, just as you yourself would like to live on, also arises. There is often a distinction between health and ethical considerations upon becoming a vegetarian. A survey of Fox and Ward (2008, p. 423) describes that ethical vegetarians considered their own practices fundamentally altruistic and involved personal sacrifice in order to prevent cruelty to animals. Lindeman and Sirelius (2001, cited in Fox & Ward, 2008, p. 423) suggest the ideological basis of ethical vegetarianism to be broadly associated with humanistic commitments. "Vegans avoid animal products for food, clothing or other purposes, while *lacto-ovo* vegetarians consume dairy produce and eggs..." (Phillips, 2005; Willetts, 1997, cited in Fox & Ward, 2008, p. 422). Some vegetarians however, claim; "I don't eat meat, only fish and vegetables". Unless founded in health concerns, these *pesco*-vegetarians are clearly distinguishing between terrestrial animals and fish, i.e. one is accepting a therocentric but at the same time neglecting or being ignorant of an ichthyocentric perspective. In other words, this might be the same as perceiving fish as soulless machines unable to be mistreated by humans, while at the same time accepting that terrestrial animals can suffer. The results of the survey of Fox and Ward (2008) showed that health and the ethical treatment of animals were the main motivators behind becoming a vegetarian, whereas environmental concerns was also widely reported but rarely the only reason behind.

³⁷ "The prey is neither friend nor foe. It is food. Therefore, hunter aggression has been designated the term non-affective aggression, and its brain center is found at a separate location in the *hypothalamus*, a little to the side of the affective-aggression. Evolutionary historically, this form of aggression is designed for interaction across species boundaries, not within the species, but between species" (Børresen, 2007, p. 36).

4.2.2 FROM AN ANTHROPOCENTRIC TO A THEROCENTRIC ATTITUDE

As humans are born human-centered, or anthropocentric, Børresen (2007, p. 56) asserts that an anthropocentric researcher is a person who, in his aversion of anthropomorphism, without knowing it is being controlled by innate emotions/instincts, and unconsciously require the same features that exist in humans (e.g. facial expressions, language, behavior and problem solving) from the animals in order for the latter to be considered as anything more than a machine.³⁸

Emmanuel Lévinas (1906-1995) has contributed to discovering the importance of “the face”. Lévinas portrays the other’s face as the fundamental portal into recognition of the humanity of others. It begins with the ability to perceive and be able to recognize others as unique as well as recognizing “the other” as similar to me. In his work of 1963; “Difficult Freedom”, later translated, Lévinas (1990) states;

The face is not the mere assemblage of a nose, a forehead, eyes etc.; it is all that, of course, but takes on the meaning of a face through the new dimension it opens up in the perception of a being. Through the face, the being is not only enclosed in its form and offered to the hand, it is also open, establishing itself in depth and, in this opening, presenting itself somehow in a personal way (p. 8).

Although Lévinas’ (1990) concept of the face was originally meant for how humans relate to each other, many humans can obviously easily relate to the “face” of their pets, and since fish also are living beings, it can be argued that they also have a face which deserves consideration. But it seems our instincts may make this difficult. Hence personal reflection is important in this regard.

The idea of a *therocentric* (*theros*, gr. for animal) view is to perceive the world from an animal’s standpoint. Such a researcher does whatever he can to step aside from his human-centered perception, his “anthropocenter”, and this is what Børresen (2007, p. 55) calls *physical empathy*.

According to Børresen (2007, p. 56), a therocentric approach requires a two-step maneuver;

³⁸ “... a lion is *leocentric*, a wolf is *canocentric*...” (Børresen, 2007, p. 55).

- (1) Researchers must recognize that humans have an innate emotional master switch that can create an impenetrable mental barrier against other species, unaffected by facts.
- (2) One must decide to override the automatic switch and consciously use both one's intellect and empathy.

When one uses the logic and objectivity of the OFF position, and combine it with the sensitivity of the ON position, Børresen (2007) states we can finally credit ourselves for a skill that we are certainly alone of: "A human is probably the only animal that has the ability to decide to create empathy across species boundaries by means of knowledge and thought" (p. 56). Advocates of the anthropocentric dogmas, may then, according to Børresen (2007), block themselves from developing perhaps the only thing that is distinctive of mankind.

4.2.3 HOSTS; FROM EGG TO SLAUGHTER

When fish swim freely, people and fish usually meet during catch, i.e. humans intervene at hunting stage when the fish is killed and eaten. In this situation humans are showing a predatory non-emotionality where the fish is normally in a defensive situation. Furthermore, if we keep fish in aquariums as a hobby, for research or in large sea cages for industrial farming, chronic predator non-emotionality is no longer adequate, as humans have then acquired full control of the fish's total life cycle from egg to slaughter. As for the transition to animal husbandry ten thousand years ago, Børresen (2007, pp. 112-113) claims man has now become "hosts" for the fish, with a responsibility for their lifelong welfare. Hence, this necessitates the need for empathy for the "guest" in all interactions.

4.2.4 BLINDNESS OF OUR POWER

As argued by Børresen (2007), our first condition for finding new ways to interact with production animals is to realize that our built-in social master switch does not have a position that suits our total power over the lives of others. Emphasized by Børresen (2007), the great challenge is not our power over the animal's death. All living beings are somewhere in the food chain and the most common way to die is to be killed and eaten. Hence, every individual on earth has to kill every day to live, whether we kill animals or plant. Even vegetarians kill animals indirectly and Børresen (2007) asserts; "If you plow up a little field, around 300 field mice and gophers die, which have a greater genetic similarity with humans than dogs and horses, and therefore should have had a much higher Bambi-factor" (p. 114).

To germinate, hatch or be born, live short or long, then become food for other organisms, is to participate in “the great dance of life”. We cannot sneak out. We need to dance, but we can dance reluctantly or with relish. Respect for life means respecting death as a necessary step in this dance. The challenge is therefore to what extent we prevent others to dance within, i.e. how we handle the life cycle of the animals in our “custody” (Børresen, 2007, p. 114).

By looking deeper into the world of fish psychology and physiology we can get a deeper understanding of the ichthyocentric approach, which obviously challenges the basket of fish related dogmas. These dogmas are confronting the perception of fish as sentient beings.

4.2.5 HOW FISH ARE ATTENDING THE MORAL CIRCLE

Experience of pain and pleasure, key aspects of sentience, has played a major role in Western society and is a commonly perceived factor or criteria for moral status of an animal. The idea that suffering capacity is morally relevant regardless of species was according to Lund et al. (2007, p. 111) first launched among western philosophers during the 18th century. “Although different schools of ethics have spelled out different types of arguments why animals should (or should not) be morally considered, most current animal ethicists use sentience as a demarcation line for ascribing direct moral consideration” (Lund et al., 2007, p. 111). Sentience is also recognized among utilitarian philosophies and Peter Singer has supported the view that sentience rather than species should decide whether individuals are to be included in the moral circle. If non-human animals are sentient, their welfare, according to Singer (1990, interpreted in Lund et al., 2007, p. 111), must be included along with the welfare of other sentient beings, humans and nonhumans alike in the evaluation of the consequences of any production practice. Thus, from a utilitarian perspective humans have a responsibility to balance the burdens and benefits of all sentient individuals affected by an action and Lund et al. (2007) continues the reasoning stating; “if fish are sentient, humans would have a responsibility to at least consider their welfare (or other interests) seriously” (p. 111). Lund et al. (2007, p. 112) claim that sentience is the least common denominator for inclusion in the moral community, and entities that do not possess sentience cannot be given moral interests or welfare (i.e. things cannot end better or worse for them without this property). A rock for example has no pain and consequently has no welfare. On the contrary, as a human child can feel pain or is sentient – he or she does have welfare. Some authors however claim that higher order consciousness (i.e. awareness of “self”) is a requirement to consciously experience pain.

“Thought about thought” is referred to a second order representation of a mental state and self-awareness is often correlated to it. On behalf of this, Rose (2002, interpreted in Lund et al., 2007, p. 113) claims dubiousness whether animals other than primates can feel pain. On the contrary, self-awareness evolves gradually in early childhood, but few will argue that an infant does not feel pain, and Lund et al. (2007, p. 112) then put forward;

1. If a being is sentient, then it deserves serious moral consideration.
2. Fish are likely to be sentient.
3. Therefore, fish deserve serious moral consideration.

The first point articulates normative ethics while the second is relying on empirical evidence. Both physiological and ethological observations shed lights over the arguments and judgments of fish sentience. As a part of the anthropocentric dogmas arisen in the shade of Descartes’ early accounts, we would like to highlight some areas of particular interests related to ichthyology.

4.2.6 STRESS AND PAIN

Cortisol measurements are generally perceived as a method of indicating stress responses in fish (see e.g. Fast et al., 2008). In addition, the study of Fast et al. (2008) show a clear pattern of how repeated handling (e.g. transportation of living fish) causes stress and subsequently a negative influence on the immune system. Zimmerman (1986, cited in Sneddon, 2003) proposes a commonly used definition of pain;

...an adverse sensory experience that is caused by a stimulus that can or potentially could cause tissue damage; this experience should elicit protective motor (move away from stimulus) and vegetative reactions (e.g. inflammation and cardiovascular responses) and should also have an adverse effect on the animal’s general behavior (e.g. cessation of normal behaviors (p. 154).

Chandroo, Duncan and Moccia (2004, p. 233) claim limited quantities of data have caused erroneous subjective conclusions about the existence of pain perception in fish, and they suggest that pain in fish may be experienced in ways similar to tetrapods. Earlier examinations of neurological, pharmacological and behavioral traits give evidence of pain perception in fish, and the problem is restated by Gregory (1999, cited in Chandroo, Duncan & Moccia, 2004); “...the appropriate question appears not to be *do fish feel pain?*, but rather, *what types of pain*

do fish experience?” (p. 233). In order to prove pain perception however, Sneddon (2003, p. 153) claims that it must be confirmed that an animal’s behavior is adversely affected by a potentially painful event and that this must not be a reflex response. Through administering a noxious chemical to fish’s lips the study of Sneddon (2003) demonstrated adverse behavioral and physiological consequences in response to a noxious, potential painful event. They used acetic acid and bee venom as stimuli since they induce irritation and inflammation in mammals. In the experiment Sneddon (2003) found that fish behaved normally after morphine administration. The clear association of a painkiller with the disappearance of pain-related behavior certainly demonstrates that fish are affected by nociceptive stimuli.³⁹

4.2.7 CONCEPTS OF FISH WELFARE

Volpato, de-Freitas and de-Castilho (2007) defines fish welfare as; “the internal state of a fish when it remains under conditions that were freely chosen” (p. 170). Instead of searching for physiological standards of fish welfare, the idea of setting up experiments where fish itself can show its preferences arises. Since the amount of results makes it increasingly likely that fish are similar to other vertebrates it is according to some scholars most ethically to assume that fish are conscious beings. “Despite the increasing amount of availability of such knowledge there are professionals who continue to insist that it is an anthropomorphic mistake assuming that fish can “suffer” as land animals seems to do” (Rose, 2007, cited in Børresen, 2007, p 115). Since empirical science is unable to objectively determine whether fish are sentient beings, Volpato, de-Freitas and de-Castilho (2007, p. 170) argue for ethical concerns to take the lead on assuming that fish are conscious beings and thus may suffer or be in discomfort if treated improperly.

4.2.8 ANIMAL WELFARE INCLUDING FISH

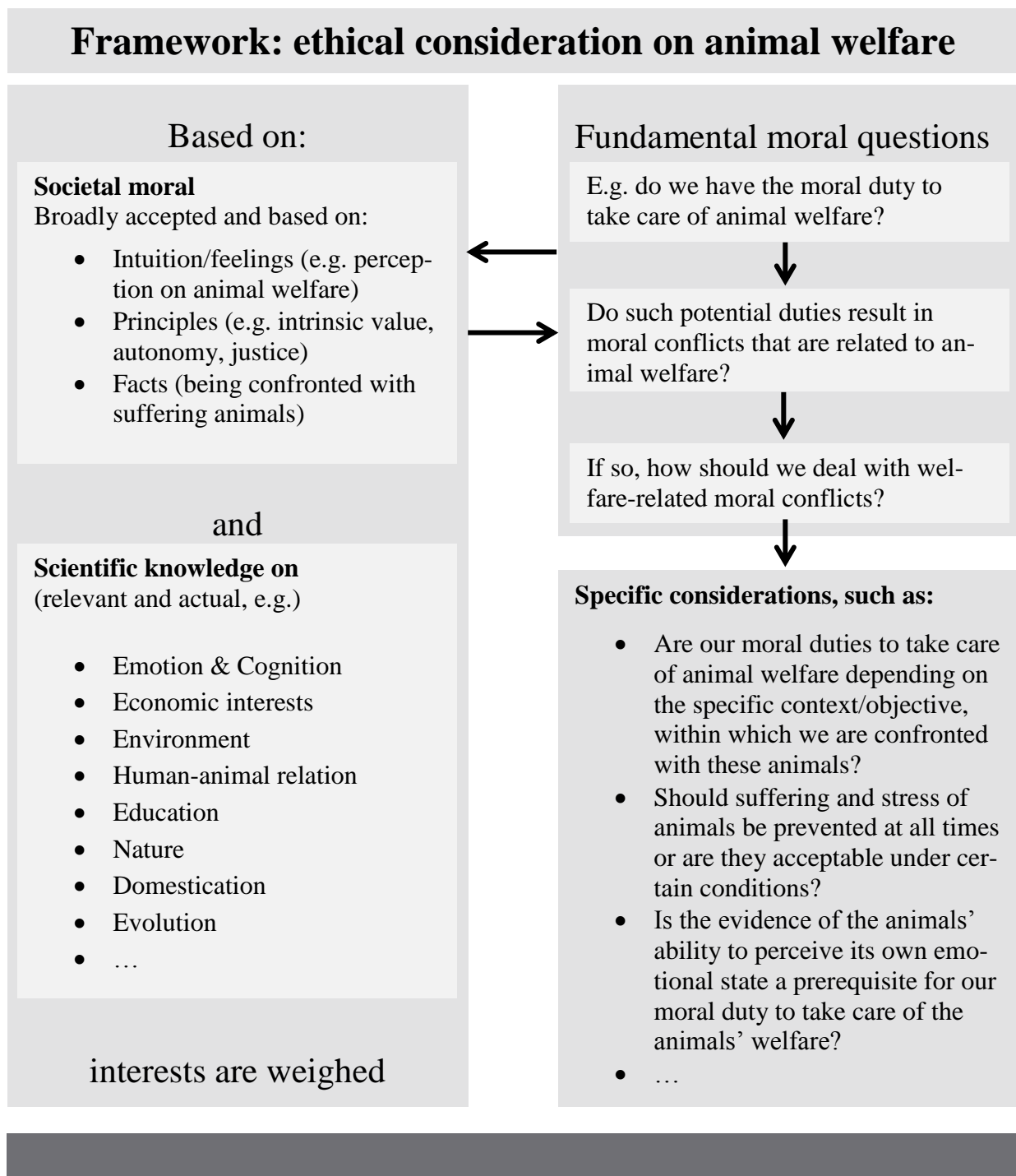
There is no consensus related to how to measure the welfare status of an animal objectively as well as welfare implications associated with management practices. Every definition of animal welfare is influenced by the societies’ standards of morality and ethics, and Ohl and van der Staay (2012) assert that “we must therefore recognize that objectivity in analysis cedes inevitably to the subjectivity of ethical assessment when determining whether a welfare status is or is not “acceptable” to society” (p. 13). Norwegian authorities for example, which manag-

³⁹ Nociception (Latin *nocēre*, to hurt); “A perception of pain through the sensory receptors capable of detecting potentially damaging stimulus” (Biology Online, 2010).

es one of the largest fish economies in the world, have understood that knowledge of fish characteristics and needs is necessary to treat fish in an ethical manner. This has resulted in incorporating farmed fish under the Animal Welfare Act (see e.g. Børresen, 2007). This thus means that governmental advisors must have an ichthyocentric attitude. Ohl and van der Staay (2012, p. 13) proclaims that the political relevance of animal welfare is strongly based on societal concerns about how animals are treated, and regardless of a society's view on the importance of animal welfare the interpretation and moral evaluation of what constitutes welfare (e.g. welfare problems) differs between cultures, regions, time, and individuals. A refined demonstration of the Dutch Animal Welfare Council's ethical framework from 2010 is presented by Ohl and van der Staay (2012, p. 14) and is portrayed in Figure 4-2, where the aim is to structure discussions about the ethics of current and possible future animal welfare issues. The discussions should cover our obligations from a moral perspective in any given situation, identify relevant ethical issues (i.e. related to animal welfare), and outline the steps that need to be taken to resolve these issues.

It should be clear that such a framework is intended to identify relevant ethical issues and potential moral dilemmas rather than to yield straightforward solutions. Furthermore, the results of these considerations will not be universally valid but will differ significantly between societies. The importance of such a framework is that it provides a basis for discussion on animal welfare within a given society (Ohl & van der Staay, 2012, p. 14).

Figure 4-2: The Dutch Animal Welfare Council's ethical framework from 2010 (adapted from Ohl & van der Staay, 2012, p. 14)



5 METHODOLOGY

5.1 RESEARCH DESIGN

Our study will be exploratory and descriptive. Exploratory studies are well suited to find out “what is happening; to seek new insights; to ask questions and to assess phenomena in a new light” (Robson, 2002, cited in Saunders, Lewis & Thornhill, 2009, p. 139). Exploratory research can be compared to the activities of an explorer (Adams & Schvaneveldt, 1991, cited in Saunders, Lewis & Thornhill, 2009). The researcher should be flexible and willing to change direction as new data and insights occur. It should be noted however, that the flexibility inherent in exploratory research does not mean an arbitrary pursuit of directions. Rather, it may mean that one’s focus is initially broad and becomes increasingly narrower as the research progresses.

This thesis is exploratory in the sense that we develop our own framework and models to be used in the empirical analysis. The models were devised, revised and updated as our research progressed. According to Saunders, Lewis and Thornhill (2009) “a search of the literature” is one of the three main ways to conduct exploratory research (p. 140). Before we could develop our models, we had to gain an understanding of what the problems and challenges pertaining to the fish farming industry are. Our initial search of the literature thus became the context chapter. Armed with this new understanding we coupled it with the theories of Mitroff (1998), and a literature review of ecology and ichthyology, to formulate a proper problem context and thus arrive at a proper model. The end result is the Fish Farm Ecology (FFE) model (cf. chapter 6). As we worked on the model, we continually adapted it in light of new information, and explored new ideas. Some concepts which initially seemed good were later abandoned. Our focus while developing the model was practical value combined with simplicity, as we think this is a requirement to make sure the framework can be used.

The context chapter is the single largest chapter in this thesis. In addition to being important for the model development, this chapter also provides the setting in which the CSR activities of Marine Harvest and Cermaq will be evaluated against. The empirical analysis seeks to describe how the broader perceptions of CSR and the subsequent CSR performances of Marine Harvest and Cermaq within the five context areas are linked to Fish Farm Ecology. This “how” is the link between the exploratory and descriptive part within our study. The purpose of descriptive research is, as stated by Robson (2002, cited in Saunders, Lewis & Thornhill,

2009), “to portray an accurate profile of persons, events or situations” (p. 140). As Saunders, Lewis and Thornhill (2009) further states: “This (i.e. descriptive research) may be an extension of, (...), a piece of exploratory research, or more often, a piece of explanatory research” (p. 140).

Overall, we feel that the exploratory and descriptive parts of our study complement each other. In a way, one could say that the descriptive part starts where the exploratory part ends. The descriptive part of the study is covered through the empirical analysis, which will be done and based on the models previously developed. The empirical analysis represents only “one half” of the thesis in that respect, as the other half is exploratory work related to developing the conceptual framework.

5.2 RESEARCH METHOD

This thesis is primarily qualitative. While we do look at quantitative data in terms of financial performance indicators from annual reports, in addition to reviewing statistics related to profitability of the fish farming industry in general, the main focus is on qualitative model-building and qualitative analyses based on said models. All primary data collection is qualitative in nature. Throughout the work of Saunders, Lewis and Thornhill (2009) it is the form of data collection which decides whether a method is considered qualitative, quantitative or multiple. As Saunders, Lewis and Thornhill (2009, p. 151) states, to give one example: “qualitative data is used predominantly as a synonym for any data collection technique (...) that generates or use non-numerical data”. We will adhere to this classification. For all practical purposes, our research method can therefore be considered qualitative.

5.3 RESEARCH APPROACH

According to Saunders, Lewis and Thornhill (2009) there are two main research approaches, namely the deductive and the inductive approach. It is also possible to combine these two. This thesis has emphasis on induction. There are several characteristics of the inductive approach. It is usually associated with the collection of qualitative data, and emphasizes a “close understanding of the research context” (Saunders, Lewis & Thornhill, 2009, p. 127). It is also recognized for having a flexible structure which permits changes in research emphasis as the research progresses. In this way the inductive approach is related to the exploratory part of our study.

Whereas deduction is about testing theory, induction is about building theory. The goal of the inductive approach is to increase the researcher's understanding of the phenomenon in question. There is no need to deduce a hypothesis first, nor appropriate to try and construct a cause-effect link when one's initial understanding of the research area is limited.

The work with the thesis started out by learning about the context of fish farming. More specifically, we looked at fish feed, sea cages, escaping, sea louse and the slaughter process. Doing this first was necessary to give us an understanding of the issues, challenges and problems with regards to fish farming. The objective in this phase was to acquire as much relevant information as possible, i.e. understand the basics of fish farming from an ecological and ichthyological viewpoint. We then used this knowledge to build the conceptual framework we intend to use in our analyses. This kind of approach fits well that of induction, as our work has been a learning process from the beginning. As we gained more understanding of our research topic, we revised it and adapted our further outlook to match it.

5.4 CASE STUDY

When comparing case studies with other investigation strategies one need to carefully discover it in its interaction with the research question. Yin (1994) expands the appraisal by adding the importance of; “the extent of control an investigator has over actual behavioral events, and the degree of focus on contemporary as opposed to historical events” (p. 4). From the range of alternatives (e.g. experiment, survey, archival analysis, history and case study) presented by Yin (1994, p. 6), the case study has considerable ability to generate answers to “how” and “why” questions. Robson (2002, cited in Saunders, Lewis & Thornhill, 2009) defines case study as; “strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence” (pp. 145-146). Yin (1994, p. 13) also emphasizes the importance of context where the boundaries between the phenomenon subjected to the studies and the context it is studied in are not clearly evident. Hence, one uses the case study method intentionally to evaluate contextual conditions. Similar thoughts are presented by Morris and Wood (1991, cited in Saunders, Lewis & Thornhill, 2009, p. 146), stating that a case study strategy is highly applicable when one attempts to acquire a richer understanding of the context of the research as well as within the endorsed process.

Our descriptive research area seeks to answer how the broader perceptions of CSR and the subsequent CSR performance related to the contextual field (cf. fish feed, sea cages, escaping, sea lice and the slaughter process) of Marine Harvest and Cermaq is linked to fish farm ecology. The scope is immersed within the basis of how and seeks to understand the performance in a descriptive structure and subsequent fits case study (cf. Yin, 1994). Equally, our research does not require control over behavioral events since we wish to enable a deeper understanding of the patterns as they are presented by the two companies. As stated by Yin (1994, p. 8), a case study is preferred in situations where the goal is to examine contemporary events and when these events are not manipulable.

On the contrary, Yin (1994, p. 9-10) proclaims some common prejudices against the case study strategy that needs consideration. First there is the possibility of sloppiness of the case study investigator that leads to equivocal evidence or bias possibly affecting the findings. As an answer to this concern we took notes from all our personal interviews. With regards to Marine Harvest and Cermaq an account was made and sent back to the companies the same day as the interviews took place. The representatives could then restate and clarify potential misunderstandings and ambiguities. Whereas Cermaq responded the following day, Marine Harvest responded less than one week before the stipulated hand-in date of this thesis (cf. chapter 5.6.1).

A second concern a case researcher must be aware of in relation to case studies is the basis for scientific generalization. Yin (1994) states case studies are generalizable to theoretical propositions and not to populations and universes; “case study (...) does not represent a “sample”, and the investigator’s goal is to expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization)” (p. 10). Our analysis will not present any statistical generalization as we try to discover two companies’ performance in a qualitative sphere. Our analysis falls into the category of analytical generalization in the scene of placing empirical findings in a theoretical conception. In this sense, our findings will be a contribution to the theoretical spectrum.

5.4.1 SINGLE VS. MULTIPLE CASE AND HOLISTIC VS. EMBEDDED CASE

A common distinction in designing case studies is the rationale between single and multiple (e.g. Yin, 1994). A single case is often favored when represented upon a critical, extreme or a unique case providing an opportunity to watch and study a phenomenon few previously have

deliberated (Yin, 1994). The foundation behind choosing a multiple case study (more than one case) is discussed by Yin (1994), where there are some thoughts of why it is preferable. Herriott and Firestone (1983, cited in Yin, 1994, p. 45) for example, claim the evidence for multiple cases to be more compelling and that it will increase the robustness of the overall study. Yin (1994, p. 45-50) further states the necessity of replication instead of sampling logic related to choosing a multiple case design. In this sense, each case must be carefully selected in order to achieve either a literal replication (predicts similar results; e.g. two or three cases) or a theoretical replication (yielding contrasting results but for foreseeable reasons; e.g. six to ten cases).

The second dimension of Yin (1994) is related to the unit of analysis, where a holistic case study is concerning the one who seeks to do a research with the organization as a whole. On the other hand, a research differentiating among e.g. logical sub-units within an organization, will inevitably involve more than one unit of analysis and is what Yin (1994) classifies as an embedded case study.

5.4.2 OUR APPROACH

From the four alternatives generated from the two dimensions of Yin (1994), our approach fits within the combination of a multiple-holistic case study. First of all, we seek to make a comparative study of the two companies Marine Harvest and Cermaq, which is clearly a multiple strategy. The comparative study is thus regarded as a literal replication. The companies, both registered at Oslo Stock Exchange, give reasonable indication of similarities (e.g. revenue, harvesting volume, no. of employees). As we seek to gain knowledge of the companies as a whole, a holistic approach is reasonable. Consequently, we end up with a multiple-holistic strategy.

The reason we chose Marine Harvest and Cermaq as our case studies rested on the following criteria: size, different ownership structures and degree of backwards integration in the value chain. With respect to size, both companies are international players and industry leaders within salmon farming. Both companies are also Norwegian, with their headquarters in Norway. Regarding ownership structure, the largest shareholder in Marine Harvest is John Fredriksen, who through his Geveran Trading Co. Ltd. controls almost 21,3 % of the shares as of 31.12.2011 (Marine Harvest, 2012a). Cermaq on the other hand has the Norwegian state as the major shareholder, with nearly 45 % of the shares. We find this private vs. public owner-

ship structure interesting as there might be different ownership values in place. Cermaq is backwards integrated in the sense that they fully own EWOS, which is a fish feed manufacturer. Since fish feed is one of the five context areas in our study, it can be interesting to see if backwards integration makes any difference in this regard.

5.5 TIME HORIZON

Evaluating the CSR practice of Marine Harvest and Cermaq from a year to year perspective would constitute far too much work, especially when taking into account that we have developed our own model, which has already been a considerable workload. Due to time constraints and practicality, our analysis is therefore more cross-sectional. Our analysis will be based on what Marine Harvest and Cermaq are currently doing, i.e. some sort of a general “snapshot” of their practice today.

5.6 THE INTERVIEW PROCESS AND TYPE OF DATA

Our primary data source has been semi-structured interviews. In other typologies, this type of interview is called “non-standardized”, or referred to as “qualitative research interviews” (Saunders, Lewis & Thornhill, 2009; King, 2004, cited in Saunders, Lewis & Thornhill, 2009, p. 320). In semi-structured interviews, the researcher has a list of themes and questions which he wants addressed. Depending on organizational context and the flow of the interview, the list may vary from one interview to another. In our case, we provided a thorough list with questions covering the five context areas fish feed, sea cages, escaping, sea louse and the slaughter process, as well as a few general questions. The list was sent by email to the companies well in advance of the meetings. The lists were slightly different for the two companies due to differences in the company-specific secondary data we used to make them (e.g. annual reports, company web sites, etc) but overall comparable. A large portion of the questions were based on articles from scientific journals (secondary literature) and was rather specific in nature. We felt this was necessary in order to avoid a shallow analysis. Because we had just a “one-shot” chance to do the interviews, due to time limitations and/or reluctance from the companies, we made sure to provide a thorough questionnaire. Our idea was that it is better to ask more than less, to ensure we would have enough data for the analysis. There is also a balance between the time we were designated for the interview, the number of questions we had, and the degree of getting detailed answers. We knew some of our questions were tough, and did not expect all of them to be answered. Hard questions are a good way to test how deep the

company's knowledge of their own activities actually goes. Because we did two company interviews, we can compare the answers and see if one company has deeper knowledge than the other. We did not record the interviews, but listened attentively and wrote down keywords as the interview progressed. We then spent the rest of the day writing down a chronological account of the interviews, and sent them back for feedback.

The results (cf. chapter 8) are extensive. With regards to Marine Harvest and Cermaq, we have reproduced a pretty much complete account of the results from our interviews with them. The results of Marine Harvest and Cermaq constitute the foundation of our empirical investigation. When reflecting the results of the interviews as complete as possible, the reader can then compare the results with the questionnaire, which we think is important. Not getting answers and how something is addressed, can be valuable results as well, as this indicates the respondent's focus areas (or lack thereof), and the general willingness to cooperate. Providing a close to full account of the results will ensure that little will be taken out of context. This will in turn make it easier for us to emphasize where the companies lack important knowledge. In terms of the results from Marine Harvest, we agreed to set the questionnaire aside during the interview, and instead have a more general discussion. This was set as a requirement from Marine Harvest's side, due to Marine Harvest's perception that our questions were too detailed and irrelevant. Marine Harvest expressed doubts regarding the relevance of our list, mostly because they claimed this level of information was not subject to public issuing. Cermaq on the other hand appreciated our questions and thought they were relevant since they said the questions contributed to keeping them updated on important focus areas.

The interviews were face to face, and took place in the company's headquarters in Oslo. At Marine Harvest we spoke to Jørgen Christiansen, Director of Corporate Communications. Our interview with Cermaq was with two employees: Lise Bergan, Director of Corporate Affairs, and Kristin V. Hurum, the Sustainability Coordinator.

We are aware that the empirical analysis could also be based on data from secondary sources, such as the companies' annual reports. The authors have read annual- and sustainability reports from both companies, but find the level of information insufficient to perform a deep analysis. One good thing about the reports however, is their inclusion of various statistical data. In order to obtain a thorough analysis, we decided to focus on interview data. The benefit of conducting interviews is that we can try to go deeper into selected issues presented in the annual and sustainability reports, e.g. ask for more information on the most context-

relevant information. Data from the annual- and sustainability reports were however used as a fundament to make the company-specific questionnaires, as well as getting general background information. Combining data from the interviews with historical data from annual- and sustainability reports is possible, and this is exactly what we did in e.g. the context area of fish feed, where we felt this approach would be particularly useful.

The secondary data we have used include documentary data in terms of written materials such as the organizations' websites, newspapers and articles from (scientific) journals, and, as mentioned, the companies' annual- and sustainability reports. Of non-written materials we watched several TV documentaries. We have utilized data from multiple sources, such as governmental publications, books and journals, and industry statistics. Most of this data collection was done in the early stages of our work, when we needed to acquire information and learn about the fish farming industry. Our questionnaires were based on much of this data, and much of it was also important for the model building.

We have also had an interview with Erik Slinde, Principal Scientist, prof. dr. philos. at the Institute of Marine Research. We conducted this interview in the beginning of the research process. This interview was also semi-structured. We have also tried to contact various non-governmental organizations, including "Bellona", "Redd villaksen", "Dyrevernalliansen". All of them declined our request for an interview, with reasons varying from not having the necessary time and resources, to not having enough knowledge. WWF Norway however agreed to let us interview them. At WWF we interviewed Karoline Andaur, Head of the Marine Programme. This interview was also semi-structured, but unlike the other interviews, it was done over Skype. We sought to have interviews with different NGO's representing both an ecological and ichthyological standpoint, but we faced challenges when trying to get interviews with other organizations than WWF. To get a medical reference point in our analysis we were in contact with dr.med.vet. Bergljot Børresen in order to try to get an interview with her. We did however not succeed, but we have had the pleasure of reading some of her written work that she suggested when we were in contact with her.

In order to understand more about the slaughter process, we acted on Slinde's suggestion to visit a fish slaughterhouse. He gave us the contact details to a slaughterhouse he had visited himself, and hence we went to Slakteriet Brekke in Instefjord. As this slaughterhouse is not affiliated with either Marine Harvest or Cermaq the motive of our visit was getting a general

overview of the slaughter process. We spent a full day there, talked to several people, in particular director Knut Strømsnes, and saw the whole range of activities being performed there.

The information gathered from IMR, WWF and Slakteriet Brekke gave us valuable information both to use in our empirical analyses, with particularly the IMR and WWF acting as a neutral and opposing viewpoint to the information presented by Marine Harvest and Cermaq. Our visit at Slakteriet Brekke was imperative for evaluating the results from Marine Harvest and Cermaq, since the personal experience we got from the visit enabled us to have a first-hand knowledge of the issue at hand. Some of the information gained from these additional sources also gave new input to evaluating the conceptual framework. This is because we got the opportunity to ask questions related to what we found interesting from the literature review we did with regards to the context areas, and because we could get a confirmation or rejection of some of the knowledge we had acquired.

5.6.1 PARTICULAR METHODOLOGICAL DIFFICULTIES WITH MARINE HARVEST


As mentioned, we made an account of the interviews we did with the two companies, which we made and sent back to the companies the same day. This was done in order to reduce risks of equivocal evidence or bias, as the representatives of the two companies could restate and clarify potential misunderstandings and ambiguities. While Cermaq used one day to return our account, Marine Harvest used 2 months and 12 days (the meeting took place 23. March 2012, the corrected account was sent back 04. June). As the representative initially asked when we would need the corrected account, but failed to give it back at our proposed date (20. April), nor responded to our reminder when the proposed date went by, we assumed the account was ok. When we finally got the corrected account, the representative claimed the delay was due to the fact that we were not prioritized because of his busy schedule. The corrected account contained several changes. To accommodate the new information we had to rewrite parts of the results and the empirical analysis at a stage where we basically had completed those parts and were almost ready to submit our work. Although we are glad to finally receive feedback, we consider it unprofessional to agree participating in the thesis, only to subsequently not allocate sufficient time to validate the results, considering how important it ought to be for Marine Harvest as well that we base our analysis on the right facts. If the representative for instance had waited just one more week before he sent us his feedback, then there would not be time to implement the changes.

The representative of Marine Harvest initially felt our questionnaire was irrelevant and too detailed, and was unwilling to go ahead with the interview if we stuck to our questionnaire. Hence, we faced the dilemma of letting the interview be on Marine Harvest's terms (to have a more general discussion) or find a new company. An important point in this regard is how a member of Marine Harvest's top management team, which we initially sent our interview request too, said that they would be happy to participate. Hence we always assumed that Marine Harvest's participation would be unproblematic. Faced with the dilemma of conducting the interview on Marine Harvest's terms or starting the process of finding a suitable company all over again, we decided it was best to do the former. One could always raise questions whether this was a wise decision. But at the time, considering both the time we had spent learning about Marine Harvest and since we had already bought plane tickets, we were in a difficult position and felt we did not have much choice.

5.7 RELIABILITY, VALIDITY AND GENERALIZABILITY

The four threats to reliability are participant error and participant bias, and observer error and observer bias (Saunders, Lewis and Thornhill, 2009). Participant bias may be an issue as the company representatives we spoke to may have an agenda of portraying their company in the best light possible. However, because we also used secondary data such as the companies' websites and their annual reports, we can to a certain extent triangulate data that way. We did not record the interviews, but took notes instead. This gives rise to potential observer error, but we feel this has not been problematic, with the reason being that we sent a full written account of the interview back to the company within the same day. The purpose of this was of course to settle any potential misunderstandings, misquotes and to get clarifications. This is also a way of triangulation. In Marine Harvest's case, since they failed to provide feedback or give confirmation on the account we sent until around seven weeks later, both observer but particularly also participant bias may pose a challenge in this case. Since many of our questions were based on scientific articles, we believe this has functioned as a filter against posing bad questions. Data from particularly IMR and WWF gave also room for somewhat triangulation of data, due to the neutral and opposing viewpoints they could present. It is perhaps impossible to rule out observer bias, but since we worked on the analysis together and can hence discuss with and arrest each other if we feel the other one is misinterpreting, we feel this reduces the chances of it.

With regards to give a nearly complete account of the results (cf. chapter 8), this will increase validity, as the reader will be able to understand the empirical analysis better. If a summary had been given instead, this could have lead to more bias in terms of the assumptions and interpretations we would have made in choosing what type of data to reproduce.



6 ANALYSIS I – BUILDING THE MODEL

6.1 INTRODUCTION

Deciding what sort of activities a fish farming company should undertake, and how it should do so, will be a recurring problem within the industry. As Mitroff (1998, cf. chapter 3.1) argues, this problem, just like any other problem, should therefore be seen from all four of the following perspectives: the scientific/technical (economic), existential, interpersonal/social and systemic one. How do these perspectives relate to the fish farming industry? Which ones are the most relevant? We will now develop a model trying to reconcile the fish farming industry with Mitroff's (1998) four perspectives.

The scientific/technical perspective is what ensures profit. It is unreasonable to expect a company to exclude economic considerations in its activities. A fish farming company needs to make money just like any other company. The fish farming industry has been overall profitable (cf. chapter 1.3). With reference to the research question (cf. chapter 1.5), how can Mitroff's (1998) framework be used to develop a model which ensures "profitability" for the other perspectives as well, i.e. not just within the scientific/technical (economic) one?

6.2 THE SYSTEMIC PERSPECTIVE AND ECOLOGY

In ecology (cf. chapter 4.1), the focus is on the holistic relationships between man and nature. This can be linked to the systemic perspective in Mitroff's (1998) model, as well as his concept of system-age thinking. The systemic perspective in fish farming relates to the effects of fish farming in a greater societal and environmental context. These effects can be local, regional and international. At the local and regional level, salmon populations may get negatively affected due to escaped salmon and increased sea lice exposure for out-migrating smolt. At the international level a possible collapse of one of the reduction fisheries is bad enough in itself, but may affect other species as well. Disrupting the natural balance in an eco-system may have unprecedented ramifications. There have been many examples of this in history, when for example new species have either intentionally or accidentally been introduced to regions where it was originally non-native. The potentially negative, irreversible effects that may happen in that regard, i.e. for example if wild salmon or an industrial fish species ends up

becoming extinct, may be beyond imagination. The uncertainty with regards to the degree of the severity of the consequences should call for the precautionary principle.

Increased complexity, uncertainty and global interaction can be linked to an increased need for system-age thinking. Today's fish farming companies source their fishmeal and fish oil partly from one place half around the world, and sell their finished product to another place half around the world. With reference to deep ecology (cf. chapter 4.1.7) there might be a danger that the fish farming industry becomes a closed system (cf. Figure 4-1) where the energy resources, i.e. the reduction fisheries, are not sufficiently accounted for. If short term thinking dominates, this leads to the economic cycle of the fish farming industry most likely not being sustainable in the long run. Given the nature of fish farming, coupled with Næss (1976) emphasis on interconnectedness (cf. chapter 4.1.7), the necessity for a sound relationship between the input and the output in the economic cycle of the fish farming industry becomes particularly important.

The rapid growth of the salmon farming industry can be linked to the inherent challenges related to exponential growth curves, as explained by Eriksen (2001, cf. chapter 4.1.2). Has the magical "threshold" already been reached? The Chile crisis was probably a wake-up call for the industry – clearly the focus had been too much on quantity rather than quality.⁴⁰ This led to a pre-mature "overkill" of the farmed salmon there. This can again be linked to the concept of "Chrematistike", which is a bit akin to short term profit maximization. The knowledge of man has enabled him to control the Earth's resources. Coupled with an anthropocentric view, in terms of the Chile crisis this may have caused salmon to be seen as nothing but a commodity to serve our needs. As the companies "owned" the fish they had the right to do whatever they liked. As long as the value of a being like salmon is based on its exchange value rather than its utility value from nature's perspective, doing things in a "chrematistike" way rather than an "oikonomia" way is likely to remain. All these terms are interlinked. Anthropocentrism can for example be closely related to man's "Biblical" right to put nature under his domain. Just as ecology look at the results of the interactions between these concepts, so too does the systemic perspective look at how they affect society in a greater context.

Sustainability is an important part of ecology, and the Brundtland definition of sustainability (cf. chapter 4.1.8) applies not only to survival of the reduction fisheries, but also to maintain-

⁴⁰ The Chile crisis was about biological challenges (an ISA virus outbreak) related to fish farming in Chile mainly in 2008.

ing healthy eco-systems. From a human perspective, eco-systems which are not worth much to us today, may be valuable to us later. Such an approach to sustainability can of course be criticized for being anthropocentric, as the inherent value of the eco-systems themselves would not be included in that equation. This would likely contradict with the core fundamental idea of intrinsic interrelation of the deep ecology platform. In other words, the concept of deep ecology goes deeper than that of sustainability. Still, such a sustainability view calls for the importance of preservation. Preservation of reduction fisheries is also important because of their existence value.

Ecology is also related to the existential perspective, as one's existential viewpoints and assumptions will influence how one relates to the greater environment. In that way ecology is the continuation of the thought processes reached from existential contemplations. While the existential perspective is mostly covered by ichthyology, ecology is mostly correlated with the systemic perspective. There is however no problem that they also overlap, as both Mitroff's (1998) and our own model seek a holistic integration of viewpoints.

6.3 EXISTENTIALISM AND ICTHYOLOGY

We do not wish to take a normative stance against fish farming companies just because they deal with living beings. Man is a "predator" and has eaten animals and fish for a long time, and we respect people's individual rights to make their own conscious choice of what they want to eat. The world is not perfect, and even if one were to become a vegetarian, one would still indirectly support the killing of many living beings. Crop farming involves much killing of small animals and insects when ploughing, utilizing pesticides and harvesting. There would also be indirect killing as there will be less food for the local animals. Just driving a car or going for a stroll involves the killing of many small insects. In short it is impossible to live without killing. We believe the fish farming industry will thrive for a long time still. Rather than opposing it, it is better to raise awareness and help improve it.

An existential issue with killing arises when you would not like to do it yourself, but are happy about letting others do it for you. In this regard staying as much ignorant as possible of what is going on "behind the scenes" might make things easier for oneself, as one can then maintain the illusion that one is just eating a lifeless product. This is why it is so important to make sure the fish farming industry is "dancing reluctantly" rather than "dancing with relish". At the same time, consumers' generally passive approach to where their food is coming (cf.

chapter 4.1.3) from means there might be less awareness on how the fish farming companies actually perform in this aspect.

As learned in chapter 4.2, because of fish's low "bambi" factor, it is easier to turn off the emotional master switch when interacting with fish than for example a lamb. But just because it is harder to see the "face" of a fish than the face of a fellow human being, does not mean there exists some kind of hierarchy where one life form is superior to another. The "face" of life is life itself, not how we may perceive it through our own biased outlook. As we understand from Lévinas (1990, cf. chapter 4.2.2) each individual fish should therefore be seen as just that, i.e. a large shoal of fish is not simply a group of fish, but a gathering of many unique individuals. Of course, when humanity fails to see the faces of each other, it is perhaps even more unrealistic to expect people to look at fish in that way. Still, it may represent an ideal which serves well as long as it stimulates ethical reflection on the fish's welfare.

Fish does not make sounds of pain like animals, but does this mean fish does not feel pain? Or does it simply mean fish express themselves differently than us? As mentioned in chapter 4.2.6, studies have indeed evidenced that fish feel pain, and hence the industry has a moral responsibility to act accordingly. Is it reasonable to assume that a fish (or animal) trying to avoid danger (or react to a threat) does so purely out of instincts rather than because it is afraid? Is it only human beings who can have a genuine desire to continue to live? Are fish "soulless" machines as Descartes would say, or are they conscious beings with needs just like ourselves? The existential perspective involves exactly these kinds of questions. The answers to such questions allow a certain degree of subjectivity, but the industry needs to make its own stance clear, so that a constructive dialogue can steer its path. Avoiding such questions altogether is questionable at best.

The concept of "oikonomia" is as explained about good "household management". How should the fish farming companies manage their fish? Should they do it from an anthropocentric or an ichthyocentric standpoint? The latter approach means the fish farming industry (or the authorities responsible for regulating the industry) should apply more resources into understanding how the fish think and feel and what its needs are. The fish farming industry has to combine the usage of intellect and empathy in the way they do business (cf. chapter 4.2.2). Just because they ultimately will kill the fish does not mean the emotional master switch should be off all the time. The upcoming ban on using CO₂ as a stunning method in Norway seems to be a good example of ichthyocentric thinking. More research of the same sort ought

to be done in other areas, as the slaughter process is just one out of many parts in the fish farming value chain. Humans are “hosts” for farmed salmon for a total of 2-3 years before it ends up on the dinner plate (cf. chapter 4.2.3). The fish did not choose its hosts, but is nonetheless under the hosts’ care. The God-like power the fish farming industry has over fish entails a great deal of responsibility. The responsibility graph based on the work of Ims (2011, cf. chapter 3.3.2) makes this relationship explicit. As the industry has total control over the production cycle, it follows automatically that the fish is extra vulnerable to actions undertaken by the industry.

To incorporate fish welfare into animal welfare builds on the underlying existential assumption (or scientific evidence, or both) that fish are equal to animals, and that this entails certain responsibilities.⁴¹ If fish is viewed as conscious beings capable of feeling pain (cf. chapter 4.2.5), deontological ethics (cf. chapter 3.3.7) would then naturally enforce us not to kill fish (or any other living being) for food. Deontological ethics is perhaps too strict, but an utilitarian approach (cf. chapter 3.3.8) of maximizing shareholder value (as the utility of the fish is ignored or not recognized) represents the other extreme. Depending on what standpoint one takes, it is quite clear that the ethics threshold (cf. chapter 3.1.2) can change dramatically! In any regards, the well-being of the fish must not be considered from a purely scientific/technical standpoint, e.g. how much a higher price the industry can get from selling increased quality due to increased fish welfare. Such an approach would constitute economism (cf. chapter 3.3.6) in the sense that the fish’s life quality would be measured purely as a mathematical equation. However, it is perhaps unreasonable to expect humans to treat another species up to an ideal standard, when human cannot even do that to each other. Hence, this argument is even more existential than initially presented. A collective consciousness shift among the entire human population would be needed to address these issues properly. However, such a discussion is well beyond the scope of this thesis. The point is simply that fish is more than a commodity, and due to the responsibility graph and the responsibility triangle of Ims (2006, cited in Jørgensen & Pedersen, 2011, cf. chapter 3.3.4) this entails responsibility with regards to how the industry should handle the fish. Just like the responsibility triangle states, the people working in a fish farming company have a responsibility not only to the fish they handle, but also to themselves (their own values, integrity, etc). Ethical reflection on the existential issues raised here and in Figure 4-2 (cf. chapter 4.2.8) certainly belong at the core of fish

⁴¹ Fish welfare incorporates fish health. As this distinction is made elsewhere we wish to point it out that we do not make such a distinction. In the author’s eyes fish health is seen as an important part of fish welfare.

farming. This is because the conclusions reached from said ethical reflection will set the stage for how the industry (employees) will exercise their activities.

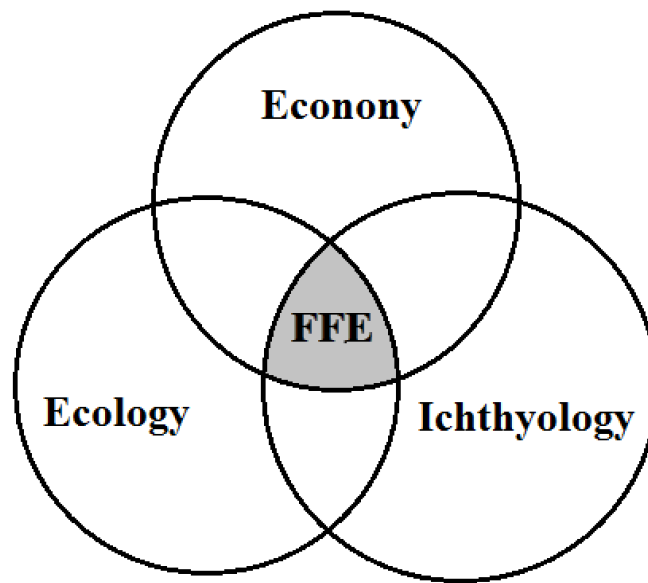
The ichthyological perspective also covers the social relationships between the fish, i.e. issues such as the relationship between stocking density and fish welfare, the relationship between salmon and potential cleaner fish such as wrasse; in general fish welfare issues. In this text we have through ethical reflections on the existential dimension reached the conclusion that fish welfare is important in its own right. Considering the interpersonal/social perspective, it is obviously harder to relate this to fish rather than to humans. The focus in this regard is therefore better directed at fish welfare. Hence the existential perspective provides a better holistic approach in this regard, as the interpersonal/social dimension is more or less automatically accounted for if the industry strives to adopt an ichthyological perspective.

It should hopefully be clear by now that the existential perspective is dominant, but also that the interpersonal/social perspective is relevant, and that both of them are closely related to ichthyology. This is precisely so because ichthyology is about understanding the fish from its own perspective. Of course, it might be hard to meet acceptance from the industry if one asks them about their existential view on fish, and they might not even understand you if you ask how they incorporate the existential perspective into their business model. Rather, it is more practical and straightforward to ask, or rather expect, the industry to consider fish welfare from the fish's own perspective in everything they do.

6.4 THE CONCEPTUAL FRAMEWORK – CREATING THE MODEL

We have now argued that both ecology and ichthyology are important concepts in fish farming. We have related these concepts to the existential and systemic perspectives in Mitroff's (1998) model. The interpersonal/social perspective is also somewhat covered by ichthyology. These perspectives need to be considered together with the economic perspective. Too much focus on a single perspective is likely to lead to E3 errors, in other words solving the wrong problem. The combination of the economic, ecological and ichthyological perspectives leads to the Fish Farm Ecology (FFE) model.

Figure 6-1: Fish Farm Ecology (FFE)



The model above (Figure 6-1) shows the relationship between the economic, ecological and the ichthyological perspectives. The shaded area in the middle represents the area where all three perspectives intersect, i.e. where all the three circles overlap. We call this area for Fish Farm Ecology (FFE). A company practicing FFE would value all three perspectives equally, and thus consider how the greater environment (the ecological and systemic perspective) and fish welfare (the ichthyological and the existential and interpersonal/social perspectives) are influenced by the company's activities (in our thesis the focus is as mentioned on overall CSR perceptions and the five context areas of fish feed, sea cages, escaping, sea lice and the slaughter process – but we believe the model is also relevant for other context areas). Although two of the perspectives in the model are non-economic, the economic perspective is not sidelined. This is because it is the overlapping area between all three circles in the model which defines the FFE area. Hence, at least in theory, this ensures that only economical activities will be undertaken. The same logic also applies to the other two perspectives. If a company doing a certain activity does so purely from a one-sided motivational perspective, like for example from the economic one, then it will only be luck or random factors which will determine whether said activity will fall in under the FFE area, i.e. there then might be a big chance that said activity will only fall within the economic circle. Hence, all three perspectives should be equally consulted when deciding upon activities to undertake. In sum, this effectively sets a boundary of the range of activities available to the company.

With regards to the four steps in the problem-solving process as referred by Mitroff (1998) (cf. chapter 3.1.1), the FFE model can be said to be the end result of the first three steps. After having recognized ecology and ichthyology as important factors with regards to fish farming, a problem was discovered, namely that more focus on these issues were needed (step 1). The process of developing the model was then pursued (step 2). The finished FFE model represents the solution to the problem, i.e. the authors believe the FFE model can help companies avoid trying to solve the wrong problem (step 3). It will be the industry itself which has to implement it (step 4). The FFE model is thus a ready-made framework the industry can use in its decision-making. It can be said to represent an idealized state from a practical standpoint. In theory there is no limit to how much CSR a company could do, but from a practical viewpoint the FFE model is mainly limited to the core business of the industry. Here, we can discover the overall usefulness of the FFE model, as it can be used both as an analytical tool for a broader interest group, as well as a management tool for companies within the industry.

6.5 THE FFE MODEL IN A FISH FARMING CONTEXT

The FFE model is meant to be a holistic framework. The author's idea is that the FFE model should first be applied on an overall level in the following way when addressing a new challenge or activity: firstly, the company (or its management) or external interest groups wanting to evaluate the fish farming industry, should use the model in a broad way to check for relevant ecological and ichthyological issues. If such issues exist, one needs to determine what the major challenges are. If, through initial analysis of a certain activity, the activity is found to have minimal relevance for one perspective, e.g. ecology, i.e. so that ecological considerations are of minimum importance for that specific activity, then this does not mean that the FFE model is invalid. Instead it would only confirm that ecological considerations are accounted for and that said activity does not raise an ecological alarm. But this might be hard to know without first consulting the FFE model, since certain issues which does not seem relevant on a surface level, may still be so at a deeper level. Using the FFE model to check for potential issues is therefore necessary. By doing this one would always stay within the FFE area.

As indirectly mentioned, the importance of the ecological and ichthyological perspectives might differ from context area to context area. While some activities are likely to be more ecology or ichthyology intensive (in addition to economic considerations), other activities are likely to require a balanced approach. This means that certain context areas might be mainly

overlapped by just two of the circles (in the FFE model), for example economy and ecology or economy and ichthyology. However, in either case, the third perspective would still be relevant, only to a lesser degree. This is because, as explained in the previous paragraph, potential ecological or ichthyological concerns would already be accounted for. Hence, one would still remain within the FFE area.

6.5.1 FISH FEED

From the FFE model, fish feed is definitely related to both ecology and ichthyology. While the ecology perspective relates to the sustainability of the reduction fisheries as well as the fishing's impact on the eco-systems, the ichthyological perspective draws attention to e.g. how the farmed salmon eat pellets consisting of vegetables and blood meal from terrestrial animals (i.e. a very unnatural diet) or how the salmon is starved prior to slaughter. Feed waste might serve as an example impacting both the environment as well as the bottom line. With regards to the making of fish feed, the ecological perspective is dominant, as sustainability of the reduction fisheries is imperative not only for long term business survival, but also due to the existence value related to survival of species. With the high feed cost in the fish farming industry, economical considerations are also important in determining feed ingredient composition. But, as we understand, the usage of fishmeal and fish oil needs to be considered from more than the economic perspective, as the ecological perspective is very important.

6.5.2 SEA CAGES

Sea cages have many ichthyological issues. Stocking density, usage of artificial light, net deformations, oxygen and temperature levels affect fish welfare, and in extreme cases poor conditions may lead to fish death. The ichthyological perspective is clearly central here. At the same time issues like site selection and fallowing is also important in an ecological view. These factors are important with regards to e.g. sewage dispersal. Closed containment systems will certainly also fall within the ecological sphere as it can be a method for solving environmental challenges (e.g. related to escaping). Ichthyological concerns will also remain in such a system (e.g. oxygen levels and water quality), and this factors are also reflected in the economic perspective. The large investment costs associated with transforming the operations are also highly relevant. We can also spot economic perspectives in the other aspects mentioned. For example, the right balance between stocking density and profit is important. A higher stocking density will give higher yield per sea cage, but the FFE model will ensure that an

ichthyological threshold for maximum stocking density for a specific site is considered. Also, the use of artificial light and measuring oxygen and temperature levels are important from an economic perspective. Artificial light for example postpones sexual maturation, which in turn increases productivity. The right oxygen and temperature levels will lead to more healthy fish leading to better product quality.

6.5.3 ESCAPING

Escaping clearly falls in under all three perspectives of the FFE model. The potential negative impact from escaped farmed salmon on wild salmon is an example of an ecological challenge. When the salmon escapes from the farm, the host relationship between humans and salmon disintegrates. From a survival point of view most escaped salmon die quickly. The industry has as hosts, responsibility to take care of their fish and prevent escaping. When looking at the the suggested implemented steps to reduce the scope of escaping we discover the usefulness of the FFE model. Ichthyological considerations (e.g. fish welfare issues) are obviously in place when different tagging systems are considered, as some tagging methods might e.g lead to the removal of the fish's body parts. Proper steps also need ecological considerations, as for instance tagging is a solution that only helps after escapes have occurred, and thus leads to potential harm to e.g. wild salmon if not proper recapture procedures are in place. The implementation of the NYTEK-regulation in Norway serves as a good example to ensure that the ecological considerations are in place as the regulation will lead to better equipment being used and thus reduce the probability of escaping. Here we can draw parallels to the ichthyological considerations as better equipment will lead to taking the role as hosts in a better manner. Since each escaped fish reduces revenue, measures that reduce the scope of escaping will thus also give economic benefits which will help offset the initial extra costs.

6.5.4 SEA LICE

Sea lice are another context area which should require an outlook from both the ecological and ichthyological perspective, in addition to the economic one. Sea lice affect the welfare of both farmed and wild salmon. As sea lice can cause open wounds on the salmon and make it prone to infections and diseases, as well as cause pain, there are obviously ichthyological concerns that need to be considered. Treatment of sea lice may also negatively affect the welfare of salmon. When considering putting wrasse together with the salmon in the sea cages there might be ichthyological considerations due to species interaction. However, this ich-

thyological concern needs to be evaluated against the benefits of using wrasse, as wrasse reduces the scope of sea lice infestations on salmon, and against the cost of this specific method (i.e. the cost of using wrasse). Similar considerations must also be made when evaluating other methods. The economic perspective also needs to be considered in relation to the effects sea lice have on growth and mortality. Reduced growth and biomass due to sea lice infestations obviously have a negative impact on the companies' bottom line. To the degree sea lice from salmon farms pose a threat to wild salmon, particularly out-migrating smolts (i.e. kill the smolt and leads to a possible threat of extinction of local wild populations), both the ecological perspective in particular, but also the ichthyological one, are highly relevant.

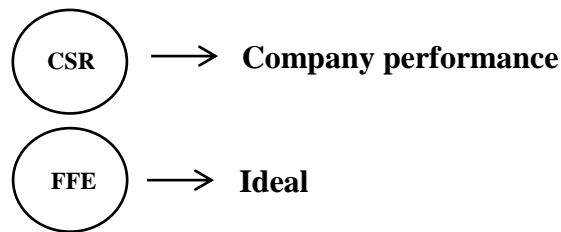
6.5.5 THE SLAUGHTER PROCESS

The ichthyological perspective immediately seems dominant in the slaughter process, considering the great number of fish which are slaughtered annually. Here the different stunning methods are important as e.g. the use of CO₂ leads to major ichthyological considerations falling behind. Both percussive and electric stunning are better from an ichthyological viewpoint. The process prior to stunning (e.g. well-boat, pumping and brailing) will include a high degree of ichthyological concerns as well and thus the physical handling of the fish should be kept at a minimum (i.e. reduce the pumping meters and use double pump systems). Here, the alternative slaughter process (i.e. slaughter at boat right by sea cages) serves as a good example of how ichthyological concerns are alleviated. When using the FFE model, the alternative slaughter method should also be evaluated from the ecological perspective as waste dispersal may serve as a constraint that needs consideration. The economic perspective is also relevant as one must take care of increased cost schemes at present. The economic perspective calls for an efficient slaughter method, the ichthyological perspective can hold the economic one in check to make sure both perspectives are considered. The ecological perspective is also present for the slaughter process in general, as waste deposits from the traditional slaughter process when evaluating waiting cages and effluents from the slaughterhouse itself may affect the local ecosystem.

6.6 MEASURING CSR PRACTICE AGAINST THE FFE MODEL

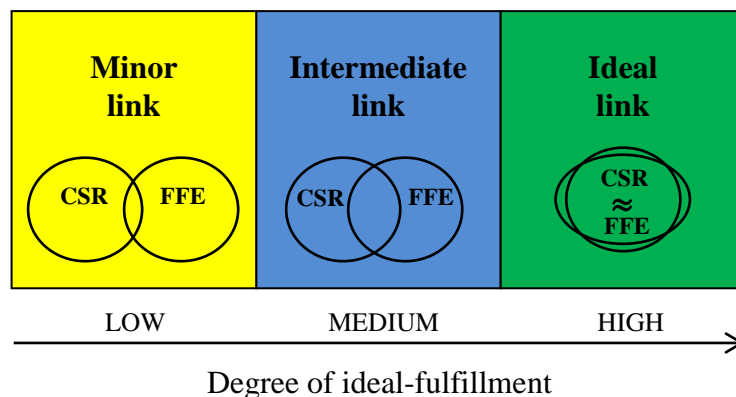
A company's CSR performance can be discovered and shown in the upper circle in Figure 6-2. The FFE model represents a holistic approach and is thus perceived as the ideal CSR performance, and this is marked in by the lower circle in Figure 6-2.

Figure 6-2: A company's CSR performance & the ideal CSR performance



The value of the FFE model increases when one is able to relate it to the CSR performances of business participants. In this sense it seems reasonable to assume that there is a great range of possible combinations that arises from e.g. one company to another. Since some combinations seem more plausible than other we have limited it to three different combinations portrayed in Figure 6-3.

Figure 6-3: The CSR-FFE link



The CSR-FFE link model (Figure 6-3 above) shows how a company's CSR activities overlap with the FFE ideal. The CSR circles represent the CSR practice of the company in question, and are based on its activities throughout its value chain (in this thesis limited to the five context areas of fish feed, sea cages, escaping, sea lice and the slaughter process, as well as the company's broader CSR perceptions). In the yellow (minor link) area the company somewhat

considers the ecological and ichthyological perspectives in their activities. This means that the company only somewhat integrates their focus on economic performance with ecological and ichthyological considerations. In the blue (intermediate link) area the company performs intermediately, but it is only in the green (ideal link) area that a company can claim to practice FFE. Under the assumption that it is impossible for a company to know what kind of challenges which will arise out of its activities before they are undertaken, the idealized CSR state is only \approx FFE state, i.e. it is assumed that a complete overlap is impossible – minor adjustments will probably be regularly needed, i.e. there is a need for continuous adaptation to a constantly changing environment. As indicated earlier, an analysis with the aim to find the overall CSR-FFE link relationship would have to be done holistically. Obviously, this will be a qualitative approach. The value of good fish welfare (ichthyology) and a healthy environment (ecology) cannot be measured quantitatively. Furthermore, a company with a negative or a low economic profit will obviously face more budget constraints in implementing a good overall FFE practice than a company with a high economic profit. But it is important to emphasize that poor profits are not an excuse to not take care of ecological and ichthyological concerns, because the whole point of the FFE model is to ensure “profits” in all three perspectives. In fact, a good FFE practice might even lead to better economic results.

It should be noted that other relationships between the CSR and FFE circles may also exist, at least in theory. One example would be the case where the CSR circle completely engulfs the FFE circle. In such a situation, the company’s CSR practice would extend beyond FFE (very unlikely in the author’s eyes since the FFE model already represents an ideal state where all three perspectives are properly fulfilled). One could also think of a hypothetical scenario that portrayed a CSR practice with no link with the FFE model whatsoever. But since actions initiated purely out of an economic incentive would likely still affect either the environment (ecology) or fish welfare (ichthyology) in a positive way, this kind of link is unrealistic.⁴² This is because all three perspectives in the FFE model are interrelated to a more or less degree. Therefore Figure 6-3 represents the realistic range of possible interaction. To keep the model simple, Figure 6-3 is limited to only 3 possible links.

⁴² E.g. treating sea lice just out of the intention to reduce loss of profit would still benefit fish welfare in the long run, as well as reducing the number of sea lice met by out-migrating smolts.

6.7 CRITICAL REFLECTIONS AROUND THE MODEL

In order to get an ideal match with the FFE model, the industry needs to utilize the precautionary principle to a larger extent, and even be willing to reduce the scope of or halt their activities if conflict with one of the perspectives, most likely the ecological or ichthyological one, demands so. This can create problems if the FFE model represents a too idealized state. If attaining an ideal link is too hard, it would limit the growth of the industry. On the other hand, this might exactly be what is needed to ensure industry-responsibility. It might also be the case, considering that the fish farming sector is still young, that it over time would naturally outgrow its “infancy” problems. Such a view would mean that problems of today are just temporary. But the FFE model is still valuable in this regard, as it can be used while waiting for the industry to mature.

7 CASE

7.1 CASE: MARINE HARVEST ASA

The Marine Harvest Group is the result of a merger between Pan Fish ASA, Fjord Seafood ASA and Marine Harvest N.V. The merger took place 29th December 2006 with Pan Fish ASA buying the other two companies and changing name to the Marine Harvest Group (henceforth shortened to Marine Harvest) (Marine Harvest, 2008). The company is listed on the Oslo Stock Exchange under the ticker MHG. Marine Harvest has headquarters in Bergen, while corporate headquarters is in Oslo (Marine Harvest, 2007). The current CEO is Alf-Helge Aarskog.

Marine Harvest was originally a Scottish company, but has changed ownership several times. It has been the largest company in salmon farming since the 1980s (Asche & Bjørndal, 2011). In 1999, the Dutch company Nutreco, who was the current owner of Marine Harvest, purchased Hydro Seafood, the largest Norwegian seafood company at the time. In 2004 Marine Harvest merged with Stolt Sea farm. Marine Harvest is the largest producer in all the four biggest salmon farming countries (Chile, Norway, Canada and Scotland) (Asche & Bjørndal, 2011, p. 40). According to Asche and Bjørndal (2011, p. 41) further growth from takeovers and mergers is likely to be hard for Marine Harvest as such a move would probably attract attention from competition authorities.

Marine Harvest is the world's largest producer of farmed salmon and, according to their own web pages, the world's leading seafood company (Marine Harvest, 2012a). Their main product is farmed salmon, and they engage in a variety of farming, processing, smoking, distribution and sales activities worldwide. The five major business units are Marine Harvest Norway, Marine Harvest Chile, Marine Harvest Canada, Marine Harvest Scotland and Marine Harvest VAP Europe.⁴³ The rest of the business units are Marine Harvest Asia, Marine Harvest Faroes, Marine Harvest Ireland, Marine Harvest Ingredients, Marine Harvest Cod and Sterling White Halibut. The Group's farming operations are located in Norway, Chile, Canada, Scotland, Ireland and the Faroe Islands.

⁴³ VAP: Value-added processing

According to Marine Harvest (2012b) there has been implemented a new organizational structure from 1. April 2011 with the purpose of maximizing the overall value creation by directing the appropriate skill set and attention to requirements throughout two business areas: Farming & Sales and Marketing. “The performance of the two business areas is monitored to reach the overall objective of maximizing the operational EBIT per kilo and margins” (Marine Harvest, 2012b). Thus, a new organizational chart is not yet publicly available.

As can be calculated from Table 7-1 below, the total net profit for the entire period was just below NOK 4.7 billion. The large negative result in 2008 was, according to Marine Harvest’s annual report from 2008, mainly due to serious biological problems (the ISA virus) which had accumulated in Chile over several years, and lead to the market value of the equity decreasing by 70 percent (Marine Harvest, 2012b). The sharp fall in net profits in 2008 explains why there was not paid any dividends to the shareholders that year. In the years prior to 2008 it was prioritized to repay interest bearing debt in order to bring the gearing down to a more comfortable level (Marine Harvest, 2012b). In the years following 2008 dividends have increased and the improved results were achieved by getting operational control in Chile in addition to strong demand for salmon in key markets, combined with the global supply situation (Marine Harvest, 2012b). As for the dividend of NOK 0.80 per share in 2011, Marine Harvest emphasizes this as the highest yield in the sector with a payment of more than NOK 2.8 billion. This payment is around 2.5 times the net profit the same year, and the reduction in equity ratio that year was almost six percentage points.

Table 7-1: Selected key figures at the aggregated level for Marine Harvest from 2004-2011 (adapted from Marine Harvest, 2012b)

	2004	2005	2006	2007	2008	2009	2010	2011
Revenue (MNOK)	1,745.7	1,501.3	5,640.5	14,091.5	13,124.6	14,619.5	15,281.2	16,023.6
Harvest volume of salmonids (tonnes)	49,143	48,108	315,230	339,848	326,864	327,100	295,712	343,685
Net profit (MNOK)	-239.4	381.5	1,853.8	5.1	-2,852	1,302.2	3,108.5	1,121.2
EBITDA (MNOK)	132.0	274.6	1,145.1	1,476.1	1,298.9	2,211.3	3,844.3	3,384.0
Total assets (MNOK)	3,062.3	4,157.7	27,857.7	23,183.0	22,736.4	20,389.3	23,528.8	22,788.6
Total equity (MNOK)	366.9	1,778.3	13,542.2	12,484.0	9,624.6	11,460.5	12,570.7	10,842.2
Equity ratio (%)	13.0 %	42.8 %	48.6 %	53.8 %	42.3 %	56.1 %	53.4 %	47.6 %
Earnings per share (NOK)	-0.74	0.41	0.57	0.01	-0.82	0.37	0.87	0.31
Dividend per share (NOK)	N/A	N/A	0.00	0.00	0.00	0.35	0.60	0.80
Share price at year-end	1.86	2.09	5.70	3.49	1.05	4.23	6.17	2.59
Number of shares at year-end (million)	502.3	1,383.5	3,472.6	3,478.9	3,478.9	3,574.9	3,574.9	3,581.1
Market value (cap) at year-end (MNOK)	934.3	2,891.5	19,794.1	12,141.4	3,652.8	15,121.8	22,057.1	9,275.2
Employees at year-end (incl. temporary employees)	938	858	8,248	8,736	7,071	6,012	6,148	6,324

Norway is by far the largest revenue contributor for Marine Harvest with a share of approximately 50 percent, as shown in Table 7-2 below. The second largest contributor is Chile, followed by Scotland and Canada.

Table 7-2: Breakdown of selected key figures for Marine Harvest in 2011 for the main business areas (adapted from Marine Harvest, 2012b)

	MH Norway	MH Scotland	MH Canada	MH Chile	MH VAP Europe	MH Other	Elimi- nations	Total
Revenue (NOK million)	8,109.2	1,865.1	1,182.1	2,648.7	4,463.3	1,858.0	-4,102.9	16,023.6
Operational EBIT (NOK million)	1,900.7	511.8	24.7	116	110.0	54.1		2,717.3
EBIT (NOK million)	735.9	391.9	-211.1	65.6	108.3	118.9		1,209.5
Total assets (NOK million)	12,626.7	1,931.5	3,080.5	3,423.4	2,438.1	4,670.0	-5,333.9	22,788.6
Total liabilities (NOK million)	-4,162.0	-452.4	-484.1	-2,188.2	-1,124.4	-8,869.3	5,333.9	-11,946.4
Employees	1,556	464	473	1,032	2,332	467		6,324
Harvest volume (tonnes)	217,510	50,174	33,917	26,825	0	15,975		343,685

As we can discover from the ownership overview, Table 7-3 below, Geveran Trading Co. Ltd. is by far the biggest shareholder, holding 21.3 % of the total shares through its two share posts. “Geveran Trading Co Ltd is indirectly controlled by trusts established by John Fredriksen for the benefit of his immediate family” (Marine Harvest, 2012b).

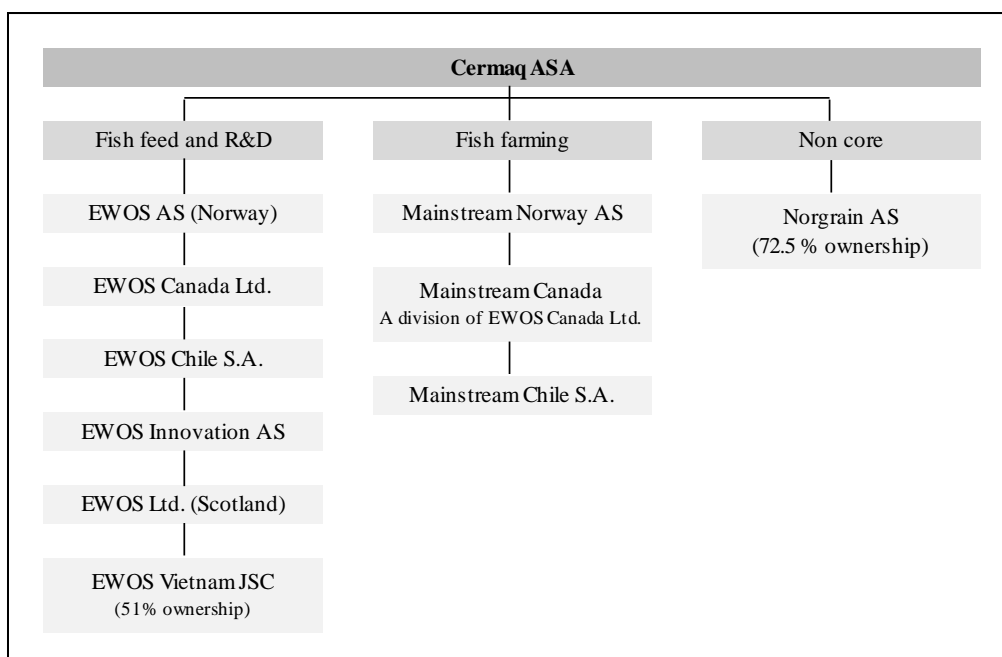
Table 7-3: Ownership structure by 31. December 2011 (adapted from Marine Harvest, 2012b)

Owners:	Numbers of shares held	Ownership
Geveran Trading Co. Ltd.	638,552,375	17.8 %
Folketrygdfondet	182,665,207	5.1 %
Equity Tri-Party (3)	159,232,552	4.4 %
Deutsche Bank Trust Co. Americas	157 284 420	4.4 %
Geveran Trading Co. Ltd.	123,480,400	3.4 %
The Northern Trust Co.	103,605,352	2.9 %
Clearstream Banking S.A.	103,106,051	2.9 %
State Street Bank and Trust Co.	87,709,848	2.4 %
State Street Bank and Trust Co.	85,514,389	2.4 %
DNB Markets, aksjehandel/analyse	73,611,255	2.1 %
State Street Bank and Trust Co.	56,323,121	1.6 %
Bank of New York Mellon	49,465,500	1.4 %
Bank of New York Mellon	42,134,062	1.2 %
Six Sis AG	39,083,568	1.1 %
Euroclear Bank S.A./N.V. ('BA')	35,393,433	1.0 %
Bhtsia Nuveen Global Investors	32,000,000	0.9 %
JPMorgan Chase Bank NA	31,255,941	0.9 %
SHB Stockholm Clients Account	31,167,788	0.9 %
West Coast Invest AS	30,012,000	0.8 %
Bank of New York Mellon SA/NV	29,293,247	0.8 %
Total 20 largest shareholders	2,090,890,509	58.4 %
Total other	1,490,250,034	41.6 %
Total number of shares	3,581,140,543	100.0 %

7.2 CASE: CERMAQ ASA

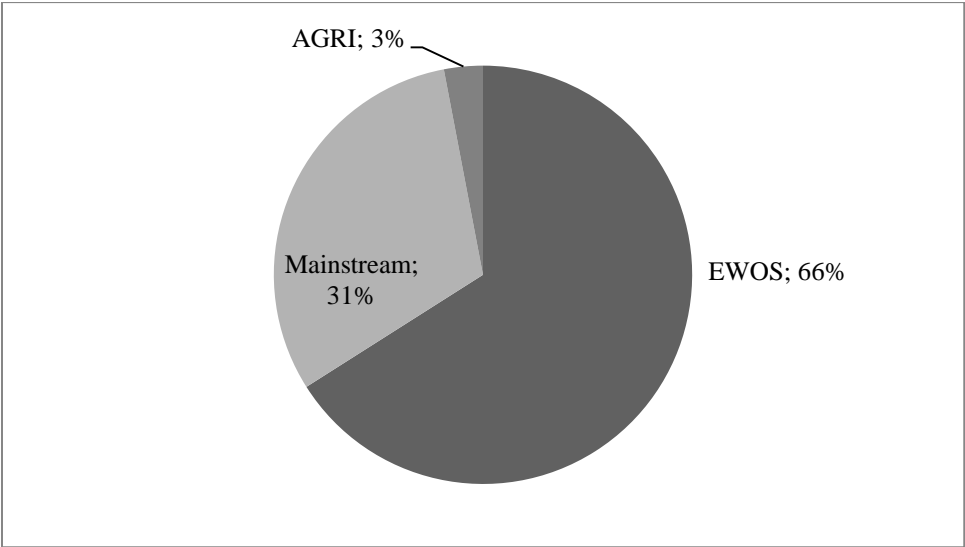
The origin of Cermaq ASA can be traced back to the founding of Statkorn Holding ASA in the end of 1994, when the Norwegian state monopoly on grain ended. Statkorn was set up to take care of and further develop the values the government had had in its operations within the grain, flour and feed sectors (Nærings- og Handelsdepartementet, 2001-2002). The company has gradually shifted its focus from agriculture to aquaculture through series of takeovers and divestments. EWOS was acquired in 2000 and is fully owned by Cermaq. EWOS is a leading international player in the fish feed producing industry, producing feed primarily for salmon and trout. 2000 was also the year Cermaq started its fish farming activities, through numerous acquisitions in Canada, Chile and Scotland, including the takeover of Mainstream Salmones Y Alimentos S.A. in Chile (Cermaq, 2010). Since 2003, all Cermaq's farming operations now carry the Mainstream name. In 2006-2007 Cermaq began operations in Finnmark and Nordland through numerous takeovers in those regions. In 2010 Cermaq sold Mainstream Scotland and entered instead the Pangasius feed market in Vietnam through a joint venture between EWOS and Anova (Cermaq, 2010). Last year, EWOS had a 36 % share of the world salmon feed market. Today, Mainstream produces mostly Atlantic salmon, but also Coho salmon and rainbow trout in Canada. In Norway, Mainstream has fish farming operations in the northern regions. Cermaq got listed on the Oslo Stock Exchange in the fall of 2005 under the ticker CEQ, and the headquarter is in Oslo.

Figure 7-1: The current organizational structure of Cermaq (adapted from Cermaq, 2012)



As mentioned in Table 1-2 (cf. chapter 1.1), Cermaq was just barely the second biggest salmonid producer in the world in 2008, with Mainstream producing somewhat over 100,000 tonnes. According to the latest annual report, Cermaq is now the third biggest salmonid producer (Cermaq, 2012). Today, the traces of Cermaq’s history as a grain company are all but gone. As seen from Figure 7-2 below, the non-core business area (agriculture) amounted to only 3 % of operating revenues in 2010. As Figure 7-2 also indicates, the operating revenues from EWOS were more than twice as big as those from Mainstream.

Figure 7-2: Operating revenues by business area in 2010 (adapted from Cermaq, 2012)



If we summarize the net profits for all the years in Table 7-4 below, the results will be just under five billion NOK in total. With the exception of 2005 and 2008, the (dividends per share)/(earnings per share) ratio have been more than 40 %. Cermaq has a long term goal of distributing annual dividends of 30–50 % of total profits after tax (Cermaq, 2011, p. 59). According to the annual report of 2008 the bad result that year was due to the Chile crisis (Cermaq, 2012). As stated in the company’s annual report for 2011, last year was one of the best years ever (Cermaq, 2012). Judging from the “CEO’s comments” in previous annual reports, the profitability in recent years seems overall good.

Table 7-4: Selected key figures for Cermaq for 2004-2011 (adapted from Cermaq, 2012)

	2004	2005	2006	2007	2008	2009	2010	2011
Revenue (MNOK)	5,014.6	5,367.1	7,533.7	7,721.2	8,715.6	8,971.7	9,990.5	11,634.3
Harvest volume of salmonids (tonnes)	67,548	88,700	114,900	111,100	102,100	108,300	96,700	108,500
Net profit (MNOK)	235.7	738.3	937.5	479.3	-55.1	340.9	1 514.7	792.8
Total assets (MNOK)	5,134.0	6,749.5	6,894.8	7,424.7	10,385.3	8,266.2	9,612.8	10,357.3
EBITDA (MNOK)	554.7	845.0	1,568.3	1,008.3	374.2	857.9	1,778.3	1,685.5
Total equity (MNOK)	3,522.5	3,622.7	4,261.7	4,246.3	4,358.9	4,353.0	5,751.9	6,159.0
Equity ratio (%)	49.7 %	53.7 %	61.8 %	57.2 %	42.0 %	52.7 %	59.8 %	59.5 %
Earnings per share (NOK)	2.71	8.37	10.13	5.17	-1.37	3.33	10.37	11.20
Dividend per share (NOK)	1.20	1.85	4.25	2.25	0.00	1.50	5.40	4.63
Share price at year-end	N/A	54.8	91.0	75.5	26.4	56.0	90.0	70.2
Number of shares at year-end (million)	87,500	92,500	92,500	92,500	92,500	92,500	92,500	92,500
Market value (cap) at year-end (MNOK)	N/A	5,064.4	8,417.5	6,980.0	2,442.0	5,180.0	8,325.0	6,493.5
Employees at year-end (incl. temporary employees)	2,961	3,681	3,937	4,008	4,072	3,277	3,533	4,047

As seen from Table 7-5 below, the Norwegian government is the single biggest shareholder by far, holding almost 50 % of total shares through Nærings- og Handelsdepartementet and Folketrygdfondet.

Table 7-5: Ownership structure of Cermaq by 31. December 2011 (adapted from Cermaq, 2012)

Owners:	Number of shares held	Ownership
Nærings- og Handelsdepartementet	40,271,600	43.5 %
HSBC Bank	4,876,628	5.3 %
Folketrygdfondet	3,982,642	4.3 %
JPMorgan Chase Bank	2,546,962	2.8 %
Svenska Handelsbanken	2,143,698	2.3 %
Bank of New York	1,602,108	1.7 %
Skagen Vekst	1,559,045	1.7 %
State Street Bank	1,369,064	1.5 %
Pareto	1,256,368	1.4 %
Montague Place Custody	1,088,400	1.2 %
State Street Bank	764,708	0.8 %
State Street Bank	653,264	0.7 %
Pareto	577,429	0.6 %
Verdipapirfondet DNB	552,759	0.6 %
Clearstream Banking	537,510	0.6 %
Statoil Pensjon	531,040	0.6 %
Nordea Bank	505,866	0.5 %
State Street Bank	496,282	0.5 %
JPMorgan Chase Bank	478,399	0.5 %
The Northern Trust	451,522	0.5 %
Total 20 largest shareholders	66,245,294	71.6 %
Total other shareholders	26,254,706	28.4 %
Total number of shares	92,500,000	100.0 %

8 RESULTS

The results are extensive. Nonetheless we have tried to reproduce a close to complete account of them. The reason for this is so the reader can compare the results with the questionnaire, which we think is important. In this sense nothing will be taken out of context, and this will make it easier for the reader to make his or her own judgments.

8.1 GENERAL VIEWS ON CSR

8.1.1 RESULTS FROM INTERVIEW WITH MARINE HARVEST

From our extensive email correspondence with Marine Harvest prior to the interview the representative pointed out that the way the term CSR is frequently used, it gives an impression that doing business is likely to conflict with society, and that one therefore in addition to normal operations, has to act “socially responsible”. The representative said that Marine Harvest does not perform CSR, but instead relate to sustainability through their guiding principles, which are abbreviated the four P’s and are: Profit, People, Product and Planet, and which Marine Harvest considers mutually dependent.

In the meeting, the representative claimed that sustainability and CSR are flexible and subjective concepts, and that companies have to adapt the way they do business over time, in line with how the environment changes. Different customer- and industry-specific certification schemes reflect different perspectives and serve as examples of this, according to the representative.

The representative referred to what he called a materiality test: Since information is coming from many different sources, Marine Harvest does materiality tests to find out which information has substance and is material.

To expect that companies in a western democracy like Norway should do activities beyond or in addition to what is required by laws and regulations, is according to the representative a bit like invalidating the governing authorities. Since laws and regulations are based on research and discussions, Marine Harvest’s starting point is that there is no reason to go beyond the legislation. However, the representative claimed Marine Harvest does much more than what is required by laws and regulations.

Furthermore, the representative said there is always room for improvements, but because of limited resources, one cannot embrace all improvement projects simultaneously. In general the representative believes more regulations are needed for the welfare of the industry, but also says that the industry can/should improve independent of that. The concept of tragedy of the commons was mentioned in this regard and related to examples of fish feed, sea lice research and development, fallowing and zoning. Furthermore, economic incentives are seen as not always sufficient to drive changes forward in the industry. With regards to reporting, Marine Harvest sees no point in reporting something externally when it is not reported internally.⁴⁴

8.1.2 RESULTS FROM INTERVIEW WITH CERMAQ

The representatives claimed that Cermaq, as a company originating within the agricultural sector, has focused on sustainability from the very beginning. The representatives said that sustainability pervades the corporate culture, and that biological results are important as sustainability is necessary to have a healthy and long-term business.

Cermaq said that “sustainable development is a social goal and CSR or social responsibility is the industry’s answer to achieve that goal”. They perceive the Brundtland definition of sustainability as central in this regard. Cermaq asserts that sustainability is a consistently used term within the industry, and that it is important precisely because of the common understanding the industry has.

8.1.3 RESULTS FROM INTERVIEW WITH WWF

The representative thinks that the regulating authorities hesitate to regulate the fish farming industry the way it should. WWF cited a report by the Office of the Auditor General of Norway (2012) to back up this claim.

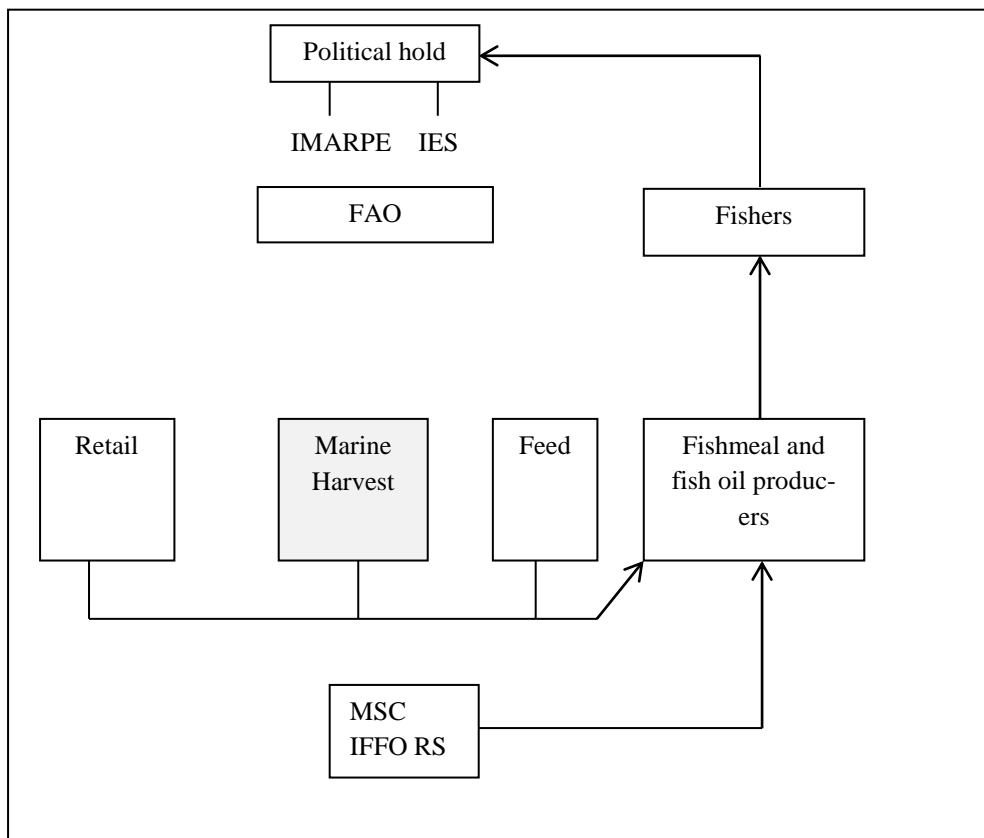
⁴⁴ This was said in relation to how the representative felt many of our questions were too detailed.

8.2 FISH FEED

8.2.1 RESULTS FROM INTERVIEW WITH MARINE HARVEST

The representative pointed out that the sourcing of feed is currently not regulated by law. The representative also presented the figure below (Figure 8-1), which shows how Marine Harvest is just one out of many actors in an intricate context.

Figure 8-1: Marine Harvest's view on the intricate relationship regarding the sourcing of fish feed



The representative said consolidation is important to increase pressure and negotiating power against the other links in Figure 8-1, as a small player has little influence. Interaction was deemed important. The representative stated that Marine Harvest's size gives them the possibility to influence other actors. Furthermore, with reference to an example where one is negotiating with a player you think should do things differently, it was said that it is better to continue the negotiations rather than aborting them, because then one can at least exercise some influence. In that regard, the representative stated the importance of making realistic and attainable demands.

Marine Harvest has been a member of the Salmon Aquaculture Dialogue (SAD) for eight years. The representative does not know when one can expect to see the Aquaculture Stewardship Council (ASC) label in the stores, and mentioned how this also will depend on the willingness of the big retail chains to sell those products.

Regarding the debate whether fish should be used for direct human consumption or for reduction, the representative stated that some of the fish used for reduction (e.g. anchovy) turn rancid quickly and that capture happens at limited times of the year. Thus, this makes using some species for human consumption less topical. Even though the price of fish for human consumption is often higher than the price of fish used for reduction, problems related to seasonal harvest may make it hard to sell those fish for human consumption, and this suggests that such fish can be used for reduction instead, according to the representative.

The representative thinks discharge of fish is a problem, but on the other hand theorizes that it might be unfortunate not to use the fish if it has already been caught. Hence, the problem of discharge is not as easy as it may seem, according to the representative. However, it was pointed out that Marine Harvest fully support Norwegian policies in this area. The representative does not know the scope of the potential problem related to by-catch, but recognizes how using products from by-catch will not reduce the scope of the problem. The representative says Skretting (Marine Harvest's supplier of fish feed) must be contacted for further information.

It was stated that the omega-3 level in farmed salmon today is much higher than Marine Harvest's own minimum requirements, and that this is because of the feed. Marine Harvest does not perceive the need in influencing the feed producers to get a lower omega-3 level, since the amount of fish oil needed to attain the current level is nevertheless in the market. The representative mentioned how fish oil, as an example, was used to hardening butter in the past, and that it is much better to use the fish oil to something where the omega-3 is not destroyed.

Furthermore, the representative states that questions such as whether corn should be used as feed for pigs (cf. which has a much higher FCR) or for direct human consumption is something which has to be discussed at the political level, and not decided by the individual farmer. This is analogous to fish farming, the representative says, and pointed out that as water is a scarce resource in agriculture, one could ask whether water should be used for beef production or for people. One a side note, the representative is asserting that so-called "organic salmon" has the highest usage of marine ingredients.

Marine Harvest does not use FIFO ratios noticeably, as the representative pointed out that the FIFO ratio is a bit meaningless, as they consider the issue is really about oil-dependency. To illustrate his point, the representative made an analogy of how eating a dish of burnt, smoked and boiled sheep's head is the same as eating a sheep. Instead of FIFO ratios, Marine Harvest says they care about the fish coming from a sustainable source. The representative could not tell offhand how much of the fishmeal and fish oil sourced from Skretting which is IFFO RS and MSC certified, nor how much of it which might come from by-catch from bottom trawling. However, the representative said this information could be retrieved, and otherwise pointed out that such issues were taken into account when Marine Harvest sits down at the negotiating table.

8.2.2 RESULTS FROM INTERVIEW WITH CERMAQ

The representatives we spoke to at Cermaq did not know and could not refute if some of the fishmeal and fish oil sourced by EWOS were the result of by-catch from bottom trawling, stating the reason for not knowing being that they simply did not sit close enough to that information. Cermaq said they follow the IUU requirement.

MSC certification was not a priority at Cermaq because, as the representatives explained, MSC primarily certifies for human consumption. However, Cermaq said they support a training program conducted by IFFO designed to help more suppliers fulfill the IFFO RS requirements. Because the process of becoming IFFO RS certified is time consuming, still ongoing and not yet finished, Cermaq claims it is impossible to require all suppliers of fishmeal and fish oil to be certified. According to Cermaq, it is primarily IFFO which has control on this, and who can tell when all producers will be certified. Cermaq also mentioned how fish oil for instance was used for margarine and other products in the past, and that there has been a shift in how fish oil is used. Cermaq also said that 97 % of fish farming is of non-carnivorous species. Because there are so many buyers of fishmeal and fish oil, Cermaq cannot use power (considering that Cermaq owns EWOS) backward in the value chain to influence the fishmeal and fish oil producers. Knowledge is instead the appropriate way to influence, says Cermaq, which said they are concerned about all of EWOS' suppliers being serious. Since EWOS is dependent on fishmeal and fish oil, Cermaq has a weaker, not stronger, influence backwards in the value chain, according to the representatives. In 2011 the marine ingredients index of Cermaq was 37 %.

The representatives said EWOS has done trials where they produced salmon completely without using fishmeal and fish oil. Both taste and the omega-3 level were comparable to ordinary farmed salmon. The omega-3 level was covered with oil from algae. But according to the representatives, cultivation of algae is not economically viable, and hence neither the trial. Cermaq also pointed out how all marine omega-3 comes from algae and plants, and that fish used for reduction only forward the omega-3 which ends up in salmon through the feed. Cermaq also mentioned how it is nutrients, and not the feed in itself, which is important. Since plants produce both nutrients and anti-nutrients, EWOS has to consider this.

Cermaq had a Marine Oil Dependency Ratio (MODR) and a Marine Protein Dependency Ratio (MPDR) below one for Norway in 2011. For the entire Cermaq group, the fish oil ratio was 1:1. Cermaq does not have a goal that these numbers should be below one, because they feel consumption is already sustainable and the feed composition is also influenced by economic considerations, as large costs are connected to feed, which is the single biggest cost factor. Cermaq perceives salmon as an efficient way to refine the use of fishmeal and fish oil, but at the same time recognize that these resources must be economized, and hence consider it important to have a low MODR and MPDR.

8.2.3 RESULTS FROM SECONDARY SOURCES FROM CERMAQ

Cermaq, through EWOS, has developed their own approach to calculate the FIFO ratio. In their view, since a reduction in fishmeal consumption would not affect the FIFO ratio (because fish oil is the constraining factor), the Tacon and Metian (2008) approach (cf. chapter 2.1.4) does not encourage best practice, and fails in providing incentives to reduce fishmeal consumption. In fact, EWOS claims, the approach by Tacon and Metian (2008) actually makes it possible to increase the fishmeal consumption considerably without affecting the FIFO ratio (as long as fish oil remains the constraining factor). Because of that, EWOS claims, the Tacon and Metian (2008) approach might lead to increased pressure on capturing fish high in fat (EWOS, 2010).

EWOS have come up with a nutrient-based approach as an alternative to the weight-based approach. As salmon is richer in both fat and protein than industrial fish, the nutrient-based approach gives a ratio much closer to one. EWOS' nutrient-based approach is divided into a Marine Protein Dependency Ratio (MPDR) and a Marine Oil Dependency Ratio (MODR). They are defined as follows:

MPDR = (kg marine protein used) / (kg marine protein produced)

MPDR = (% fishmeal in feed * % protein in fishmeal * FCR) / (% protein in salmon on whole fish basis)

MODR = (kg marine oil used) / (kg marine oil produced)

MODR = ((% fish oil in feed + (% fishmeal in feed * % fish oil in fishmeal)) * FCR) / (% fish oil in salmon on whole fish basis)

Assuming fishmeal contains 68% protein and 8% fat, that fish oil is 100% oil, and that whole salmon contains 17.5% protein and 19.7% fat, respectively, as outlined by EWOS, in addition to our established assumptions regarding inclusion of both fishmeal and fish oil in feed, we get the following MPDR and MODR values (EWOS, 2010):

MPDR = (25% * 68% * 1.25) / (17.5%) = 1.21

MODR = ((15% + (25% * 8%)) * 1.25) / (19.7%) = 1.08

The nutrient-based approach gives the lowest ratio of the three FIFO methods, and is close to one. The nutrient-based approach eliminates any potential bias towards fatty fish, according to EWOS.

8.2.4 RESULTS FROM INTERVIEW WITH IMR

The representative said that most of the fishmeal and fish oil is mainly made from pelagic fish, thus bottom trawling is therefore not such an important issue for the salmon farming industry.

8.2.5 RESULTS FROM INTERVIEW WITH WWF

The representative mentioned the importance of looking at the current condition of the specific reduction fisheries rather than looking at fishmeal and fish oil production statistics. Just because production has remained stable does not mean that the fisheries in question are sustainable – they may for instance have been gradually overexploited over time. WWF also believed that one of the reasons MSC does not certify much of the fisheries that are used for fishmeal and fish oil is precisely because many of them are not sustainably managed. According to WWF, the problem with IFFO RS is that they, unlike MSC, do not do an independent evaluation of the sustainability of the different species, but rather just accepts and expects its

members to obey the capture quotas set by the various governments. In that way IFFO RS is more about following laws and regulations, in addition to being about food safety and to ensure traceability, rather than being about sustainability. An example illustrating this problem would be if a country set a non-sustainable quota. Since MSC does their own sustainability evaluations and the certified fisheries have to follow these guidelines, an MSC certification would ensure better sustainability than an IFFO RS certification in this regard. In a longer perspective, the representative also pointed out how it will be cheaper to adjust fishing policies now than say, in for example five years.

With regards to SAD and ASC, WWF feels the cooperation with Marine Harvest has been good, and said it is important that Marine Harvest was a part of SAD, as cooperation with the industry is likely to lead to more effective results (as the industry will then be a part of the solution). WWF said it will still take a couple of years before the ASC label will be in the stores. Furthermore, WWF stressed the importance of customers making conscious choices and influencing the industry that way.

8.3 SEA CAGES

8.3.1 RESULTS FROM INTERVIEW WITH MARINE HARVEST

Marine Harvest accepts and follows the standards set for organic salmon production, but the representative also said that the lower stocking density required for organic salmon production may seem random.

Regarding stocking density, Marine Harvest might move fish from one sea cage to another as the fish grows. With regards to stocking density, the representative said the differences between countries are due to different regulations and customer requirements. The representative considered stocking density as a highly practical and relevant issue as many factors must be considered (e.g. oxygen levels, temperatures in different water layers etc.). The representative could not answer what kind of focus Marine Harvest has on net deformations in relation to fish welfare. The representative could not tell whether artificial light was used during night time.

The representative said seaweed on the sea cages was flushed away while the fish are present in the sea cages, either with divers or with a hose-down machine supervised by divers. If there

is a lot of plankton on the nets, the representative also mentioned how wrasse will eat that instead of the lice on the salmon.

With regards to sewage, the representative said that criticism that compares fish sewage to human sewage is based on the amount of nutrients, but that only two percent of the supply of nutrients in Norwegian fjords comes from human activity (including aquaculture). The representative also pointed out how nutrients dissolve. Marine Harvest said that fallowing is done to counteract the effects of accumulation of particles on the seabed (not nutrients), so that nature can recover. Marine Harvest does not like the term “fish sewage”, which the representative thinks cannot be compared with sewage from human activities, partly because the fish have a different digestive system adapted to the environment they live in, and partly because fish sewage does not contain a lot of other waste materials as human sewage does. Still, fish sewage was a problem before when the production plants (sea cages) were in more shallow water, but to have such facilities is no longer economical, according to the representative.

8.3.2 RESULTS FROM INTERVIEW WITH CERMAQ

The representatives from Cermaq emphasized that the regulations in Canada do not contain any clauses regarding fallowing time. Despite this, Cermaq does conduct fallowing there. Cermaq fallows their sites longer than required by regulations, not because Cermaq considers this necessary (Cermaq believes that the statutory requirements are good enough), but rather as a result of the production planning process.

Cermaq does not use the biggest sea cages in Norway, so the Norwegian regulations stating a maximum of 200,000 fish in each sea cage does not create any consequences for Cermaq. Furthermore, Cermaq mainly uses ring (circular) cages in Norway, while in Chile and Canada they use rectangular cages in a row due to predator considerations (they claim it is easier to assign safety nets to rectangular cages). The representatives do not know what the requirement of stocking density is in Canada, but said that in Chile it was 16 kg/m³. Cermaq says they follow the legislation in this area for all the countries they operate in.

Regarding stocking density, Cermaq might occasionally relocate small fish as it grows. This would be done to achieve increased capacity utilization of the sea cages when the fish are smaller. When it comes to cage design, Cermaq said they brought with them general farming knowledge from Chile when they started up in Canada.

The representatives at Cermaq said that stocking density requirements are set in relation to total biomass distributed throughout the cage volume. However, because the fish shoals, Cermaq said stocking density will vary naturally within the cage anyway (some areas will have a much higher density than the requirement, while other areas a much lower density). Thus, the representatives do not perceive net deformations as a major problem. The representatives do not know what measures Cermaq might use to reduce net deformations, nor about the potential use of systems for the detection of stronger currents. They neither knew about the potential relocation of weights to prevent net deformations. The representatives however claimed that Cermaq continuously monitor the oxygen levels in the cages. Cermaq said there are problems with regards to the natural oxygen levels in the sea cages in Canada, and referred to Cermaq's quarterly reports to provide more detailed information regarding fish deaths due to low oxygen levels. Cermaq has attempted implementation of artificial oxygen in fish farms in Canada. The representatives have no direct opinion regarding the possible consequences of the oxygen level falling below 6.5 mg/liter, as well as if the fish's position in the cages may be monitored. In Norway, Cermaq said the tendency is that the sea cages are placed in harsh environments, which provides high oxygen levels. Therefore, they claim low oxygen levels are not a very relevant issue in Norway. Cermaq impregnates the sea cage nets to prevent algae blooming and use water jetting to clean the nets. According to the perception of the representatives, this is done without divers to prevent unnecessary risk taking.

Cermaq does continuous temperature measurements. As temperature affects the feeding, Cermaq says they therefore have a vested interest in that the temperature is correct. If it is very cold (close to zero or below, which occurs at Cermaq sites in northern Norway) the fish do not eat. The problems regarding sea lice and temperature are linked. The representatives further said that while in Norway there is weekly reporting of temperatures, authorities in Chile and Canada do not have systems to receive weekly temperature data. The representatives also claimed sea lice is a particular problem in Norway. Furthermore, they said that in northern Norway the growth is lower and as a consequence the EBIT/kg is normally lower, which in turn is reflected in the prices of licenses. Cermaq mentioned how Norway has higher temperature fluctuations than Chile and Canada. The representatives also said that algal blooms are a bigger problem than temperature in Canada. In Chile, the temperature was said to be stable and around 14 degrees Celsius. The representatives furthermore said that artificial light is used, but do not know to what extent. They pointed out that artificial light can affect fish welfare positively because the fish can otherwise smack into the net, etc. when it is dark.

Cermaq has no system of submergence, but find it an interesting topic. Cermaq do not appreciate the term sewage and believes it is misleading, because they think there are no hygiene risks associated with fish feces. Cermaq said sewage was previously a problem when the fish farms were located in shallower water, which then led to anaerobic decomposition of feed. Cermaq believes that the fish waste does not create problems for the operations, especially in Norway, as harsh weather conditions lead to rapid dispersion of it.

Regarding closed containment systems on land, Cermaq claims it will require much land and energy consumption (e.g. pumping water, adding oxygen). Sea based closed facilities still pose a problem regarding escapes, according to Cermaq. Cermaq then mentioned how a closed system in Canada (not Cermaq's however) was damaged by a storm subsequently leading to salmon escapes. However, ordinary sea cages remained unharmed and had no escapes. Cermaq said the density of closed containments in the sea is higher (75kg/m³). Cermaq believes that closed facilities can be interesting for research purposes. Cermaq through EWOS Innovation has tested closed facilities in the sea, and it turned out that there were problems getting the fish out of the tank. Cermaq claim it is too early to conclude anything on closed systems since the technology is developing rapidly. At present, due to the resource requirements, Cermaq feels closed containments are not a commercially viable alternative.

8.3.3 RESULTS FROM INTERVIEW WITH IMR

The representative was of the opinion that it is difficult to make judgments of fish welfare in sea cages. With regards to the measurements of stocking density, there has previously been a focus on the area of the sea cage. Now however the representative said the focus is related to the biomass (i.e. kg/m³). The representative claimed that the focus should be more concentrated on the number of fish in each cage. He further asserted that, since fish do not directly express satisfaction/dissatisfaction like other animals (except when presented to brailing and crowding), the scientific research on fish welfare is important with regards to an increased perception of responsibility for animal welfare. Furthermore, there is also a demand from the market that fish should experience good welfare and die happily. The representative further claimed that it is important to relocate the sea cages within different areas, in order to spread the waste from them (analogous to the need of spreading fertilizer on a big field rather than in concentration, as too high concentration would be detrimental in sea as well as on land. When considering closed containment systems, the representative felt there can be challenges regarding stocking density.

8.3.4 RESULTS FROM INTERVIEW WITH WWF

Regarding sea cages, the representative from WWF perceives the through flow of water as one of the most important environmental factors related to sea cages. Hence, oxygen levels are also important. When discussing location of sea cages, it is regarded as something more important than stocking density for WWF as they are an environmental organization and not an animal welfare organization. This is related to the oxygen levels and thus the currents.

When considering closed containment facilities, the representative said sea based containment facilities are preferred to land based. This is related to the required energy levels, and pilot projects with testing are seen as a necessity. In addition, to cope with the issues regarding stocking density, one would require an increased number of cages, which would thus occupy a greater sea area. The representative said the energy costs of the companies need to be related to the savings due to reduced feed waste, which occurs at traditional sea cages. Moreover, there might be risks associated with new diseases arising. There is however, not enough research on this topic. Since WWF are just considering environmental topics, they could not express any thoughts on fish welfare regarding sea cages.

8.4 ESCAPING

8.4.1 RESULTS FROM INTERVIEW WITH MARINE HARVEST

The representative believes it is more likely that escapes do have effects on wild salmon than not. Marine Harvest therefore has a zero escape policy. To help clear up the myth of escapes, the representative claimed tagging is a measure to make the companies accountable, but at the same time said assessments are needed to determine which tagging method is best suited. Wire-tagging or other physical markings were mentioned as alternatives.

The representative said it is not very likely that Marine Harvest has hidden statistics regarding escapes. As a major player, the representative pointed out that the risk of being exposed and thus lose credibility is too big, and hence works as a deterrent. The representative furthermore pointed out the importance of not criticizing the entire industry if escapes occur from a single irresponsible player. Marine Harvest believes that this is analogous to examples of poor conditions on some regular farms. When escapes occur, Marine Harvest places recapture nets and alerts local fishermen. The recapture rate varies a lot, from a few % to 50 %. In 2011, Marine

Harvest had six cases of escapes in Norway (six fish), as well as an escape incident in Canada involving two fish.

The representative knew about one river in the Hardanger fjord where wild salmon had reappeared, after being absent for many years. Marine Harvest thinks there is an uncertain cause-effect relationship with regards to this, as many factors can play a part. The representative furthermore referred to the NYTEK regulations, which will imply entire sea cage facilities to be certified. Until now, separate parts of the sea cages have been certified separately with the risk that individual parts do not fit well enough together in overall terms. The representative did not have an overview of penalty levels across countries related to escape incidents, but admitted the company has received fines. Furthermore, the representative also said that the survival rate of escaped salmon is from close to 0 % up to 6 % according to scientists, but that the rate is higher if sexually mature fish escape during late summer or autumn.

8.4.2 RESULTS FROM INTERVIEW WITH CERMAQ

The Group had two fish that escaped in 2011, which was related to the slaughtering process. The fish disappeared from a tube/hose. Cermaq says efforts against escaping are a win-win situation, where Cermaq has great interests in avoiding escapes since it directly affect the EBIT.

Cermaq says that tagging does not prevent escapes, but is appropriate in the future with the purpose of separating wild salmon from farmed salmon, as well as to determine which fish farm is guilty. Regular routine and quality checks on cages (e.g. ropes, chains, bottom chains) are essential to prevent escapes. Human errors explain more often reasons behind escapes than the equipment. Therefore, focus is centered on procedures and operational aspects. However, the representatives also claim many escapes happen because of friction between the bottom chain (used for mooring) and the sea cage nets. Hence, Cermaq perceive that the use of ropes can be a better alternative than using chains.

There has been some escape incidents related to delousing processes which include bath treatments. This process was getting more difficult with new regulations. This is often seen as a dangerous process because you have to cover the whole sea cage with a tarpaulin, and then pull up the bottom edge of the sea cage. Cermaq's employees working in Mainstream do training operations on delousing procedures in empty sea cages. The training process includes test colors to simulate the bath treatment and to test the dispersion of the treatment in the

cage. The training is followed by controlling the sea cages. Cermaq say they continuously prepare checkpoints in this regard, and the representatives also pointed out the importance of exchanging experiences in this area, since the delousing process is risky. Hence, the companies need to learn from each other's experiences. In general, there are always risks of escapes related to operational processes. Cermaq, through EWOS Innovation, have reported a small scale escape incident in 2012, but the numbers are not yet clarified.

Mainstream Canada is drawn towards the NYTEK-regulation when it comes to standardizing sea cages. In Chile, Cermaq uses mainly squared sea cages with surrounding predator nets in place. This is because large sea lions have great prevalence in Chile, and surrounding nets prevent sea lions getting close to the sea cages. The fish becomes afraid when there are threatening sea lions close by, resulting in fish stress. The representatives claimed operators could look at the fish's behavior and determine whether there were sea lions close by or not. Mainstream Chile uses noise/sound to scare predators, but this is done with care because predators learn to associate the sound with fish presence in the cage. Thus, there is a danger that the sound is counterproductive.

The representatives claims Atlantic salmon cannot adapt to the wild in Canada, and that in Chile there is no natural presence of salmon (all salmon south of the equator is brought by humans). Thus, they claim escape to be a particular Norwegian problem. Moreover, Atlantic salmon do not mate with Pacific salmon (which could have been a problem in Canada) according to the representatives. In Chile and Canada, Cermaq feel there are no genetic problems, but Cermaq focuses on a precautionary principle in Norway. The representatives assert that problems in Norway are explained by the fact that farmed salmon often destroys wild salmon's spawning pits and also mate with wild salmon. They perceive the solution to the gene problem of escapes once they have happened to be tagging. The representatives proclaimed that tagging arrangements must be adapted efficiently and be used by every industry participant. They signal that other institutions than the companies themselves must be responsible for genetic research. The representatives at Cermaq know a lot about research, including that the results are contradictory. Therefore, they think it is good that the Norwegian Research Council has taken an initiative to collect and clarify what is known and how the seemingly contradictory conclusions can be explained. The representatives are emphasizing however, that this does not mean a limitation of Cermaq's responsibility.

The representatives could not tell what kind of insurance schemes are connected to escapes, but pointed out that it was unlikely that there were arrangements that cover all losses for any reason (i.e. more likely to cover situations related to storms etc.)

8.4.3 RESULTS FROM INTERVIEW WITH IMR

The representative stated reporting as an important issue regarding escaping. The banks and insurance companies have a challenge related to the understanding of all aspects regarding the industry. Hence, problems can often be seen in relation to companies trying to mislead banks (e.g. reporting higher numbers of currently held fish – getting the assets increased) and thereby getting better terms. Also, challenges are related to the stock market and risks associated with reporting escapes can lead to volatile share prices.

The representative said the current farmed salmon is the 10th generation of farmed salmon, and that its genes are a mixture of salmon genes from all over Norway. As for gene interaction between farmed and wild salmon, the representative claims in our interview that escapes are not harmful – it is perceived as leading to increased genetic variations (increased heterozygosity) of the wild salmon, which is a good thing. The fact that a small portion of the wild salmon populations naturally “forget where they came from” and subsequently return to spawn in a different river than where they were born is a bit analogous to escaping.

8.4.4 RESULTS FROM INTERVIEW WITH WWF

Implementation of tagging was according to the representative, undisputable and should be prepared. Moreover, human failures were among the prevalent explanation factors and routines as well as check lists should be implemented. In this sense, staff training should be prioritized. In addition, the equipment is also a focus area and a monitoring system is needed to keep track of it. Thus, it should be systems in place to cope with eventualities such as breakdowns. The representative also focuses on the sea cages to be constructed in a way that they can withstand boat collisions. These are examples of preventative implementation, but the representative also stressed the need for tagging. Hence, coded-wire tags (in snout) could be implemented simultaneously as the fish were vaccinated to ease the burden of the companies. The representative however, did not perceive WWF to take part in the discussion of what kind of tagging that is best suited for implementation. The most important thing for WWF is that it is easy to trace fish back to the location it escaped from.

8.5 SEA LICE

8.5.1 RESULTS FROM INTERVIEW WITH MARINE HARVEST

The representative could not tell the extent of the sea lice problem, and perceive that no one else can determine this scientifically. Annually, Marine Harvest Norway spends NOK 250 millions to combat sea lice. In addition, sea lice bring additional costs such as loss of feed etc.

The representative asks the rhetorical question: “What is a sustainable level of lice?” Moreover, the representative thinks the scope of the sea lice issue is complex, and used the following thought experiment to illustrate the point: “Assume there are 100,000 fish in each sea cage, and cages are scattered over an area. If the sea lice infestation levels equal zero or is very low for several months, how can one then say, or reasonably assume, that wild smolts are infected with lice from fish farms as they swim past the facilities? Marine Harvest has a portfolio of ongoing research projects to increase the chance that at least one of them will be a good way to combat lice in the future. One a side note, Marine Harvest stressed the need to distinguish escapes (policies) from the consequences of escapes (environmental problems). With regards to treatment against sea lice, the representative alerts us to the discussion of action levels vs. statutory levels. A wide-spread opinion has been that statutory levels may lead to over treatment and resistance among the lice, according to the representative. Marine Harvest however has not concluded on what they think is best, but do not think statutory levels lead to over treatment and resistance. The representative mentions several methods which can be used to avoid resistance among sea lice (e.g. zones, fallowing and product rotation). Regarding rotation of medicines; the lice which is not killed by the first product is killed by the next one. It was also mentioned how there are different types of sea lice in Chile than in Norway and that spring delousing is required by law in Norway.

The representative proceeded to talk about Vivian Krause, who is a Canadian woman who has looked at the funding of various organizations that oppose the salmon farming industry. She found, according to the representative, that some of these organizations had been given earmarked funds specifically for the purpose of changing consumer preferences from farmed salmon to wild salmon. The representative pointed out that Marine Harvest does not support her, nor are suspicious of their critics in general. The representative asked the open question whether “Redd villaksen”, a Norwegian organization working for the well-being of wild salmon, is actually perhaps better labeled as an organization against aquaculture in general, as

the representative thinks there is a inconsistency with regards to the mission of “Redd vil-laksen” and their arguments. Furthermore, Marine Harvest said they are willing to talk to everyone who is fact-oriented and interested in a mutual dialogue.

With regards to wrasse, it is not a new phenomenon, according to the representative. Wrasse was used in the early 1990s. In 2001 Slice (a functional feed) proved effective against sea lice. The good results lead to other measures being put on hold. But as the lice got resistant to Slice in 2008, the sea lice crisis emerged. Now, wrasse is again in focus. Marine Harvest says it is out of the question to introduce ballan wrasse to Chile as that would involve introducing a new species to a non-native environment.

8.5.2 RESULTS FROM INTERVIEW WITH CERMAQ

Cermaq acknowledges that sea lice affect their operations, but claims there are few lice on their farms and refer to sustainability reports to back up these claims. The representatives we spoke with at Cermaq said that the responsibility of the industry cannot be measured by looking at the well-being of wild salmon, because many factors apart from fish farming may influence wild salmon. They claimed that the industry, including Cermaq, should of course take responsibility for the potential negative impact it has on wild salmon.

Cermaq has separate delousing programs in Chile, Canada and Norway (among other reasons because of different types of sea lice). There are also less sea lice in colder waters. In Nordland Cermaq controls a large area encompassing only Cermaq farms. This has given Cermaq the opportunity to coordinate delousing programs for a large area, which has given good results. This is what Cermaq calls; area management. The goal is to optimize the biological production and risk in relation to sickness and lice. Preventive treatment is important, not just treatment. Cermaq says it is challenging to coordinate sea lice treatment when there are many players, and that they have had 10 years of coordinated treatment on farms in Nordland. Cermaq reports externally overall sea lice statistics, but only internally for every delousing method. Furthermore, Cermaq does not use wrasse, as it would not thrive as far north where Cermaq’s farms are. Cermaq is not interested in introducing wrasse to Canada or Chile because it does not exist native there and it would be illegal to do so.

Regarding action levels vs. statutory levels, Cermaq feels there should be a balance between the numbers of sea lice on the fish and how often one should start treatment. Cermaq thinks this is what the authorities have done, which is good. Experts may also disagree on how to

conduct treatment in different areas. EWOS has launched a feed type which prevents the lice from attaching itself to the fish. However, sick fish does not eat, and this can create challenges in treating sick fish (with functional feeds). When considering adding supplements to the feed as a preventive measure it is important to also consider the taste of the feed.

Bath treatments cause stress in general, especially hydrogen peroxide. Bath treatments can be done in well-boats, which will make delousing easier. With bath treatments one will lose several days worth of growth, and some units (i.e. local fish farms) have calculated the cost of this (which equals (loss of weight) * (kilo price)). But this is not something Cermaq calculates centrally, it is only decentralized information. Cermaq furthermore mentions how spring delousing is required by law in Norway, and that Cermaq is involved in the salmon louse genome project FUGE together with other companies. Cermaq also says they consider it important to rotate the different initiatives in the treatment of salmon lice, so that one prevents resistance. Therefore one cannot solely rely on one single treatment. Whether one uses feed as source of treatment or e.g. bath treatment is of less importance. The ability to alternate treatments is more important.

8.5.3 RESULTS FROM INTERVIEW WITH IMR

The representative stated that the main problem regarding the use of wrasse is efficiency, i.e. the problem of having either too little or too much wrasse. For instance, wrasse will eat the eyes of the salmon if there are not enough lice. The representative also said that the salmon may eat the wrasse. In general the representative feels virus is a worse issue than sea lice. SFI (Senter for Forskningsdrevet Innovasjon) spends NOK 20 million a year researching salmon lice.

8.5.4 RESULTS FROM INTERVIEW WITH WWF

The representative we spoke to at WWF mentioned hydrogen peroxide and mechanical delousing through hosing down the fish, as examples of sea lice treatment. WWF opposed introducing ballan wrasse to Chile as it is not a native species there. However, Atlantic salmon in Chile, which is also not native there, has been there for decades and come to stay. Issues related to Chilean salmon farming must be resolved on Chilean premises, not Norwegian.

8.6 THE SLAUGHTER PROCESS

8.6.1 RESULTS FROM INTERVIEW WITH MARINE HARVEST

The representative claimed Marine Harvest is subject to more thorough certification schemes than Nortura. With regards to the stunning methods, Marine Harvest said electrical stunning can lead to internal bleeding. Marine Harvest received many inquiries regarding CO₂ as a stunning method and the opinions on whether CO₂ is a humane stunning method differed. The representative could not tell whether CO₂ as well as which slaughtering method was used in Chile. With new investments in Chile, there will be focus on more automated processes however. This is also because of efficiency considerations. The representative could not tell if stunning methods were used as a part of the slaughter process in all slaughterhouses used by Marine Harvest.

Marine Harvest has an employee in Bergen who works almost exclusively with slaughter methods. Marine Harvest has considered whether to define acceptable margins of errors related to stunning. According to the representative, the slaughter process is a difficult subject, and it was also pointed out how the authorities accept margins of errors in both aquaculture and farming.

Marine Harvest has four slaughter plants in Norway, two in Canada, one in Chile, one in Scotland (manually operated) and has outsourced the slaughter process in the Faroe Islands. Consolidation of slaughterhouses creates greater efficiency and is a desired direction to move.

Marine Harvest has implemented the alternative slaughter process (slaughter on boat right by the sea cage) in Norway with one boat. The representative claims there are benefits related to transporting dead fish in confined areas, like for example avoiding getting jellyfish into the well-boat when the fish is pumped from the sea cage (i.e. an issue when transporting live fish to slaughterhouses the traditional way). One also avoids the risks of transferring sea lice eggs and pathogens when the fish is unloaded to the waiting cages prior to slaughter.

Another advantage is increased efficiency and reduced energy consumption (less CO₂ emissions). The disadvantage is that it is more expensive. The representative also mentioned that live fish could be transported with boats with the ability to be temporarily closed. Such boats could for example be closed in coastal waters, to e.g. help prevent the spreading of disease,

but remain open at sea. If such boats are closed too long however, the representative pointed out that ammonia may be created, and that this would lead to fish death.

Marine Harvest has invested NOK400-500 million in slaughterhouses in Norway the recent years. The representative also mentioned how laws, regulations and customer standards like for example “freedom food” in the UK, affect the harvest methods.

The representative could not offhand tell what Marine Harvest’s stance is with regards to whether fish feel pain or not (“the fish wriggles both before and after it is dead”). But the representative said Marine Harvest complies with existing laws and regulations.

8.6.2 RESULTS FROM INTERVIEW WITH CERMAQ

In Canada, Cermaq owns one slaughterhouse and outsources through another. They do not report for the outsourced slaughterhouse. In Chile, they own two slaughterhouses, while in Norway they own three. The slaughterhouses in Norway also have capacity to process slaughtering for other fish farming companies.

Cermaq has no focus on rigor mortis since the products do not reach out to customers during this time anyway (up to 24 hours). From Norway, there is truck transportation to the rest of Europe. From Chile the fish is transported to the east coast of the United States, Latin America and to Japan. From Canada, there are sales to the west coast of the United States.

Cermaq measure cortisol levels in fish (as an indicator of stress level). This is not done for every fish, but as a part of optimizing the production and thus implement adjustments reducing fish stress. However, the focus has been mostly regarding the transferring of smolts to sea cages.

The representatives could not tell much about pipe systems and brailing. They perceive advantages regarding waiting cages prior to slaughtering as it contributes to calm down the fish after being transported. The representatives could not tell what kind of stunning methods were used (with the exception of the kind that was used in Scotland, but that business unit is now sold). Stunning methods is not a focus area for the two representatives. Neither could the representatives present any statistics regarding stunning methods.

The representatives do not know why the slaughter method at boat right by sea cages is not used by Cermaq. Despite the method is not in use, the representatives find this method satisfactory in terms of the hygiene factor. In addition, they consider this method good for fish

stress levels. With regards to whether fish feel pain or not, the representatives claim they support the experts who say that salmon feel pain, and have established requirements for slaughter based on this.

8.6.3 RESULTS FROM INTERVIEW WITH IMR

Related to the slaughter process, the representative was claiming there were minor developments regarding slaughter processes in fish farming. Hence, in countries where labor is cheap, the slaughterhouses mainly use manual stunning methods (e.g. a manual stroke by a priest to the fish head)⁴⁵. Regarding the method of slaughtering at boat by sea cages, the representative were claiming major hygiene concerns, as bacteria and viruses harmful to humans could easily spread among the fish when transporting dead animals.

8.6.4 RESULTS FROM INTERVIEW WITH WWF

Since WWF does not have any focus on fish welfare, they have not considered slaughter methods. However, they say that waiting cages used prior to slaughtering are problematic, because they are placed close to shore followed by risks of poor water flows, leading to ecological problems. Waiting cages are also problematic as it can spread sea lice and viruses when the fish is waiting since you cannot treat with chemicals in the holding pen. As a result, they perceive that slaughter at boat by sea cages can be a better alternative. In that regard the representative remarks the necessity of ensuring proper water circulation in addition to good waste management.

8.6.5 RESULTS FROM FIELD TRIP TO SLAKTERIET BREKKE

In this slaughterhouse they were using an electrical stunning machine and an automatic gill cutting machine. The gill cutting machine was an expensive high-tech machine equipped with lasers to ensure proper gill cutting. It was highly accurate, and the machine even recognized when fish came in backwards (i.e. tail first), and ensured correct gill cutting of these fish too. However, nearly all the fish came in with head first. We were astonished by the accuracy of the machine and soon realized that humans could never have achieved the same accurate handling of the gill cutting, at least not during an entire work shift. To additionally ensure that all fish were gill cut prior to entering the bleeding area (bath), two operators were manually

⁴⁵ Wooden or polypropylene priest (Roth, Slinde & Robb, 2007).


checking/re-cutting using a knife, as needed. We perceived the stunning and gutting process as very professional and highly controlled. The fish seemed to get immediately immobile and we never saw any wriggling activity subsequent of stunning, with the exception of one fish. With regards to determining the voltages used, they did not adjust continuously, but instead adjusted the right amount of voltages in the morning. Since all fish were almost of equal size there was no need for adjusting. Hence, the first few fish in the morning were kind of “test fish” with regards to the voltage amount, and for controlling that the equipment functioned as normal. Those fish were properly monitored and the staff claimed proper voltage were important, to prevent the risks of fish’ braking the vertebrae. The further processing was also highly logistically efficient, including an automated gutting machine.

When considering the steps prior to stunning, the slaughterhouse was equipped with six waiting cages in the bay right outside the slaughterhouse. Nets used in the cages were adjusted both manually and by an electric engine. The operator controlled the efficiency of the pump by tightening or loosening the nets, as that subsequently increased or decreased the stocking density and the number of fish being sucked in. Vacuum pumps were used and there were water in the pipes at all times, so the fish was not out of water for more than around 5 seconds (our estimate) (i.e. when entering the stunning device prior to gill cutting). Since there were six waiting cages, the distance of pumping was longer from the cages furthest away, perhaps somewhere between 40-60 meters (our estimate). There was one bend of 90° related to the pumping process. Crowding was indirectly adjusted by the processing speed in the slaughterhouse. When there were too much fish entering the stunning machine, workers turned on a red light which showed the operator outside (who controlled the crowding) to loosen the nets (making the waiting cage larger again – more space for the fish). On the contrary, when a white light was turned on, it meant there was unutilized capacity in the slaughterhouse, and the operator could then tighten the nets to increase crowding and thus pumping efficiency. As we can derive, the brailing process controls the sequences and intensity in the rest of the slaughter process. When looking at all waste (e.g. intestines) handling, it was collected and nothing was thrown away. In addition, the directors asserted that all water that was discharged into the fjord was properly cleaned and there was even a three kilometer long discharge tube (out in the fjord) with the purpose of ensuring good environmental water circulation.

When the equipment investments were done, the representative said they had to consider the percussive vs. electrical stunning methods. They chose electrical as he perceived the percus-

sive stunning machine as very noisy. Every stroke gave a sharp sound. On the contrary, we perceived the electrical stunning machine to only make minor noises.

In our conversation with the director, he was as amazed as us, with regard to the high-tech slaughter process. They had an annual harvesting volume of 12,000 tonnes (which constitutes close to 2.5 million fish if average weight is around 5 kg). The representative said that one could slaughter just 20 % of current volume if everything was done manually, with his point being that it would simply have been impossible to achieve an economic viable result with a less efficient slaughter method. This is also correlated with the fact that they were only doing the slaughter process (even not filleting) and got NOK 2.5/kg. They did not have their own fish farms, but were just one link of the total value chain. As a small participant in the fish farming industry, the director was claiming there were too many parts attending the value chain that claimed profit on the fish. Hence, an annual harvesting volume of < 10,000 tonnes would simply not be economically viable to keep up with monthly payrolls for the 35 employees (whereas 30 % were mostly Lithuanian and Russian). Moreover, in the representative's perspective, he was more than satisfied if the operations of Slakteriet Brekke could provide the monthly salary to its employees. As being a minor player, the representative claimed Slakteriet Brekke could exert a responsible practice since communication and adaptations can be done easier than in larger organizations.



9 ANALYSIS II – EMPIRICAL INVESTIGATION

9.1 GENERAL CONSIDERATIONS

When considering how the CSR performance of Marine Harvest and Cermaq fit the FFE model, one must keep in mind that we are basing our assumptions on a partial fragmented picture. Difficulties have arisen as our indicative questions fell way beyond the scope of what the companies could/would share with us. This was particularly the case with Marine Harvest, as the representative claimed they would not participate in this master thesis if we had intentions to carry out the prepared questionnaire sent out to them in advance.⁴⁶ The reluctant behavior of Marine Harvest was mostly related to the level of detail in our questionnaire, when the representative claimed this was far beyond what they reported publicly. Instead we therefore agreed to talk to Marine Harvest at a more overall and general level within the context areas. Cermaq had a different attitude towards the questionnaire, as they said they were impressed with the quality of the questions. In addition, they said that our questions brought added value to them as it would help maintaining their awareness on important focus areas. However, despite they admitted upfront that they would not be able to answer all of our questions, we do have more comprehensive results with regards to Cermaq and this is reflected in some areas of the analysis. The lack of answers on certain questions has given us challenges with regards to evaluating the CSR practice of the two companies. Despite these constraints, we have tried to make best use of the information we did get.

One could always ask questions like: Were the questionnaires properly conducted? Were the authors too optimistic about what information they intended to achieve? Was the gap between the literature review in the context areas and the companies' knowledge too high? Since we always had the target of getting a deeper understanding of how the major fish farming players Marine Harvest and Cermaq perform their CSR practices, we thus wanted to pursue the analysis despite the difficulties that have occurred. Therefore, based on these underlying concerns, one must be careful not to make an overall definite conclusion that applies to the two companies. With this in mind, one could perceive our analysis more as an entry analysis. This analysis can be regarded as useful however, since important thoughts and practices are discussed.

⁴⁶ Similar to the one presented for Cermaq (cf. chapter 13.1).

Moreover, the issues discussed could shed light over some vital aspects of the two companies' performances; useful knowledge for the companies itself, authorities, researchers as well as the broader society.

9.2 THE BROADER CSR PERSPECTIVES OF MARINE HARVEST AND CERMAQ

With its ecological undertone, both Marine Harvest and Cermaq rely on the sustainability terminology. We can understand from the perception of Marine Harvest, that they do not find themselves comfortable with the term CSR. We can discover the approach equally to Friedman (1970) and Jensen (2010b), cf. chapter 3.2.2, when the representative from Marine Harvest is stating: "To expect that companies in a western democracy like Norway should do activities beyond or in addition to what is required by laws and regulations, is a bit like invalidating the governing authorities". On the contrary, Cermaq is stating that: "Sustainable development is a social goal and CSR is the industry's answer to achieve that goal". So, if we apply the thoughts of Marine Harvest into the perception of Cermaq it will be the same as saying that sustainable development is impossible! In addition, the perception of Cermaq can be interpreted as sustainable development is not possible with just following the regulations. Thus, this can be a warning sign for the regulatory authorities, and confirming a lack of control.

It is worth mentioning a few more words about Marine Harvest's view on CSR. It should be obvious that a company cannot simply proclaim that the term CSR do not apply to them, as Marine Harvest tries to do by saying that they instead focus on the four "P"s. CSR is not about what you say, but what you do. Every company can perform their activities more or less responsibly, and this is what CSR is about. The representative of Marine Harvest displays a lack of understanding of the term CSR when stating that the term, and thus the need to operate properly, does not apply to them, and that doing business is likely to conflict with society. If Marine Harvest takes what is said in the "P" for "Planet" seriously, they would automatically be doing a lot of good in terms of CSR; for society, for their own reputation, and perhaps also create some competitive advantage. Hence, despite Marine Harvest saying that they do not perform CSR, we will still analyze Marine Harvest's activities up against the term CSR, and thereafter measure their CSR performance.

When Marine Harvest claims the term CSR gives an impression that doing business is likely to conflict with the society, one can clearly perceive them to take a distinctive shareholder

perspective. This can also be reflected in the dividend history of 2009-2011, so it is thus not surprising that the shareholders are the top priority stakeholders. The ideas of strategic CSR presented by Porter and Kramer (2006, cf. chapter 3.2.3), could, according to the ideas presented by the representative at Marine Harvest, fall apart when practices set by regulatory authorities are the basis for business. Moreover, a reconfiguring of the competitive landscape presented by Husted and Allen (2007, cf. chapter 3.2.3), could also fall beyond the scope of possible opportunities when the main unit to possess the ability to make a reconfiguration is the regulatory authorities. If both Marine Harvest and Cermaq would only focus on following the regulations, they would exert similar fish farming practice. Then it would be difficult to create competitive advantages through changing the value chain activities (e.g. mapping social opportunities through an “inside-out perspective” by Porter & Kramer, 2006).

Based on what the two companies say about their overall CSR perspectives, what can we expect in line with the FFE model when we analyze further? As Marine Harvest says they do much more than what is required by laws and regulations, they indirectly proclaim themselves to fall within either the 3rd, 4th or 5th level within the CSR pyramid developed by Bach and Reid (1991, cited in Nordhaug, 2011, cf. chapter 3.2.1). However, since Marine Harvest considers laws and regulations as the basis for doing business, they indirectly admit that they cannot fall within the highest level. The representative’s statement of “doing much more” seems to better resonate with the 4th level, *Emerging ethical*, rather than the 3rd level. As mentioned in the results (cf. chapter 8.1.1) Marine Harvest relates to sustainability through their 4 P’s. Since “Planet” is the “P” where sustainability is covered, this can be seen as some sort of ethical objective. The “P” for “Profit” also indicates that the economic perspective is considered. However, the statements from Marine Harvest’s representative are inconsistent when it is stated that the term CSR frequently gives “an impression that doing business is likely to conflict with society, and that one therefore in addition to normal operations, has to act “socially responsible”. Doing a lot more things than what is required by law and regulations, is exactly what CSR can be about. With regards to Cermaq, when they say that CSR is the industry’s answer to achieve sustainability, this kind of statement also indicate that one can expect Cermaq’s CSR practice to be higher than what is in line with the 3rd level of the CSR pyramid. This reasoning should also be seen in relation to how Cermaq’s representatives said the entire corporate culture was pervaded with a focus on sustainability. However, both Marine Harvest’s and Cermaq’s focus on sustainability (and lack of focus on ichthyology) means that ichthyological considerations in line with the FFE model might be ignored. Hence, before

a further analysis is done, one would assume that both companies will score well with regards to the ecological perspective, but not so well with regards to the ichthyological perspective. In the following analyses, we will investigate the five context areas in detail to see if there is a correlation between how Marine Harvest and Cermaq perceive themselves, according to our analysis so far, and what they actually do.

Before we start on the context-area specific analysis, we wish to establish a few key assumptions we make. In general, when key employees like the ones we have talked to lack knowledge on certain issues, we interpret this to mean that the lack of focus is equal to a lack of priority. We understand that even key employees like the ones we talked to cannot know everything. Hence, an alternative interpretation of their inability to answer certain questions could be to remain neutral and not conclude anything at all. However, we think that the inability to answer important questions or simply answering “do not know” clearly shows a lack of focus on said areas. Just because external stakeholders rarely ask certain important questions, does not, in our eyes, excuse the companies from not having considered or taken a stance on the issues. Hence, a lack of answer or simply answering “do not know” is likely to count more negative than neutral in our eyes. We admit to this potential observer bias, but nonetheless stand by it, as we can only analyze the information actually available. We also wish to emphasize that we only analyze the information from the results chapter. The limited time the companies gave us, as well as our inability to ask follow-up questions, or go back to one company to ask for their opinion on a matter raised by the other company, means that the analysis will not be as comparative as we would like.

9.3 THE CSR PERFORMANCE WITHIN THE CONTEXT AREAS OF MARINE HARVEST AND CERMAQ

9.3.1 FISH FEED

If indeed the sustainability of some of the reduction fisheries are threatened like the representative from WWF claimed, and that it is exactly for this reason that MSC certify little fishmeal and fish oil, then Cermaq, when they gave us the impression that acquiring MSC certification was not a priority since MSC primarily certify for human consumption, can be said to follow a moral disengagement strategy (cf. chapter 3.3.3). More precisely, Cermaq would then be guilty of a moral justification and a displacement of responsibility strategy. The former strategy would apply because Cermaq justified not acquiring MSC certification be-

cause it was hard to get. The latter strategy could be linked to how Cermaq displaced the responsibility of securing sustainability of the reduction fisheries to MSC as a certifier rather than more actively taking this responsibility themselves. Cermaq's support of IFFO's training program to help more suppliers fulfill the IFFO RS requirements fits with how they see CSR as the answer to sustainability, but they might be "betting on the wrong horse", if indeed WWF is right in their criticism of IFFO RS.

Marine Harvest can also be accused of pursuing a moral disengagement strategy when their representative drew Figure 8-1 (cf. chapter 8.2.1). In that figure, Marine Harvest is seen as just one out of many players in the fish feed value chain. While it might be true that Marine Harvest has limited influence, they have always the choice whether they want to play along or not. Figure 8-1 by Marine Harvest therefore seems to represent a diffusion of responsibility strategy, where Marine Harvest tries to get support for having limited influence and thus responsibility. By downplaying their importance and putting the responsibility on other links in the value chain, the end result may be that no one really takes responsibility. It is interesting to note how also Cermaq, which is backwards integrated through their ownership of EWOS, says they cannot use extra power backwards in the value chain because there are so many other potential buyers of fishmeal and fish oil. Since Cermaq is involved in more parts of the value chain than Marine Harvest with regards to the sourcing of fish feed, Cermaq should have, according to Porter and Kramer (2006, cf. chapter 3.2.3), a greater potential to solve a larger extent of the impact their activities have. Such an approach could be placed in a social dimension of a competitive context as stated by Porter and Kramer (2006), which can give Cermaq a better opportunity to leverage their capabilities to create competitive advantage (e.g. development of more responsible fish feed, use alternative ingredients). The fact that Cermaq said EWOS makes their influence further back in the value chain weaker rather than stronger, is in clear conflict with this view. Comparatively, it is interesting to note how both Marine Harvest and Cermaq downplay their influence backwards in the value chain in this regard. This means that if Marine Harvest's and Cermaq's sourcing of fishmeal and fish oil is sustainable, it would not be so due to their own efforts, but rather mostly due to other players in the value chain taking responsibility. While Marine Harvest say they care about sustainability and consider it important (cf. e.g. Marine Harvest's "P" for "Planet"), it is odd that they could not tell how much of their fishmeal and fish oil which came from MSC and/or IFFO RS certified fisheries. This discrepancy fits well with what McWilliams, Siegel and Wright (2006, cf. chapter 3.2.3), said about companies often scattering fuzzy words in their annual

reports, which in combination with a lack of candid information makes it hard to find true motivations behind CSR. From the fishmeal and fish oil suppliers' perspective, Marine Harvest and Cermaq might not have enough power, in line with Mitchell, Agle and Wood's (1997) stakeholder model (cf. Figure 3-2 in chapter 3.2.2), to force a more responsible production of fishmeal and fish oil. This argument may therefore explain Marine Harvest's and Cermaq's behavior, but due to the responsibility triangle of Ims (2006, cited in Jørgensen & Pedersen, 2011, cf. chapter 3.3.4), not justify it, as the companies themselves can also be said to have a personal responsibility at the overall level (the responsibility triangle will be discussed more in detail in chapter 9.5).

We agree however when the representative of Marine Harvest pointed out the need to address certain questions at a more political level. The concern that reduction fisheries deprive poor people of a cheap source of protein is perhaps analogous to asking if modern beef production causes water scarcity or starvation, considering how much water cattle drinks and how high their FCR is, which is considerably higher than that of farmed salmon. Given the relative low FIFO ratios for farmed salmon, this indicates that eating farmed salmon is less resource-consuming than eating beef. With regards to Figure 4-1 (cf. chapter 4.1.7) the input to the economic cycle of cattle production will be different than that of fish. Unless this fact is taken into consideration, directly comparing FCR's and FIFO ratios where applicable should not be done uncritically, since qualitative judgments regarding for example the sustainability of the reduction fisheries must also be made. Marine Harvest's point of addressing certain questions at a political level can be related to Besley and Ghatak's (2007, cf. chapter 3.2.1) discussion of how to ensure provision of public goods. Considering how the world's meat consumption is rising, as well as how resource-inefficient it is to eat for example beef instead of farmed salmon, it might indeed be appropriate to ask rhetorical questions on vegetarianism. In other words, the criticism that industrial fish ought to be used for direct human consumption rather than as an ingredient in fish feed, is a criticism which is probably even more valid for ordinary meat production, considering that even the FCR^{ADJUSTED} is comparatively low. Hence, Marine Harvest's point of addressing certain questions at a more political level is appropriate in our views, but perhaps a sidetrack.

But in general, if Marine Harvest or Cermaq argue favorably about salmon farming due to salmon's low FCR compared to the FCR of land based animals, this would represent a moral disengagement strategy of the advantageous comparison type. The lower FCR of farmed salmon does not mean much if the reduction fisheries are not sustainable. In addition, with

reference to chapter 2.1.3, we remember that the normal FCR is lower, and therefore less accurate, than the $FCR^{ADJUSTED}$ when comparing FCR's between animals and fish. If Marine Harvest operates with an FCR close the global average (of 1.25), it should be clear that such a low number is misleading when compared to the $FCR^{ADJUSTED}$ (of 2.2). It is also misleading when Cermaq operates with their own MPDR and MODR ratios opposed to the traditional FIFO ratios. Cermaq's MPDR and MODR ratios were 1.21 and 1.08 in 2010, as shown in chapter 8.2.3. Cermaq's use of MPDR and MODR ratios instead of traditional FIFO ratios can be seen as a moral disengagement strategy of the euphemistic labeling type, because although the lower ratio obtained from MPDR and MODR puts Cermaq in a better light, that method might not be the most appropriate one from a sustainability perspective. In this sense, one can draw parallels to Luetkenhorst (2004, cf. chapter 3.2.1), who states that some CRS motives may be defensively oriented, with the aim of protecting image and reputation. One could thus say that Cermaq, in making their own formulas with the purpose of putting themselves in a more favorable light, recognizes an external pressure to be more sustainable, and that the MPDR and MODR formulas represent an attempt to lower their ecological footprint on the visual arena. In the author's perceptions however, this attempt fails upon closer inspection.

The viewpoint of the representative of Marine Harvest, when stating that FIFO ratios are a bit meaningless, coupled with the analogy that eating just a sheep's head is equivalent to eating a sheep, does not make sense to us at all. If one does not eat sheep when eating sheep's head, then what is one really eating? It is impossible to kill *just* the sheep's head, and the same argument will of course apply to fish. If the representative meant to criticize the approach to FIFO ratios as of that from Tacon and Metian (2008, cf. chapter 2.1.4), i.e. $FIFO^{Tacon \& Metian}$, then we would agree in that criticism. But refuting the concept of FIFO ratios all together, even the approach to FIFO ratios from Jackson (2009b, cf. chapter 2.1.4), i.e. $FIFO^{Jackson}$, which gives much lower values, does not testify to a focus on sustainability in our eyes. Under our assumption that FIFO ratios are a valid indicator of environmental impact and a number which should be kept low, this kind of statement is a moral disengagement strategy of the dehumanizing type, indicating little respect for existence value.

In terms of the ecological perspective it should be clear that both companies have a responsibility, as outlined in Ims' (2011) responsibility graph (cf. chapter 3.3.2) to make sure the reduction fisheries remain sustainable. Perceived uncertainty is not a good enough excuse to not take action. On the contrary, increased uncertainty should, in line with the responsibility graph, instead call for increased application of the precautionary principle. This is because

increased uncertainty might lead to higher vulnerability. The game theoretical approach to environmental crisis and the tragedy of the commons theory are highly relevant in this regard. Due to the separation of existence and exchange value (cf. chapter 3.3.6) the true costs related to not acting ecologically responsible, are likely deflated. From the game theoretical perspective this increases the chances of ending up in the lower right part of Table 3-3 (cf. chapter 3.3.5). In addition, the perhaps best known example of the tragedy of the commons is precisely fishing. The coming implementation of the ASC-standard, as mentioned by the WWF representative, can be seen as an attempt to empower consumers to make conscious choices. The ASC label has the potential to improve both the ecological and ichthyological perspectives in fish farming, but as it is not yet ready it is hard to say how exactly it will change the industry. But unfortunately, one cannot rely solely on ethical consumer patterns as price, value, quality and brand familiarity often dominates personal rather than societal needs (cf. chapter 4.1.3). Still, empowering consumers is important. In relation to the game theoretical approach, if governments and the broader international community fail to set down regulations which ensure a result in the left part of Table 3-3, conscious consumer choices can make a big difference.

The fact that Marine Harvest has been a member of SAD for eight years already, and which according to the representative from WWF has cooperated well, this can either indicate that Marine Harvest sees how the industry needs to improve or it can indicate that Marine Harvest simply wants to influence the agenda of SAD. Of course, there might be nothing wrong in having both motives. As an industry player it is important that Marine Harvest's views are discussed, to ensure that the standard will be achievable and is realistic. Both Marine Harvest's and Cermaq's focus on sustainability may mean that the ichthyological perspective is more or less ignored. While sustainability of the reduction fisheries, i.e. the ecological perspective, is more important than the ichthyological one in terms of fish feed, such a focus loses its credibility when there is uncertainty whether those fisheries are sustainable or not. With WWF clearly saying many of the reduction fisheries are not sustainable, it becomes hard to judge what the truth is. This ought to call for a genuine wish from the industry to for example get MSC certified, so that to prove in action that their fishmeal and fish oil is indeed from a sustainable source. If WWF is right about its criticism against IFFO RS, then Cermaq's support of the IFFO RS is not as noble as it may first appear. The fact that it is more expensive to become MSC certified than IFFO RS certified may explain why Cermaq focuses on IFFO RS.

Considering how both Marine Harvest and Cermaq say they are concerned about sustainability, it is odd how neither of them can tell more about fishmeal and fish oil from by-catch (from bottom trawling), knowing the ecological problems related to these forms of fishing. However, the companies' lack of knowledge here is in line with what the representative from IMR said about bottom trawling not being an important issue for the salmon farming industry. Still, the companies' lack of knowledge has its place in an overall evaluation of their CSR performance.

From the economic perspective and for both companies, it is currently not viable to substitute fishmeal and fish oil completely (cf. Cermaq's Omega-3 from algae trial). On the other hand, Cermaq's ownership of EWOS may give them a first-mover advantage later in this regard. Just like the economic perspective limits Cermaq from using Omega-3 from algae, so too should the ecological perspective in the FFE model limit Marine Harvest's and Cermaq's future growth, as long as ecological concerns remain. If not this is done, it means that the economic circle in the FFE model will dominate the two other perspectives.

Concluding observation on fish feed:

Due to the uncertainty with regards to the actual sustainability of the reduction fisheries, it is hard to accurately pinpoint where Marine Harvest's and Cermaq's CSR practices relate to FFE. Both companies say they care about sustainability, but failed to answer important questions which would give credibility to their claim. Both companies point out their limited influence backwards in the value chain, even though Cermaq according to the theory has a greater potential. Cermaq's use of MODR and MPDR instead of the FIFO ratio is highly questionable. The same can be said about Marine Harvest's seemingly rejection of FIFO ratios altogether. Marine Harvest's point that some questions need to be addressed at a more political level is appropriate, but does not correlate to any company-specific activity related to the FFE model. In sum, both companies therefore achieve either a minor link or an upper edge minor link with regards to the FFE model.

9.3.2 SEA CAGES

This is a comprehensive area to evaluate because of the wide range of factors necessary (e.g. site selection, cage design, stocking density, net deformations, dissolved oxygen, temperature, light etc.) to ensure ichthyological and ecological concerns. What is striking with the case of Cermaq, as well as for Marine Harvest, is that none of the representatives could tell much

about net deformations, and the fact that net deformations are not regarded as important. Thus important ichthyological and indirectly also ecological considerations may fall behind. As there is obviously room for operational improvement, this kind of example creates potential for CSR activities which can help distinguish the companies in a positive way. With regards to Cermaq, the two representatives admitted a lack of knowledge regarding net deformations, as they did not know either about the potential usage of systems to detect stronger currents as well as potential measures that could be implemented to reduce net deformations. With regards to reducing the scope of net deformations, we can understand there are economic constraints in terms of extra sea cage equipment as well as systems for identifying e.g. currents. From this we can understand that the companies' focus with regards to the FFE model lies in the economic sphere. On the other hand, the fact that Cermaq impregnates the nets of the sea cages can serve as a good aspect in this consideration as it will indirectly reduce net deformations, as water will thus flow more easily through the nets. This is also the case for Marine Harvest as sea weed is flushed away. From chapter 2.2, we can understand that the efforts of the companies will reduce the chances for biofouling leading to increased risks of net deformations, poorer through flow of water and subsequently lower oxygen levels.

If Cermaq are right when they claim that the following requirements set by the governments are of sufficient time to maintain good ecology, then this serves as an example of how governmental regulations have taken care of the ecological considerations related to the FFE model in this aspect. As there are no regulations regarding fallowing time in Canada, Cermaq does well in this aspect as they still operate (i.e. fallow) as if there indeed were requirements. The fact that Cermaq may be doing this due to a suboptimal production planning process does not matter so much, as long as the results from an FFE perspective are beneficial.

For Marine Harvest and Cermaq there are trade-offs as higher stocking densities mean higher yields per sea cage. But, the economic incentives may get a prominent role when ones desire is to have a stocking density as high possible, leaving major ecological and ichthyological interests behind. When considering organic salmon production in relation to stocking density, Marine Harvest seems to question the effects around lower stocking densities and to think there is a lack of scientific research validating the need for this. Here we can discover similarities with the ichthyological implications learned from chapter 2.2.4. If the threshold of 22 kg/m³ could serve as an indicator, the density requirement of 10 kg/m³ for organic salmon farming seems unreasonably low. On the other hand, stocking densities may have enormous welfare and environmental implications, which becomes apparent when e.g. Norway has

placed regulations on this. Since customer requirements according to Marine Harvest influence stocking density, one could say customers may indirectly help ensure that all perspectives in the FFE model are considered. This example therefore shows the power of consumers when they act as active stakeholders.

When considering the performance of Cermaq, the fact that they measure both temperature and oxygen levels put the ichthyological aspect well in place. We can also spot some economic interests with regard to temperature as they (Cermaq) see the feeding activity in relation to it. Since both companies seem to use artificial light, fish welfare considerations may have already been thought of, especially from Cermaq's side, when they mentioned the example of how the fish could otherwise smack into the net.⁴⁷ From what we know, the use of artificial light can increase welfare as well as making sense economically as the fish grow faster and sexually matures later. As both companies could not tell much about the use of artificial light there might be unused opportunities according to the FFE model. However, when we compare the focus on artificial light against the focus on net deformations, it appears that the economic perspective has dominated the two others. While the use of artificial light clearly brings economic benefits, the same can perhaps not be said about reducing net deformations. As long as net deformations are not severe enough to cause mass mortality, they might not bring any other advantages than increased fish welfare. Hence, the ichthyological benefits from using artificial light may in fact simply be seen as welcome side effects rather than being a central part of the motivation behind the implementation. But again, as it seems the benefits from artificial light outweigh the downside, the use of artificial light is overall good from an FFE perspective.

To follow up the idea of stocking density a bit more, the companies tell us that they are moving fish as they grow, which is done to achieve increased capacity utilization in the cages when the fish are smaller. Of course a regulation, like what the representative from IMR proposes (i.e. just measure the number of fish and not the biomass), will enhance the space given to smolts entering a cage and thus prevent the necessity of transferring the fish as they grow, a phase which is highly associated with escape risks. In this sense, the Norwegian authorities take an increased responsibility when implementing a threshold for maximum fish in one cage.

⁴⁷ While it is clear from the results that Cermaq uses artificial light, it is not 100 % clear from the results from Marine Harvest whether they do so or not.

What we heard from Cermaq, regarding fish shoaling in the cages, which they used as an argument that net deformations were not a problem since the stocking density would vary within the sea cages anyway, we cannot recognize. Based on our review of the scientific literature (cf. chapter 2.2) and from our personal experience of seeing sea cages, we raise questions whether it is actually possible at all to maintain proper schooling patterns in a sea cage, especially when considering how currents (causing net deformations) may vary. Furthermore, the fact that Cermaq does not use submergence can have ecological and ichthyological implications, but the fact that they perceive it as interesting indicates their willingness to understand and learn in order to obtain a better practice.

Although facing great challenges (presented by the representatives of WWF and IMR), the possibilities of implementing closed containment systems instead of ordinary sea cages can serve as a good example of reconfiguring the competitive landscape sometime in the future (e.g. Porter & Kramer, 2006; Husted & Allen, 2007 in chapter 3.2.3). Circumstances related to raising fish lie within the core activities of a fish farming company, and are in line with the activities they are best equipped to solve. Hence, the ideas of Bhattacharyya (2010, cf. chapter 3.2.3) also fits good to this discussion as closed containment facilities lie within the real strategic activities of a company, and are as a consequence action oriented. However, there is still a lot of research left to make closed containments an economically viable alternative. The ideas of Porter and Kramer (2006) with regards to mapping social activities can be put forward. Since closed containment systems will directly involve an “inside-out” view, the whole value chain needs to be considered closely. We heard from Cermaq that they had problems of getting fish out of a test project with closed containment. Hence, we can understand the need for evaluating existing value chain knowledge, and replacing it with new. Since there are unsolved challenges regarding closed containment systems and the fact that it is not yet economically feasible, the “outside-in” perspective, regarding social influences on competitiveness, will mostly create difficulties at present time. Shifting to closed containments will, with the existing knowledge, not yet be viable in a competitive context. Furthermore, if future science favors closed containment systems, it can be highly presentable for consumer preferences (e.g. labeling farmed fish from closed containments). So, when Porter and Kramer (2006) present ideas of how companies can enhance knowledge of the degree of social issues, closed containment systems can be placed in the third area: social dimension in a competitive context (cf. chapter 3.2.3). As Cermaq seems to be a step ahead of Marine Harvest in terms of closed containment systems, it follows that if Cermaq can implement closed containment systems in

the future before Marine Harvest and realize a first-mover advantage, this would serve as a good example of how the core of strategic CSR could be applied. There is however opportunity costs associated. Here, ideas that social performance cannot go hand in hand with profits are relevant, and so to speak fits well into the idea of closed containments. As long as policy makers refrain from any progress on this area, the idea of closed containments can only be put forward by the companies and thus are in line with the possible opportunities of restructuring the competitive landscape (Husten & Allen, 2007). Opportunities may be ahead, but neither of the two major players we are looking at has taken the step forward. In line with the game theoretical approach to environmental crisis (cf. Table 3-3 in chapter 3.3.5), both companies' costs of implementing closed containment facilities are probably declining, as the field is still in development. As long as the government does not act, there is likely to be a late or no restoration at all with regards to starting with closed containment. However, if the government enters the field and somewhat forces a change, this could perhaps speed up the development of closed containment as a viable option.

Keeping fish in sea cages can be related to the responsibility graph of Ims (2011, cf. chapter 3.3.2), and what Børresen (2007, cf. chapter 4.2.3), emphasizes regarding humans as hosts for the fish for their entire life (2-3 years). When Marine Harvest and Cermaq act as hosts, they are responsible for the fish. Since sea cages is a comprehensive topic, we can understand that the responsibility of the hosts becomes more complicated. Due to the many factors influencing the ichthyological aspect in a sea cage, it follows that the fish is extra vulnerable to external impact. Cermaq's artificial oxygen implementation into the water in fish farms Canada can serve as a plausible example of how to consider their increased responsibility according to the responsibility graph. Cleaning nets in order to secure proper through flow of water can also serve as an indication of being conscious of this increased responsibility. As Marine Harvest flushes away sea weed, this argument can also be applied on them. These examples can be interpreted to a move up the vertical axis on the responsibility graph, in line with the fish's high vulnerability. Here, as both economic and ichthyological benefits accrue, in addition to potential ecological benefits, these examples fit well within the FFE model as well. Due to increased fish welfare (which includes fish health) mortality rates are likely to drop, which means more fish will reach the harvest phase in a better shape, thus also increasing both production and product quality.

Concluding observation of sea cages:

Both companies' lack of focus on net deformations and submergence counts negative from an FFE perspective. At the same time both companies are doing activities which are good from both an economic as well as an ichthyological perspective, and these activities may also create synergy effects for the environment. In general, Cermaq's answers indicate a higher awareness on issues related to fish welfare in the sea cages. As Cermaq also has focus on closed containment systems they therefore score higher on the degree of ideal-fulfillment than Marine Harvest. In conclusion we find Marine Harvest to achieve a minor link with regards to the FFE model, while Cermaq achieves an intermediate link.

9.3.3 ESCAPING

With regards to escaping, both companies take a clear standpoint to avoid escapes. There is however some divergent opinions between Marine Harvest and Cermaq. First of all, it might be interesting to look at how they view escaped salmon affecting wild salmon populations. Marine Harvest claims the likelihood of possible negative effects is the reason behind their zero escape policy. Cermaq perceives the impacts of escaping to differ depending on where it occurs as they think of escaping as a particularly Norwegian problem. As commented in chapter 2.3, Atlantic salmon only occurs naturally in certain areas. Hence, considering that Cermaq claimed Atlantic salmon does not mate with Pacific salmon, this can explain Cermaq's focus. So, when considering just genetic impact (and not e.g. sea lice risks) one could perhaps understand Cermaq's claims that escaped salmon is mainly a Norwegian problem. On the other hand, the ichthyological perspective will be left behind in such a statement as Cermaq's commitment as host's for the fish would not be fulfilled when escapes occur. Also, potential ecological problems may arise if the salmon manages to establish itself in e.g. Chile and start affecting the eco-system there. As is known from the past, introducing a species to an area where it is non-native may lead to unforeseen ecological consequences. In that regard it may be unfortunate that Cermaq sees escaping as mainly a Norwegian problem.

Also, when Cermaq perceive avoiding escapes as a win-win situation it is clear that there are economic interests involved in reducing escapes. This argument will of course also apply to Marine Harvest, and hence both companies have self-interest in reducing escapes. The pressure groups (e.g. environmental organizations like WWF) clearly perceive escapes as something negative and put effort in avoiding escaping as well. But the one you would think would

verify this assumption scientifically, the representative at IMR, is actually contradicting it when claiming escapes to be favorable leading to increased genetic interaction, just like natural fault-migration. But in this sense it is also important to remember that escaped salmon are likely to increase sea lice exposure to wild salmon (smolt). If the view of IMR's representative is accepted, the final conclusion on escape incidents would be uncertain, since there would be both a positive and negative effect. However, as mentioned in chapter 2.3.1, there is a divergent scientific view on gene impact, and this therefore leads to uncertainty on the issue. Hence it is good that Marine Harvest and Cermaq have not adopted the aforementioned view, something which could have been considered a moral disengagement strategy of the moral justification type, as this would not represent a precautionary principle approach.

Since governments (e.g. Norway's implementation of NYTEK, cf. chapter 2.3.7) are taking precautionary steps in reducing the escape occurrences, they have probably also taken another opinion than the representative at IMR. To follow up the companies' perception of solution strategies, there are some differences to discover. Marine Harvest sees tagging as an important tool for holding companies responsible for their escape incidents. As we know, tagging is only a measurement which can deter additional future escapes. Hence tagging is not a solution perfectly aligned with a zero escape policy. From what we know from the statistics of escape causes in chapter 2.3.3, equipment based structural failures explain close to 70 % of them. A zero escape policy should thus require more focus on equipment improvement, and this (i.e. improving the equipment) should be a continuous focus, rather than addressed primarily when the media reports that your salmon has been found in the rivers. Therefore the NYTEK-regulation fits well in this context. From our perception however, Marine Harvest is more focused on tagging rather than NYTEK as a measure against escaping. In the long run, tagging will likely discipline the players, due to the costs related to escapes (loss of revenue and reputation, extra costs related to fines, etc.), but focusing on improving equipment rather than tagging, is perhaps a more pro-active and efficient solution. In this sense, the steps taken by the Norwegian government in implementing the NYTEK regulations seems appropriate. This move can be seen as a confirmation of what Midttun, Gautesen and Gjølberg (2006), refer to as the Nordic model (cf. chapter 3.2.1), where the public sector takes care of many of the concerns included in CSR issues. Of course, there would be nothing wrong in implementing tagging as well, as an additional measurement to achieve the polluter pays principle. The fact that Cermaq's Mainstream Canada is drawn against the NYTEK-regulation when it comes to standardizing sea cages indicates pro-activity, and one could thus say the Norwegian govern-

ment's regulations have synergy effects on a company's operations across country borders. This is thus an argument for the appropriateness of the Nordic model, as it in this case seems like governmental regulations will better ensure a company performance more in line with the FFE model. In addition, if Cermaq adopt the NYTEK-regulation also in Canada, this would be a good example of what Besley and Ghatak (2007) call public good provision (cf. chapter 3.2.1), since Cermaq's efforts would be a reaction to the Canadian government's bias.

Cermaq emphasize the fact that tagging has nothing to do with preventing escapes. Since Cermaq tells us they routinely check ropes, chains and perform training prior to technical operations, such activities are likely to reduce the risk of escaping. Staff training is also fronted by WWF's representative. Because Cermaq's activities are likely to affect both the ecological, ichthyological and economic perspective in a positive way (if we assume the costs of training are less than the savings achieved due to less escapes) these activities can be seen in relation to the FFE model as well as being CSR inspired. The fact that Marine Harvest alerts local fishermen and places recapture nets can also be seen in such a way, but reliance on local fishermen is perhaps a too easy and unreliable solution.

What is particular about Marine Harvest with regards to escaping is their focus on the reputational side effects, when claiming there are high risks associated with losing credibility. Interesting thoughts here can be the fact that the news picture of major parts of the customer groups (e.g. Southern Europe, Russia, Asia and USA) are far away from the possible location of an incident (and subsequent news release). Therefore, the publicity risk is probably more related to sanctions and penalties from governmental actions than from the revenue side. This is also mentioned when Marine Harvest admits having received fines. This can also be placed in the thoughts of IMR's representative mentioning that companies can have incentives to hide escape numbers as they can benefit more from banks and also prevent the risks of a stock price fall. This can be discussed from the utilitarian perspective exemplified by Painter-Morland (2008, cf. chapter 3.3.8) – that managers justify manipulations in the sense that they protect the broader interests. However, Marine Harvest says it is improbable that they have hidden statistics on escapes. As it is impossible for us to confirm the correctness of this claim, it is equally impossible to conclude anything in this regard. What we can conclude is that tagging would make the utilitaristic approach less tempting, as the risk of being caught in a lie later would increase. As Marine Harvest pointed out, it is important not to criticize the entire industry based on the irresponsibility of one player. Tagging is a good tool in this regard, as

long as it is collectively implemented. Hence the government must take action to help ensure the fruitfulness of tagging.

Cermaq's practice of placing additional predator nets in Chile to protect the fish from sea lions, as well as using noise to scare away the sea lions, which would otherwise cause fish stress, is a good example of activities which fit well within the FFE model. An interesting question in this regard arises, namely why does not the companies use predator nets in Norway as well? They could simply call them "escape-preventing nets". If extra predator nets can keep sea lions at a distance, then it also seems reasonable that such nets could keep salmon which escaped from the inner sea cage at bay from escaping further. Of course, certain adaptations would perhaps be necessary, as predator nets might be constructed differently than the sea cage nets (e.g. mesh sizes). An extra net could perhaps provide extra insurance against escaping. Having an extra net would indeed fit within the FFE model, as all three perspectives could be affected in a positive way. With regards to the economic perspective, less escaped fish means less lost revenue. With regards to ichthyological considerations this step would be in line with taking one's role as hosts for the fish more seriously. Of course, in this matter, one would need to evaluate the design of the net and the handling of it (e.g. flushing and treatment of the additional net) to ensure the same levels of oxygen and water flows. Ecological considerations are also in place as the measure would possibly reduce the interaction between farmed and wild salmon. In addition, the scope of the sea lice problem would perhaps also be reduced. Since this step has not been implemented, it may be that the economic perspective, i.e. the initial investment cost, dominates the ecological and ichthyological considerations. In other words, the current losses due to escaping might not be large enough to offset the extra investment costs. This should be seen in relation to how Jensen et al. (2010a) see the companies' economic losses due to escaping as small (cf. chapter 2.3). The issuing of fines for each escaped fish found in rivers home to wild salmon could perhaps remedy this incentive problem. Thus, the government would first have to put down laws for implementing tagging. Again, this highlights the appropriateness of the Nordic model.

It is also interesting to note that neither company mentioned anything about the use of either triploid salmon and/or acoustic conditioning. Acoustic conditioning appears in particular to be an interesting possible solution as in, opposed to for example creating triploid salmon, there are less negative ichthyological consequences. With regards to the use of triploid salmon, there would obviously be an ichthyological trade-off between the advantages (i.e. less interaction between farmed and wild salmon) and disadvantages (i.e. ignoring the existence value of

having natural salmon). This trade-off would also have to be measured against the perceived benefits with regards to the two other perspectives in the FFE model.

Concluding observation on escaping:

First of all, it is good that both companies recognize escaping as a potential problem. However, Marine Harvest and Cermaq differ in their perception on how to combat escapes. While Marine Harvest seems to focus on tagging and for instance relies on local fishermen to recapture their fish, Cermaq takes a more precautionary stance focusing on equipment and staff training. Cermaq's approach matches better with the idea behind the NYTEK regulation. Because of this difference Cermaq has a closer link between their CSR performance and the FFE model. However, since Cermaq views escaping as mainly a Norwegian problem, ichthyological concerns and potential ecological problems may arise in other operating countries. This therefore draws their link to the FFE model down. Both companies had a pretty clean escape record last year. It is a bit surprising that neither company mentioned anything about either triploid salmon or acoustic conditioning, and hence this may indicate a lack of holistic considerations. Overall, because Cermaq seems to have more activities related to preventing escapes they reach a higher degree of ideal-fulfillment than Marine Harvest. With regards to the FFE model, while Marine Harvest achieves an upper edge minor link, Cermaq achieves a lower edge intermediate link.

9.3.4 SEA LICE

While Marine Harvest could not tell the extent of the sea lice problem, Cermaq highlights that many factors can influence the well-being of wild salmon. Both views can be well understood in light of the literature review in chapter 2.4.2 (since it concludes there is no scientific validity regarding sea lice from salmon farms' impact on wild salmon (smolt), and due to Figure 2-11 in the same chapter, which lists many different factors influencing the well-being of wild salmon). This uncertainty suggests that the government should be more active in setting laws and regulations. The industry's responsibility needs to be measured against something, so that potential sanctions can be duly given. Since wild salmon itself could be classified as either a discretionary or dependent stakeholder (depending on how much wild salmon is considered threatened) (cf. Mitchell, Agle & Wood, 1997, in chapter 3.2.2), it is necessary that stakeholders with power enter the field. Laws and regulations are needed to coerce the industry into taking the responsibility it admits to have, because otherwise the industry may have a

self-interest in downplaying the threat (from sea lice from fish farms) on wild salmon. We are not saying this is what the industry does, but our normative stance is that the effects of sea lice from fish farms on wild salmon is a question particularly well suited to a governmental stance. The government is better suited to do more of the research required to understand the issue better. The government is also likely to have more credibility in objectively answering questions of the type posed by Marine Harvest, namely “what is a sustainable level of sea lice?” Here one could add the thoughts of Zsolnai (2007) regarding the moral economic man theory (cf. chapter 3.3.1) to help understanding the efforts done by participants like Marine Harvest and Cermaq. When the social costs of transgression are low (e.g. no specified thresholds) Marine Harvest and Cermaq have incentives to downplay the threat of sea lice.

The status of the wild salmon population seems to fall in under what Porter and Kramer (2006), call “value chain social impacts” (cf. chapter 3.2.3). As long as sea lice remain a by-product of fish farming, it appears difficult to convert fish farming operations into something which will benefit the wild salmon. A responsive approach of reducing as much harm as possible is more practical. Such an approach further necessitates an active government setting laws and regulations to ensure cooperation. Both companies participate in spring delousing programs in Norway. This can be seen as CSR practices, but as it is required by law it perhaps rather serve as a good example of the importance of an active government eliminating the problem of free-riders (cf. chapter 3.2.1). It is therefore interesting to notice how the representative of Marine Harvest in general believed more regulations were needed, but that the industry could/should improve independent of that. Governmental regulations would ensure that every company improves its practice, and that no company effectively gets punished for doing so alone. It is precisely because no one owns the wild salmon that the government is the best stakeholder to act on its behalf. This approach can be seen in relation to Fassin’s (2009) stakeholder, stakewatcher and stakekeeper theory (cf. chapter 3.2.2), where the government watches and regulates the stakes of the fish.

Marine Harvest’s portfolio of ongoing research projects directed at combating sea lice seems to fit into the FFE model. Combating sea lice does not only make economic sense, but is also likely to reduce the pressure on wild salmon as well as increasing fish welfare, due to fewer lice. In this way all three perspectives in the FFE model would be covered. A counterargument in this regard is that it was precisely the fish farming industry itself which increased the sea lice problem. Hence, if Marine Harvest succeeds with one of their research projects, one could say they would simply be successful in cleaning up their own mess.

The fact that Cermaq is the sole operator in large parts of Nordland meant that they are able to coordinate delousing programs. Further consolidation of the industry may make similar initiatives easier to achieve. Another possible benefit is economies of scale. Because of this, Cermaq might have a greater opportunity, when controlling a large area, to be a contributor of shared benefits between the company and society, as stated by Porter and Kramer (2006). Their CSR performance will then be better than what they could achieve if they were just one out of several minor players (i.e. because it would be harder to coordinate delousing programs without governmental intervention).

With regards to wrasse, since Cermaq does not use it, the discussion here will be centered on Marine Harvest. In our interview with IMR the representative alerted us to the issue of how wrasse will eat the eyes of the salmon if there are not enough sea lice. If Marine Harvest does not take this issue into account it will be an example of a moral disengagement strategy of the dehumanization type. If blind salmon grows and taste just as well as ordinary salmon, then there might not be, from the FFE perspective, any economic incentives to reduce the scope of this problem. A dehumanization strategy could then be used to justify why wrasse eating the eyes of the salmon is not a problem. As we have no information whether Marine Harvest considers blind salmon an ichthyological problem, this analysis is more general. If one considers the view of the Institute of Marine Research (2011a, cf. chapter 2.4.3) that the current consumption of wrasse is not ethically responsible, it appears that the fish farming industry in general are trying to solve/reduce the scope of one ecological problem (i.e. how the great numbers of sea lice from fish farms negatively affect wild salmon populations) by creating a new one (i.e. consuming so much wrasse that its sustainability is threatened). In addition, it is also easy to see how there are ichthyological problems related to blind salmon. Hence, there seems to be unresolved issues both ecologically and ichthyologically from an FFE perspective with regards to the usage of wrasse.

When the representative of Marine Harvest spoke about Vivian Krause and her findings, that can be considered an attribution of blame strategy, where Marine Harvest diverts the original discussion, perhaps trying to get a victim status itself. Even if Vivian Krause's findings are true, one's own responsibility is not reduced simply because others can also be blamed for something. The case of Vivian Krause is therefore a separate issue, which really was not relevant to the sea lice discussion, unless Marine Harvest wanted to make a point out of it.

Both companies' focus on alternating treatments against sea lice is a good example of an activity well fitted within the FFE framework. Alternating treatment methods will reduce the chance for the sea lice to become resistant, which thus increases the lifetime of the various treatment methods. Combating sea life effectively will therefore influence all three perspectives in the FFE model in a positive way. With regards to wrasse, there are some challenges which need to be overcome, before Marine Harvest can be credited for using it. Neither company would like to introduce wrasse to Chile, as it would represent introducing a new species to a non-native environment. However, in a historical perspective, Atlantic salmon is also not native to Chilean waters. Such a contradiction can perhaps be explained with Zsolnai's (2007) moral economic man theory. The cost of not introducing wrasse to Chile is much less than the foregone profit of never introducing Atlantic salmon in the first place (but of course, changes in laws may also play a big part here).

Concluding observation of sea lice:

As both bath treatments and the use of wrasse have unresolved ecological and ichthyological considerations that need to be considered (e.g. bath treatments could lead to fish stress, wrasse eats the eyes of the salmon and its usage might not be sustainable), it seems currently hard for the companies to reach an ideal link to the FFE model with these methods. However, negative side effects of these methods must be measured against the ecological and ichthyological benefits related to having less sea lice in the sea.

Due to a lack of hard company specific data, it is hard to conclude where exactly Marine Harvest and Cermaq locate on the ideal-fulfillment scale with regards to the FFE model. In general, since sea lice still constitute a problem for wild salmon, it is obvious that the fish farming industry at large does not live up to an ideal link. However, both companies see sea lice as a problem and do several activities to combat it. We therefore suggest that both companies would end up in the intermediate link with regards to the FFE model.

9.3.5 THE SLAUGHTER PROCESS

With regards to the slaughter process, governments like Norway have taken steps towards a more ichthyocentric slaughter method in relation to the CO2 ban. One can say stunning methods are prioritized by the government, thus confirming their important role with regards to what we know from scientific research. From what we know of the importance of stunning methods prior to gill cutting it is remarkable that neither of the two companies could tell spe-

cifics about what stunning methods were used. In general, there is a huge discrepancy between the questions we sent the companies, and the corresponding results from the interview. Overall, the discrepancy between our questions, which were highly detailed and relevant from an ichthyological perspective (cf. chapter 13.1), can only be interpreted in one way, namely that the slaughter process is a down-prioritized area.

When we visited Slakteriet Brekke we realized it was utmost necessary to have an automated slaughter method to cope with the efficiency requirements in a western country. Since Marine Harvest indicated that they were going to focus on more efficient slaughter methods in Chile in the future, this may be a sign that economic efficiency requirements and technology improvements, lead to better slaughter methods from an ichthyocentric perspective.

Our experience of the high-tech electric stunning machine used at Slakteriet Brekke, indicates that it is impossible to reach the same accuracy with a manually operated system. Thus, one could say that economic interests are in line with a more responsible practice (i.e. increased efficiency due to technology leads to better CSR performance). One could also draw parallels to the reconfiguration of the competitive landscape in a strategic CSR context (e.g. Porter & Kramer, 2006; Husted & Allen, 2007, cf. chapter 3.2.3). As both Marine Harvest and Cermaq do most of their slaughtering by themselves, the slaughter process is absolutely a field to create competitive advantage in, since the slaughter process is exactly one of the set of societal challenges that they are best equipped to solve. As the slaughter process lie within their core value chain activities it creates a good fundament for what Porter and Kramer (2006) call mapping the social impact of the value chain. It would also fall within the scope presented by Bhattacharyya (2010) claiming that CSR activities should be action oriented and thus focus on the real strategic activities of an organization (cf. chapter 3.2.3).

Knowing it takes around 2-3 years to get the salmon ready for slaughter, this means that the salmon arriving at the slaughterhouse has already been invested in and been under the companies' care for at least 2-3 years. The slaughter process is the last stage in a time-consuming value chain. It does not make much sense to invest in a product for 2-3 years first, only to neglect it in the end. As in line with the FFE model, this can be related to how reduced stress and increased fish welfare in the salmon's last life stage can increase fillet quality. When we visited Slakteriet Brekke the salmon there were subjected to a classification (e.g. superior – non superior) which directly involves the profit. When the salmon is subjected to e.g. a violent brailing system it means more scars and soars, which makes it harder to sell it under the

HOG category, which requires the fish to have an “attractive exterior look”.⁴⁸ As we discovered from the slaughterhouse, their best salmon were carefully selected whereas examples of the worse ones were thrown and used as ingredients for e.g. fish oil.⁴⁹ Therefore, the slaughter process can serve as a connection between ichthyological and economic interests. This example contradicts the proposal of Jensen (2010b) who claimed that social performance cannot go hand in hand with profits (cf. chapter 3.2.3). Moreover, it serves as a good description of the possibilities of overcoming the trade-offs related to how Jensen (2010b) claimed one can only maximize one dimension at a time.

Stakeholder theory can serve in relation to the slaughter process, because the fish itself can be considered the most important stakeholder. The contradicting viewpoints of Friedman (1970) and Freeman (1984), cf. chapter 3.2.2, can fit directly into the slaughter process discussion. One can say that maximizing shareholder value according to Friedman (1970) gives incentives to just focusing on following the regulations. But, due to lack of regulations with regards to for example pipe systems (e.g. prohibiting pipe angles of 90°) one could easily implement a pipe system that is legal, but which would cause ichthyological concern. Doing so would then not create shared value (for shareholders and fish alike). In this sense the proposals of Friedman (1970) represent some shortcomings whereas the contradicting stakeholder approach of Freeman (1984) can serve as a holistic approach. The fish itself should ideally be considered what Mitchell, Agle and Wood (1997) call a definitive stakeholder (cf. chapter 3.2.2). Because fish fail to express themselves in a way humans understand (i.e. do not scream or shout like for example when a pig is slaughtered improperly) the ichthyological perspective in the FFE model gives the fish the voice they urgently need. Within the framework of Mitchell, Agle and Wood (1997), fish certainly have legal and urgent rights, but lack power to make their claims heard. As a consequence, fish fall into the category of dependent stakeholders. Depending on how fish is perceived, certain people (e.g. people with anthropocentric viewpoints) might question fish’s legitimacy. Such an attitude would perhaps align well with the lack of knowledge displayed by both Marine Harvest and Cermaq with regards to the overall slaughter process. In Cermaq’s case, such an attitude aligns poorly with their claim of supporting experts who say that salmon feel pain. In general, there is little media coverage on fish slaughtering, and this might explain the companies’ lack of focus on the issue.

⁴⁸ The customer can see the entire fish (skin and head), as opposed to just fillets, and hence exterior quality is also important.

⁴⁹ Fish oil used as animal feed (e.g. pig feed).

The fact that Marine Harvest has implemented the alternative slaughter method (cf. chapter 2.5.6) of slaughtering the fish at boat right by the sea cage, serves as a good example in the strategic CSR setting.⁵⁰ From the literature we know that this method improves fish welfare. IMR's representative however, raised hygiene concerns with regards to this method. But with proper waste handling, this method is highlighted by WWF as a method less damaging to the environment (cf. the use of waiting cages). The alternative slaughter method has many ichthyological and, also some ecological benefits compared to land based slaughterhouses. Current economic concerns (Marine Harvest claims this method is more expensive) may explain why it is not used more frequently. Considering the fact that Marine Harvest so far has not discontinued with the alternative slaughter method, it is reasonable to assume that it is still profitable to slaughter fish in this way. Hence it can be deduced that the alternative method is still profitable, albeit not as profitable as the traditional method. Greed for maximizing the economic perspective therefore seems to dominate the other two perspectives in the FFE model, thereby explaining the limited focus on the alternative method. It thus appears that the economic sphere is limiting the possibilities for an improved slaughter method. Despite it is limited implemented (i.e. just one boat), Marine Harvest can be seen as some sort of pioneer of how one can reconfigure one's competitive landscape in this regard when compared to Cermaq, as Cermaq is currently not using the method. Still, the lack of governmental focus on this method creates a huge potential for increased CSR performance for both companies if the alternative method is properly implemented.

None of the representatives we spoke to had much to tell about the slaughter process. Cermaq's representatives say Cermaq supports the experts who say salmon feel pain, and that they have established requirements for slaughter based on this. Marine Harvest's representative on the other hand could not tell what Marine Harvest's stance on whether fish feel pain or not was. It is therefore very interesting to see how Cermaq who says they recognize fish's ability to feel pain has not implemented the alternative slaughter method, while Marine Harvest, who appears to have limited focus on the issue, has. Of course, when mismatch between actions and words, action is always more representative. Selection of type of slaughter method can be related to Zsonlai's (2007) moral economic man framework (cf. chapter 3.3.1). The cost of the alternative slaughter method is higher than land based slaughtering. The fact that Marine Harvest chose this method and not Cermaq may at first glance therefore indicate that

⁵⁰ Dead-hauling.

Marine Harvest has a stronger moral character in this regard. However, Marine Harvest has only one such boat, and are after all also a bigger company than Cermaq. Hence, one should not exaggerate the differences here. Still, it will be interesting to see future development in this area for both companies.

Since e.g. CO₂ as a slaughter method will become illegal in Norway, the social cost of transgression is leading to more ethical behavior. But, this may be different with regards to other operating countries. Since slaughter process is not a focus area within the two companies, the risks of applying a worse, from an ichthyocentric perspective, slaughter practice in other countries may arise (since the representatives do not know what practice is done). Because of the almost non-existence of pressure groups (animals rights groups etc.) within this area (i.e. no need for transparency) and the possibilities of less social cost of transgression (e.g. Chile) the risks Zsolnai (2007) refers to might make it more likely that the companies will be performing less ethical in other countries where the regulatory regimes have a weaker position than for example in Norway.

For Marine Harvest, that fact that they have one employee who works almost exclusively with slaughter methods is good, but the fact that manual stunning is still used in Scotland does not seem to correspond well with the higher efficiency automated stunning methods have. In addition, their somewhat divergent performance is discovered when considering the large investments in slaughterhouses in Norway recent years, amounting to NOK 400-500 millions, while manual slaughter is still practiced in Scotland. Considering from Table 7-2 (cf. chapter 7.1) that Marine Harvest Scotland produces more than 15 % of total harvest volume from Norway, Scotland, Canada and Chile combined, there should be both economic and ichthyological incentives for an automated slaughter method in Scotland as well. However, with purely ichthyological goggles, one could claim that a manual slaughter process, when done properly, could be preferable. This because one could carefully monitor each fish's death. But this would likely cause a big trade-off on efficiency (i.e. the number of tonnes produced), and hence might not be economically viable according to the FFE model.

For Cermaq, there is a rather contradicting impression, as they focus on measuring cortisol levels, but on the other hand does not focus on rigor mortis. This is remarkable as these to parameters are correlated – i.e. increased stress gives shorter pre rigor time, and thus increased risks of poor fillet quality and drip loss, which affects the profit. This is therefore a good example of a process that can be improved from several perspectives' viewpoint in the

FFE model. Moreover, the fact that Cermaq recognized waiting cages as a good way for fish to calm down does not correspond to e.g. a violent pumping system from the waiting cage into the slaughterhouse. As we were not supplied with specifics regarding the pumping system we can only apply our experience from visiting Slakteriet Brekke and from chapter 2.5. From this experience and the levels of fish welfare of Table 2-2 (cf. chapter 2.5.4), we can only highlight the ichthyological dangers that may arise in this part of the slaughter process. These concerns will of course apply to both Marine Harvest and Cermaq.

Concluding observation of slaughter process:

Both Marine Harvest and Cermaq are more or less ignorant of matters related to the slaughter process and unable to answer most of the related questions. Not knowing what slaughter methods are being used, or not being able to tell much at all, indicates that the slaughter process is a down prioritized area. Although we do not know, it appears as if the representatives have not been facing the fish's death with their own eyes in their own slaughterhouses. Even if their automated slaughterhouses are comparable to Slakteriet Brekke, Marine Harvest's and Cermaq's unawareness of the slaughter process in general count negative in a FFE context, as they ought to know more about this. Lack of knowledge indicates a lack of ichthyological concerns. The fact that Marine Harvest has some experience with the alternative slaughter method increases their performance, but the fact that Marine Harvest's representative could not answer what kind of stance Marine Harvest has taken on whether fish feel pain or not, counts negative. Marine Harvest still achieves a slightly higher degree of ideal-fulfillment than Cermaq. While Marine Harvest achieves an upper edge minor link, Cermaq achieves a minor link.

9.4 EXPECTANT PERFORMANCE VS. ACTUAL PERFORMANCE

When evaluating the broader CSR perceptions of Marine Harvest and Cermaq in relation to the FFE model, one could, as mentioned before we started on the context-specific analysis, and based on what the companies said themselves, expect both companies to perform reasonably well, at least within the ecological (sustainability) perspective within the FFE model. As we have now done a context-specific analysis, we see that the picture is more fragmented. The companies' links to the FFE model indicate that there is a discrepancy between what they say they do, and what they actually do. As a matter of fact, when remembering what Marine Har-


vest' representative said about Marine Harvest doing many activities in excess of what is required by laws and regulations, it is hard for us to validate this claim based on our empirical analysis. Even though Cermaq's representatives gave the answer "do not know" more frequently than Marine Harvest's representative, Cermaq's representatives also had more knowledge in general, and stuck more to our intended agenda. Marine Harvest's representative on the other hand, did not always give a clear-cut answer. This different approach to our interviews can clearly be seen when comparing the results between the two companies. Cermaq's greater openness can perhaps be explained with the fact that they care more about performing their activities responsibly. But, even Cermaq does not live up to the expectations they created. Both companies thus seem to view themselves in a better light than what our analysis indicates.

Lastly, considering how the fact that Marine Harvest's representative needed around seven weeks to validate the results from the interview, and how he admitted that we were at the bottom of his "to do list", serves as a good example of how stakeholders without a direct economic link, are down-prioritized. Such a view fits well with a shareholder focus.

9.5 PERSONAL RESPONSIBILITY

With regards to the positions of the people we have spoken to, and the broader interests they (as communication directors) are hired to address, their reluctance/lack of knowledge to present proper information in line with the questionnaire prepared by the authors (cf. chapter 13.1), can be questioned. Particularly, the representatives from both Marine Harvest and Cermaq knew little about subjects within the chapter of sea cages, and their lack of knowledge was especially apparent with regards to issues related to the slaughter process. From the responsibility triangle (Ims, 2006, cited in Jørgensen & Pedersen, 2011, cf. chapter 3.3.4), the role-mediated behavior of the representatives is to represent their companies. However, they still have an unavoidable, personal responsibility to know more of the value chain impacts. In other words, it is surprising from the authors' perspectives, that neither of the representatives from Marine Harvest and Cermaq possessed more information vital to the FFE model. For example, since the slaughter process is a very central part of the value chain, one almost has a duty, because of one's personal responsibility, to know what this activity involves, since such information is indeed important for so many stakeholders (fish + consumers). The representatives' role-mediated behavior may have caused them to be defensive with regards to what information they are willing to give. There might be an intricate balance be-

tween what the representatives could or would say. Also, the representative's unwillingness (to discuss the issues)/lack of knowledge may reflect that the common morality around especially fish welfare from an ichthyological viewpoint is low. Due to media attention on sustainability and other environmental factors, which correspond to the ecological sphere in the FFE model, the common morality is more developed in this sense. This can also explain why the companies say they are very concerned about sustainability, whereas important ichthyological considerations may fall behind. It can thus be said that the common morality has clearly influenced the representatives' role-mediated behavior, whereas the perception of personal responsibility has remained more untouched. This of course, violates the idea behind the responsibility triangle, which depicts personal responsibility as always present.



10 CONCLUSION

10.1 CONCLUDING REMARKS OF ANALYSIS I – BUILDING THE MODEL

Research question one is answered through developing the FFE model. Using the concepts of Mitroff (1998) has been imperative in enabling us to understand how the fundament of the interrelation of the three spheres economy, ecology and ichthyology applies to the fish farming industry. In this sense, the analysis has been mainly focusing on discovering systemic perspectives in relation to ecology and important existentialistic dimensions connected to ichthyology. This is because the industry seems already to have considered the scientific/technical (economic) perspective as both the industry in general is profitable (cf. chapter 1.3), and the companies themselves overall have had a strong financial performance (cf. chapter 7). All businesses will by nature focus on the economic perspective. The purpose of the FFE model is to make sure focus is also directed to the other important perspectives; ecology and ichthyology. With this in mind, one is better able to detect whether a company is making E3 errors (i.e. solving the *wrong* problem correctly). Here, the FFE model will ensure that these risks are significantly reduced.

The FFE model has indeed showed its usefulness as it can be applied as an analytical tool for broader interest groups as well as a management tool for business participants. Because of the holistic considerations captured within the intersections of the three spheres, the FFE model can be applied on both an overall level as well as into more specific activities or issues related to the fish farming industry. At the overall level the FFE model can be used to look at companies broader CSR perceptions. At the more specific level, it has been considered through the five fish farming context areas; fish feed, sea cages, escaping, sea lice and the slaughter process, but it can also be applied on other context areas. At the specific level the FFE model will serve as a guide in revealing important considerations related to an evaluation or a decision. In this sense, one is better capable of addressing the right problem, and thus reduces the risks of focusing on a single perspective associated with risks of solving the wrong problem.

The practical relevance of the FFE model makes it suited for evaluating the CSR performance of companies in the fish farming industry. Because of the holistic considerations the FFE model represents, this is seen in relation to an ideal state and the FFE model can thus be used as a reference point with regards to analyzing companies' CSR performance. Hence, this will

enable a discovery of potential gaps between a company's CSR performance and the ideal. This is discovered through either a minor, intermediate or ideal link (which corresponds to a low, medium or high degree of ideal-fulfillment) between CSR and FFE. As a consequence, the user is better equipped to evaluate important CSR performances of business participants.

One must critically evaluate the consequences and practical implications of the FFE model. A limitation might be that the idealized state in the FFE model is too hard to reach. But on the other hand, this might just indicate that the industry needs a greater change.

10.2 CONCLUDING REMARKS OF ANALYSIS II – THE EMPIRICAL INVESTIGATION

10.2.1 GENERAL VIEWPOINTS RELATING TO BOTH COMPANIES

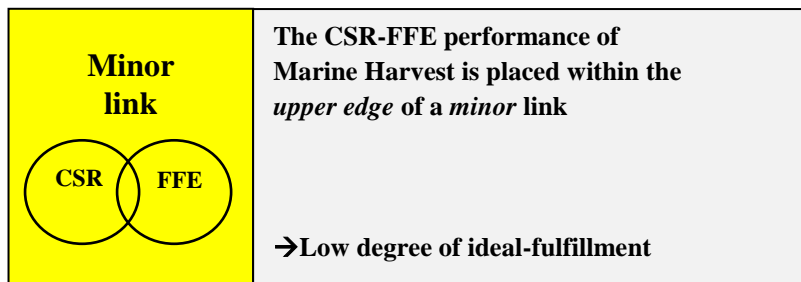
There is a discrepancy between the companies' broader CSR perspectives and how they actually perform with respect to the five context areas. It appears all the representatives we spoke to has not taken enough personal responsibility to be able to provide us with important information related to for example issues related to sea cages and particularly with regards to the slaughter process. The discrepancy in general can be interpreted that both companies try to elevate their CSR performance to a higher level than what is actually the case. Hence it is important to analyze the companies' activities on a detailed level.

As we have only looked at five context areas, additional scrutiny could be applied on other activities performed by the companies. This is necessary to get an even more holistic analysis. Our entry analysis indicates that both companies can improve their CSR performance on several issues.

10.2.2 MARINE HARVEST

When evaluating fish feed Marine Harvest portrays either a minor link or an upper edge minor link. Marine Harvest depicts a minor link with regards to sea cages. When considering escaping they find themselves in the upper edge of a minor link. An intermediate link is observed with regards to sea lice. With regards to the slaughter process Marine Harvest locate at the upper edge of a minor link.

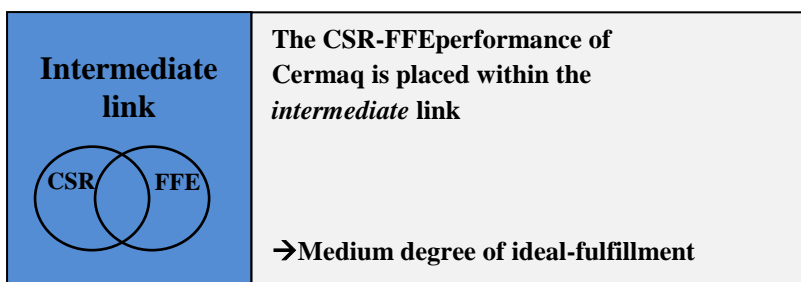
Overall conclusion:



10.2.3 CERMAQ

Cermaq is within either a minor link or an upper edge minor link with regards to fish feed. Cermaq achieves an intermediate link with regards to sea cages, and a lower edge of an intermediate link when considering escaping. When considering sea lice, Cermaq places in an intermediate link. In relation to the slaughter process, Cermaq locates at the minor link.

Overall conclusion:



10.2.4 FINAL CONCLUSION

Since both companies do not perform according to the ideal link between CSR performance and the FFE model, one could wonder why this is the case. As we have seen from chapter 1.3 and chapter 7, both the industry in general as well as the two companies are overall profitable. Hence, the economic considerations seem to have potential for influencing the performances regarding ecology and ichthyology. According to what we have learned from the conclusion

of analysis I (cf. chapter 10-1) we can understand that Marine Harvest is at high risk of committing an E3 error. It seems plausible to consider that the economic perspective dominates the two others, particularly the ichthyological one. This is based on the financial performance they are presenting and the result of analysis II which portrays major gaps in CSR performance towards the holistic considerations of the FFE model. When looking at Cermaq, they are likely to be at less risk of committing an E3 error, since they obviously have taken more considerations with regards to the FFE model. However, the economic perspective seems herein also to determine many of the ecological and ichthyological concerns. But this is to a lesser degree than what is the case for Marine Harvest.

Based on our empirical investigation, this indicates that Marine Harvest and Cermaq put most value on the economic perspective. One could easily think that the economic sphere plays a dominant role, which thus leaves the ecological and ichthyological spheres behind. In other words, economic considerations determine whether ecological and ichthyological concerns are handled. Positive ecological and ichthyological results are welcomed when they are side effects of economic-driven initiatives, but are otherwise de-prioritized. This fact can explain why there obviously is room for a better link between the CSR performance of both companies and the FFE model. Since the result of our analysis confirms that there are discrepancies between the companies' CSR performance and the ecological and ichthyological concerns, this fact contributes to explain so. We can of course not draw any conclusions on the fish farming industry in general since just two players are investigated. However, the two companies are industry leaders in salmon farming and thus ought ideally to be good examples for other smaller companies to emulate. Tragically, this is not the case. However, Cermaq is a better role model than Marine Harvest, but also they can do more in order to reduce the gap to the ideal state of the FFE model. In addition, since we based our analysis on rather fragmented information with methodological difficulties, more information is needed to evaluate the two companies further. This support the claim of this analysis as more of an entry analysis of the companies based on the limited information we were able to get from the interviews. Evaluating the two companies at a more detailed level could therefore have resulted in an alteration of the current conclusion.

11 FUTURE RESEARCH

One future research area is obviously extending the FFE model to even more context areas, like for example the handling of diseases and vaccination, and to a greater part of the value chain, e.g. the hatchery process (egg, fry and smolt production). Egg, fry and smolt production obviously have an important place in the salmon farming value chain, and ichthyological considerations might be of particular relevance here. Some of the context areas can also be considered more closely, from either ecological or ichthyological standpoints. In terms of fish feed and an ichthyological standpoint examples include starvation of fish prior to slaughter, or the unnatural diet the salmon eat (vegetable proteins and oils, by-products from land-based animals, etc.) Functional feeds could also be worth looking into. Within the context of sea cages, one could look closer at toxic waste dispersal, feed waste and salinity levels. One could also take a closer look at potential fish sewage problems, as there might be ecological concerns in relation to these factors. With regards to escaping one could expand the context area to e.g. dispersal of diseases and pathogens, an issue which clearly has both ecological and ichthyological undertones. This could for example be seen in relation to how escaped farmed salmon might transmit diseases and pathogens to wild salmon. With regards to sea lice it is worth looking more into bath treatments and the use of chemicals, as some chemical agents might cause stress for the fish. A potential sea lice vaccine, the effects of using functional feed to combat sea lice, and taking a deeper look at FFE considerations towards wrasse are other possible areas to examine further. From the slaughter process perspective, one could use the FFE model to evaluate manual slaughter methods, since they still are being used within the industry. More empirical research could also be done considering ichthyological issues related to pumping and brailing. Overall, it could be interesting to look deeper into the ASC-standard, and how it relates to the FFE model on the various context areas as well as on an overall basis. This would constitute an extensive analysis in itself, which would soon be relevant considering it might be only a couple of years before we will find the label in the stores. The future ASC-label can furthermore be seen in relation to consumer responsibility, as the label might empower consumers to purchase more ethically. One question then becomes how suitable the ASC-label is to accommodate ichthyological considerations in addition to the ecological ones. Therefore, reviewing or analyzing the effects of the ASC-label against context areas in an FFE perspective seems like a worthwhile research topic in our eyes.

With regards to using the FFE model to evaluate CSR performance of companies, future research could involve taking a deeper look into Marine Harvest's and Cermaq's activities. If possible, more interviews from other company sources would be required to clarify certain issues. A future analysis of Marine Harvest and Cermaq could also be extended to focus more deeply on the existing context areas, as well as including new ones. But as we have seen from our attempt, this would require more cooperation and willingness from the companies to present more relevant data of their actual activities.

An empirical analysis like the one done here could also be applied to compare different types of companies. For instance it might be interesting to use the FFE model to compare the CSR performance between large, multinational companies (like Marine Harvest and Cermaq) opposed to small and medium enterprises (SME's). Also, as we have seen how Cermaq, where the Norwegian Government is the dominant shareholder, performs better in relation to the FFE model than Marine Harvest, which is dominated by private investors, it can be interesting to investigate ownership structure further, to see how this might affect CSR performance within fish farming. As government ownership indirectly implies that a wider array of stakeholders are represented on the ownership side, this may indicate that governmental policies have a greater influence on corporate governance within a publicly controlled/owned company. Sustainability is a social goal most people expect the government to help secure. In addition, the government might have more incentives to consider for example environmental issues than a private company because the potential backfire effects related to pursuing bad policies (e.g. unsustainable policies) are likely to affect the broader society greater than the individual investor. There is therefore perhaps more room for pursuing societal values, and thus the wish to maximize more than a single dimension (e.g. the economic one) in a publicly controlled/owned company. This again might be related to how the organizational culture may differ from that of privately owned institutions, with regards to e.g. the organizations' mission and value statements. As we have seen, fish farming has considerable impact on both ecological and ichthyological issues. Hence a study combining the FFE model with a closer look at the effects of ownership structures may therefore be interesting.

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13 APPENDIX

13.1 QUESTIONNAIRE

Agenda with indicative subjects/questions related to interview at the headquarter of Cermaq ASA

1. Feed

- How much of the fishmeal and fish oil you are using comes from MSC (Marine Stewardship Council) or RS (Responsible Sourcing) certified fisheries?
- How do you actively support the RS-scheme? What about MSC?
- Can you deny that by-catch from bottom trawling is used as a part of your feed suppliers production process of the fishmeal and fish oil?
- What are the latest figures on the average percentage inclusion of fishmeal and fish oil in the feed (which are subject to constant changes)?
- To what extent can you substitute fishmeal and fish oil if necessary/changed consumer preferences?

2. Sea cages

Site selection

- Fallowing is used, but what are the effects? Are the fallowing times that are used sufficient?
- How is location rotation applied (e.g. moving the sea cages as a measure against sewage, bottom chemicals etc.)?
- You mention that EWOS has developed a model for calculating ecological footprint, but that this has so far has only been done with regards to fish feed. Can you explain more about the model and possibly when a model for farming will be developed?

Cage design

- Do you have statistics on what kind of sea cages you are using with regards to size?
- What reasons/criteria lie behind the choice of cage design (i.e. circular, rectangular)?
- Is there a difference between maintenance and the general handling of cages with respect to whether rectangular or circular cages are used?
- Are different sea cages being used for different fish sizes?

Stocking density

- You follow the Norwegian regulation of 25 kg/m³. Is this upper limit carried out in all your operating locations (i.e. countries) independent of different regulations? From your perspective – do you perceive the necessity for further decrease in stocking density?
- How is the stocking density applied as the fish grows? Is the fish transferred from one sea cage to another? How often is stocking density calculated?

Net deformations

- What measures are taken to reduce net deformations (e.g. as some examples shows this can cause a 40 % volume reduction in the sea cage, subsequently leading to a stocking density as high as 60 kg/m³) caused by currents, tidal effects, wind etc.? Do you have continuous camera monitoring of the sea cage (net) movements beneath the surface?
- Do you have systems for revealing stronger currents?
- Have you available systems in place for moving weights attached to the bottom of the sea cages on a regular basis (adapted to cope with different weather-/current conditions in order to prevent/reduce net deformations)?

Dissolved oxygen

- Can you tell more about the loss of fish you have had in relation to Mainstream British Columbia as a consequence of low oxygen level in the water?
- Is the oxygen levels in the water continuously monitored?
- What is your perception of oxygen levels falling below 6.5 mg/liter?
- How is the monitoring of fish positioning in the sea cages done (as an indication of how well the oxygen levels are distributed in different depths in the sea cages)?
- Is copper oxide used for cleaning the nets (of the sea cages)? Are other chemicals or methods used, and what experiences have been achieved in that case?

Temperature

- Do you have continuous temperature monitoring? Is the practice different between the countries?
- How often is rapid temperature fluctuations experienced, and how does this pose challenges for the operations?
- How often does the temperature rise above 20 degrees Celsius?

Light

- To what extent is artificial light used? Is this applied during night time? Is this applied all the year?
- What is the effect of applying artificial light, and how is your perception of this with regards to fish welfare?

Submergence

- Are systems for submergence in place (i.e. making the surface inaccessible to the fish – the fish is forced further down in the sea cage) related to e.g. storms or large temperature fluctuations?
- In case of submergence being used – how is measurements applied to examine whether the salmon have the need for going to the surface to adjust its swim bladder?

Sewage

- To what extent do you perceive fish sewage as a problem for the operations?
- Is there applied cleaning of sewage (e.g. ammoniac) or is it done through natural removal (through nature)?
- How often are samples taken from the seabed in surrounding areas of the sea cages?

Closed containment facilities

- How do you perceive the effects of closed containment systems on fish welfare?
- What opportunities do you think they may have for the future fish farming industry (e.g. financial, efficiency)?
- To what extent have you (or your perception of the industry in general) come to manage the challenges connected to the economic viability of closed containments systems?

3. Escaping

- Can you tell more about how you take action to prevent escapes, and what procedures you have for recapture and for possible adverse effects?
- Have you done statistics on causes of escapes (propellers, collisions, animals, nets, etc.)? What does this statistic portray?
- Measures are taken against animal/fish attacks to prevent damage on sea cages subsequently leading to fish escapes. How does noise/sound methods work, and how does it affect stress on fish? How often do you have to kill other animal/fish to prevent attacks?
- Apart from animal attacks – what other steps are taken to reduce the risk of equipment damage? Do you implement different measures in different countries?
- What is the current status on the zero escape vision since the last sustainable report was released?
- How do insurance schemes apply to escape scenarios? What insurance premiums exist and what are the key conditions underpinning it?
- Do you have systems in place for identification/tracing of escaped farmed fish? Or, how does the company contribute to research of e.g. physical tagging, “coded wire tags” or “DNA-stand-by-method”?
- Do you perceive any advantages when e.g. electronic tagging can make it easier to monitor the fish’s movements inside the sea cage?

- What steps have been taken from the company with regards to monitoring the development/changes of genes on farmed fish? Are there different challenges in relation to the countries you operate in? E.g.in Norway, the genes of farmed salmon is 10 generations old (originally put together as a mixture from wild salmon in different Norwegian rivers in the 1970s). How is it in Chile and Canada?
- How does the company perceive the severity (e.g. economically, for the farmed fish, for the wild salmon) of escaped salmon vary depending on where escaping occurs (respectively Chile, Canada, Norway)?

4. Sea lice

- Do you feel responsibility to reduce the extent of salmon lice on wild salmon?
- Can you tell about potential coordinated delousing programs taking place in the spring at the same time as wild salmon smolt migrates to sea?
- Are you involved in genetic research on salmon lice?
- Do you have statistics on how much you have used of the different delousing agents (alphamax, betamax, hydrogen peroxide, etc) in relation to bath treatment?
- Do you have statistics regarding how many fish that dies due to bath treatments?
- Do you have statistics on potential negative consequences with regards to the use of wrasse, if you use that (which eats the eyes of the salmon if there are not enough lice etc.) Do you take actions to prevent this?
- Do you initiate steps to use the same wrasse year after year or do you capture new wild wrasse every year?
- What is the mortality of the wrasse, if you use it?
- How does the salmon's environment change when measurements to combat sea lice are initiated?
- What is your economic loss due to salmon lice every year?

5. Slaughter process

Pipe systems

- How do you perceive the difference between vacuum pumps and siphon pumps, and which is used by your slaughterhouses?
- What is the sharpest angle of the pipe systems used as a part of the slaughter process?
- What procedures exist to detect sharp edges in the pipelines due to pipe joints?
- Do you have any statistics on fish injuries as a consequence of the pumping process? In case, what does it tell?
- Are any steps taken to minimize the pumping process?
- What are the water temperature-/oxygen levels in the pipes? Do you apply additional oxygen supplements or temperature adjustments?
- If slaughtering is outsourced – what procedures are in place to ensure desired practice?

Brailing

- Is brailing used as an alternative to pump systems?
- In that case - how many kilos of fish are handled together?
- Is wet or dry brailing used?
- How are the procedures for emptying a brail?

Stunning methods

- What methods do you use across the countries you operate in?
- To what extent is CO₂ used as a stunning method in other countries, even if it now becomes illegal to use it in Norway from 1. July 2012?
- How do you relate to different legislations across countries with regards to stunning methods? Do you practice a general company standard or does the practice vary?
- On what criteria do you choose stunning methods?
- Do you have statistics regarding margin of errors for the different stunning methods?
- Have you established procedures for re-stunning if the first attempt fails?
- What is your view on the potential of using CO (carbon monoxide) as a stunning method in the slaughter process?

Slaughtering at boat right by the sea cages (dead-haul)

- How do you perceive the efficiency of this method? Is it a desired method compared to well-boat transportation to the slaughter site?
- Are there any particular hygiene concerns (diseases and infections) that need extra considerations with this method? (We have talked with a principal scientist at the Institute of Marine Research that claimed this process is not optimal with regards to hygiene concerns related to dead-hauling).
- How do you perceive the fish's stress levels related to this method?

Other questions:

- Have you done any investigations to map out why farmed salmon seemingly have more deformations than wild salmon? What kind of potential measurements can be adapted to reduce the prevalence in this regard?
- Have there been done any studies on how deformations influence fish welfare? If so, to what extent?
- What do you think is the biggest challenge the industry will face in the future?
- What is your stance whether fish feel pain or not?