NTNU – Trondheim
Norwegian University of
Science and Technology

Challenges and Potential of the Aquaculture Stewardship Council Standard in Salmon Fish Farming

Case: Marine Harvest Group

Erik Bonsaksen

Master in Industrial Ecology
Submission date: June 2014
Supervisor: John Eilif Hermansen, IØT

Norwegian University of Science and Technology
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Problem Description

To analyze the ASC standard through a comparative study and suggest recommendations related to future implementation processes in accordance to environmental, social and sustainability aspects.

Main contents:

- A literature review on material related to aquaculture standards.
- Overview of awareness on environmental, social and sustainability aspects held by the ASC standard – uncover key features of having the standard or not.
- Assessment of major conformities and non-conformities of the ASC standard and current implementation processes.
- Benchmarking and comparison of the ASC standard with identical standards in the market

Assignment given: 15. January 2014
Supervisor: John Eilif Hermansen

PREFACE

This document is my Master's Thesis in MSc Industrial Ecology at the Department of Industrial Economics and Technology Management at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. The thesis is written in collaboration with Marine Harvest.

I would like to thank my supervisor John Eilif Hermansen for continuous support on my master thesis, for this motivation, enthusiasm, patience and knowledge. Our multiple meetings and his guidance helped me along the way to finalize the writing.

I wish to thank Catarina Martins, group Manager of Environment and Sustainability at Marine Harvest, for her patience, value feedback and contributions.

I thank my fellow Industrial Ecology students for stimulating and dreary late night discussion. For out cooperation, their inputs and support before the deadline.

SUMMARY

Effective and sustainable management in aquaculture is crucial to meet challenges related to global food production, increased world population, and climate change. Principles and criteria embodied in 'standards' have become means to counter such challenges. Standards has the potential to manage complexity in order to reduce costs and energy consumption, determine trade competitiveness, give access to new markets, provide traceability and accountability. A great proliferation of standards and certification schemes has emerged to address food safety and quality, environment, social responsibility and animal health and welfare - important issues within aquaculture. This is a trend also in salmon aquaculture and especially within Norway having salmon as the third biggest export product. Marine Harvest, the case company and world largest producer of Atlantic salmon has BAP, GLOBALG.A.P and ASC certified farms - three recognized schemes within the industry. Furthermore, Marine Harvest committed in 2013 to become 100 percent ASC certified by 2020. Upholding the scheme is the ASC Salmon Standard, held to be a frontrunner in term of environmental and social responsibility in salmon aquaculture

The aim of this research is to analyze and illustrate the content of ASC Salmon Standard, and uncover key features by comparing it to GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standards through quantitative and qualitative methodologies. Methods consist of analyzing with control points, external indicators, a GAP- and descriptive analysis. A multidisciplinary and thematic literature review concerning aquaculture standard builds the theoretical framework of the analysis, and analyze non-conformities in current implementation processes. Ultimately, all research will assess challenges and potential of an ASC Salmon Standard implementation and relate the results to the case company Marine Harvest.

ASC Salmon Standard performs well in comparison to GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standard in environmental and social matters, but do not specifically address animal welfare and food safety. The standard of GLOBALG.A.P and BAP contain to larger extent minimum requirements, and depend more on local regulation. The ASC certification program is a viable scheme to address future challenges in term of environmental and social issues and to guide the salmon aquaculture industry towards sustainable development.

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LIST OF TERMS

Aquaculture production system	A process for growing aquatic animals and plants in an aquaculture facility (USDA 2006)
Aquaculture	The farming of aquatic organisms such as fish, crustaceans, molluscs and aquatic plants, and it involves cultivating freshwater and saltwater populations under controlled conditions. It can be contrasted from commercial fishing that is focused on harvesting wild fish (USDA 2006).
Aquatic animal	Any finfish, molluscs, crustacean, or other aquatic invertebrate grown in fresh, brackish or saltwater, except amphibians, reptiles, birds and mammals (USDA 2006).
Certification	Procedure by which an official certification body or officially recognized certification body gives written of equivalent assurance that a product, process or service conforms to specified requirements. Often form the basis in audit activities that include continuous audit in the production chain (ISO 2004).
Certification body	Competent and recognized body that conducts certification. A certification body may oversee certification activities carried out on its behalf by other bodies (ISO 2004).
Certification scheme	The processes, systems, procedures and activities related to standard setting, accreditation and implementation of certification, including the labelling of practices, operations and products (ISO 2004).
Control Point	Set of points used to determine performance, condition or value of something.
Finfish	Aquatic vertebrate animals, not including mammals, birds, amphibians and reptiles (USDA 2006).
Hazard Analysis and Critical Control Point (HACCP)	Quality system. A systematic preventive approach to food safety and allergenic, chemical, and biological hazards in production processes that can cause the finished product to be unsafe, and designs measurements to reduce these risks to a safe level (FAO 2011).
Organic Aquaculture	A holistic system designed to optimize the productivity and fitness of the aquatic ecosystem, and it included those of benthic organisms, seaweed, aquatic plants and aquaculture animals. It has during the last centuries become more popular as a result of consumers getting more environmentally aware and concerned about sustainability and harmful impacts of aquaculture (Bergleiter et al. 2009).
Salmon farming	The farming and harvesting of salmon under controlled conditions. Opposed to wild salmon captured by commercial fishing techniques. Most commonly farmed salmon is the Atlantic salmon *Salmo Salar*, for which Norway is the largest producer (European Commission 2009).
Retailers	A business or person that goods to the consumer, as opposed to a wholesaler or supplier, who normally sell their goods to another business. Examples are IKEA and Rema 1000 (BusinessDictionary 1999).
Wild fish	Any species of fish or shellfish, raw or processed, harvested from wild sources used for food or in animal feeds, including feeds for aquatic animals (USDA 2006).

ACCRONYMS AND ABBREVATIONS

ASC	Aquaculture Stewardship Council
B2B	Business-to-Business
B2C	Business-to-Consumer
BAP	Best Aquaculture Practice
CEN	European Committee for Standardization
CSR	Corporate Social Responsibility
FAO	Food and Agriculture Organization of the United Nations
GAA	Global Aquaculture Alliance
GLOBALG.A.P.	Global Good Agricultural Practices Standards
GSI	Global Salmon Initiative
HACCP	Hazard Analysis and Critical Control Point (system)
IFFO	International Fishmeal and Fish Oil Organization
ISEAL	International Social and Environmental Accreditation and Labelling Alliance
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
NGO	Non-Governmental Organization

ROI	Return-on-Invest
SAD	Salmon Aquaculture Dialogue
SPS Agreement	Agreement on the Application of Sanitary and Phytosanitary
TBT Agreement	Agreement on Technical Barriers to Trade
USDA	U.S. Department of Agriculture
WHO	World Health Organization
WTO	World Trade Organization
WWF	World Wide Fund for Nature

1 INTRODUCTION

Aquaculture can be a promising field to counter challenges related to global food production and the tremendous increase in world population. However, this highly depends how the industry can persuade effective and sustainable management. A mean to achieve this is to apply guiding principles and criteria typically contained within a 'standard'. Implemented throughout the whole aquaculture industry, these standards address relevant issues mainly concerned with food safety and quality, environment, social responsibility and animal health and welfare. Marine Harvest utilizes three major aquaculture standards forming the core in three recognized certification programs. One is the recent ASC Salmon Standard, held to be a key component in fulfilling Marine Harvest's sustainable ambitions. A decision used as a platform to conduct a case study. A benchmark examines the potential of the ASC standard by using quantitative and qualitative methodologies, comparing all three major standards used by Marine Harvest. Scientific tools were used to illustrate features of each standard by analyzing with control points, external indicators, a GAP analysis and qualitative assessment. A thematic literature review builds the theoretical foundation of the analysis. A discussion based on the information and results from the analysis will examine how aquaculture standards can benefit salmon farming companies. Part 1 presents all frameworks necessary to conduct the analysis. Part 2 presents a detailed description of data analyzed in part 3. Part 4 presents an extensive description of the results later discussed in part 5. Part 6 will bring concluding remarks.

1.1.1 Purpose of Research

All research relates to Marine Harvest's decision of implementing the ASC Salmon Standard, thus making them a case company. Three fundamental areas of focus will address this aspect:

1. Literature review with an interdisciplinary approach of material related to aquaculture standards, to explore key features and create awareness of environmental, social and sustainability aspects held by aquaculture standards for later applying the theory to an assessment of the ASC Salmon Standard.
2. Benchmark the ASC Salmon Standard with similar standards currently used by Marine Harvest ASA, being GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standard, followed by an analysis of how they align with the environment and social scope of ASC Salmon Standard.
3. Analyzing the challenges and potential of each aquaculture standard utilized by Marine Harvest.

The total embodiment of specified goals forming the foundation of the thesis is the following:

- Why companies would chose to implement the ASC Salmon Standard - the position and status it hold in the market and the aquaculture industry.
- Constraints and limitations of aquaculture standards. Market importance, how they can provide economic growth and synchrony with sustainable development.
- How the ASC Salmon standard can function as basic component for improved environmental and social managements, fill gaps from legislations or align with an overall focus on sustainable development.

System boundaries are limited to standards developed in relevance to aquaculture, whereas the first order of relevant standards is those based upon process criteria. This could be most standards centralized on quality and social aspects, and not the least those with environmental concerns. The opposite corner is technical standards that, due to their nature, are less suitable for analyses and have a different function within the structure of a system.

Geographical boundaries restricts to Norwegian salmon farms when possible. Target Company for salmon aquaculture production is Marine Harvest ASA, one of the largest seafood companies in the world, and the world's largest producer of Atlantic salmon.

1.2 Main Actors

Two actors partake in the foundation of the thesis. First is Marine Harvest ASA being Catarina Martins (group Manager of Environment and Sustainability), the contact person. Second is the Aquaculture Stewardship Council, runner of a strong program to improve environmental and social performance.

1.2.1 Case Company: The Marine Harvest Group

In 2006, the Norwegian companies Pan Fish, Fjord Seafood, and the Dutch company Marine Harvest N.V., three major European seafood producers, merged into the Marine Harvest Group, for this study plainly referred to as Marine Harvest. The company is a world-leading producer of Atlantic salmon, halibut and white fish, but have salmon and salmon-derived products constituting their biggest revenue representing 91.1 percent in 2013 (Marine Harvest Group 2013a). It operates in an integrated value chain with freshwater broodstock, grow-out and processing plants, which both harvest and manufacture their own distribution operations (see

Figure 1). Marine Harvest is headquartered in Bergen, Norway, present in more than 22 countries and employs approximately 10 200 people. Year of 2013 was an exceptional one for the company, having a strong turnover of NOK 19 billion, acquiring Morpol on September 30, a world leading second processor salmon and being listed in the New York Stock Exchange (NYSE), an additional listing to their prior in the Oslo Stock Exchange (OSE). Their first feed plant in Bjorn, Norway will also be finalized summer 2014, a step that will according to Marine Harvest CEO Alf-Helge Aarskog give further ”control over the whole value chain and makes it easier to secure top quality throughout the process” (Feed Navigator 2014).

Figure 1: Integrated Value Chain of Marine Harvest (Marine Harvest Group 2013a)

Marine Harvest has acknowledged their position as a leading producer of aquaculture products including large-scale operations, and therefore acknowledged the environmental and social challenges the aquaculture industry face, and the long-term consequences they amass. As a preeminent company with an integrated value chain, Marine Harvest would therefore need to take responsibility for multiple fields along their extended value chain. To continue being profitable, they must put the financial strength and resources necessary to take a leading role in the sustainable development of the industry, to involve and engage multiple stakeholders and ensure constant improvement of regulations and responsible practices. The commitment taken in 2013 to become 100 percent ASC certified until 2020 (topic expanded in subchapter 5.5) will be important to remain a sustainable industry.

1.2.2 Aquaculture Stewardship Council (ASC)

WWF had extensive involvement in the certification of sustainable forestry (FSC) and wild-capture fisheries (MSC), and therefore had a natural enactment in the development of standards concerning environmental and social impacts for aquaculture certifications. The organization initiated the Salmon Aquaculture Dialogue (SAD), a range of ‘round tables’ involving numerous stakeholders from the industry such as producers, seafood processors, retailers, foodservice companies, scientists and conservation groups. The round tables created standards for 12 aquaculture species, therein salmon, by the end of 2010, and entrusted them to a separate,

independent standard holding entity, namely the Aquaculture Stewardship Council. ASC is an independent not for profit organization, to be the "standards holding body" to manage the global standards for the most credible social and environmental standards in responsible aquaculture.

The ASC is a global organization working internationally to promote the best environmental and social choice practices, to increase the availability of aquaculture products certified as sustainable and responsibly produced. The ASC aims to transform aquaculture practices globally through:

- Credibility: Standards developed according to ISEAL guidelines, multi-stakeholder, open and transparent, science-based performance metrics.
- Effectiveness: Minimizing the environmental and social footprint of commercial aquaculture by addressing key impacts.
- Adding value: Connecting the farm to the marketplace by promoting responsible practices through a consumer logo.

1.2.3 The Global Salmon Initiative (GSI)

In 2013, a group representing 70 percent of global salmon industry announced commitment to sustainability. The commitment is a major industry led initiative embodied as the Global Salmon Initiative (GSI), aimed at making aquaculture salmon a sustainable source of healthy protein to feed for a growing world population, to minimize environmental footprints and to conduct social contributions (GSI 2013a). GSI builds on the principles of sustainability, transparency and cooperation with the objective to:

1. Bring together global farmed salmon producers and other industry stakeholders to strive towards significantly improving the sustainability of salmon farming.
2. Cooperation to continue to outperform other sources of animal protein in terms of contribution to human health, environmental responsibility, and efficient feed conversion rate, and to be widely recognized for this accomplishment.
3. Achieve the highest standards of corporate citizenship in the regions where members operate.
4. Translate environmental and social sustainability into greater economic sustainability through enhanced social license and market acceptance.

GSI acknowledge further effort towards sustainability is necessary despite current endeavors and compliance with requirements of demanding standards. As a result, GSI has taken the step

to adopt the ASC Salmon Standard guide and report the initiatives progress. However, the global implementation of the ASC standard requires significant challenges in term of technology and finance. Adjustments that need field experience and evolving science. GSI therefore extends the cooperation threads, to share technology and practices and a full out ASC certification of its members within 2020 (GSI 2013b).

1.2.4 Other Relevant Actors

Several organizations and initiatives have a central role in the discourse development and enhancement of the aquaculture industry, and the following actors all have a key position therein in addition to the thesis.

Food and Agriculture Organization of the United Nations (FAO)

A specialized agency from the USA that leads international efforts to defeat hunger, share knowledge and information and help developing countries. It also aims to make a significant contribution to the attainment of the Millennium Development Goals and the targets set by the World Summit on Sustainable Development and the World Food Summit. The FAO Code of Conduct is among many aquaculture companies an international fundamental framework for development of sustainable aquaculture standards (Washington & Ababouch 2011).

International Social and Environmental Accreditation and Labelling Alliance (ISEAL)

The ISEAL Alliance is an international non-profit organization that codifies the practices for designing and implementing social and environmental standard systems (ISEAL 2010). It is a membership-based organization with several sectors including forestry, agriculture, manufacturing, fisheries and aquaculture, and work on the basis that voluntary standard systems, which is effective and accessible, can bring significant impacts in social, environmental and economic matters. ISEAL have developed a Code of Practice that emphasize multi-stakeholder involvement and consensus building, which leads to a transparent process in the creation of social and environmental standards.

1.3 Structure of the Thesis

Thesis divides into six parts, see *Figure 2*. Part 1 introduces the subject of focus, main actors and all relevant frameworks. Part 2 gives an overview of data, in this case relevant aquaculture standards. Part 3 performs the analysis of the main standards through applied method. Part 4 will evaluate the Marine Harvest's sustainable targets in accordance to the results from the

analysis, and assess compliance with ASC principles. Part 5 discusses the collected information and Part 6 will assemble concluding remarks with recommendations.

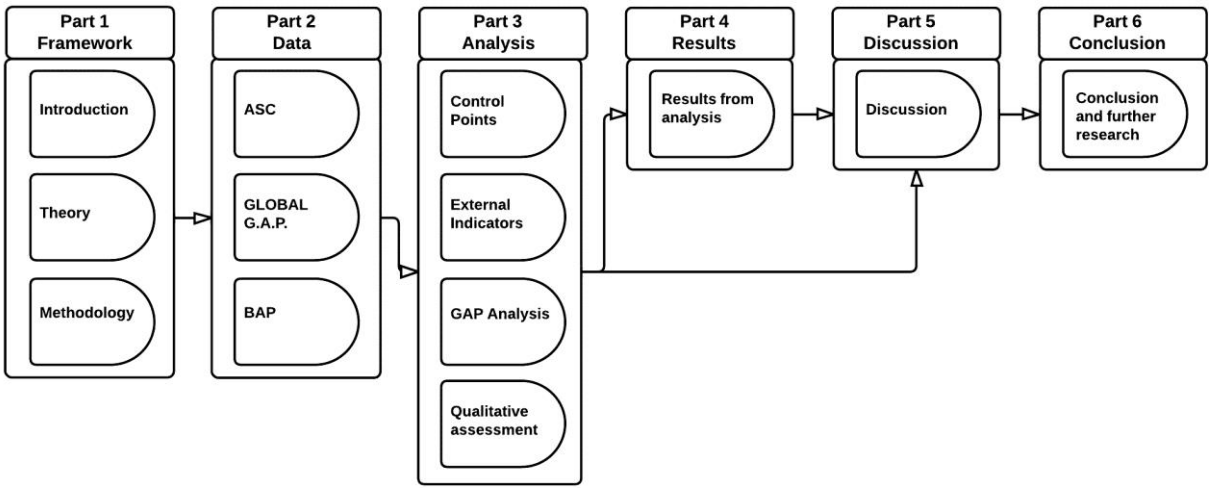


Figure 2: Structure of thesis

2 THEORETICAL FRAMEWORK

The chapter will describe the importance of aquaculture in light of global food production and later elaborate on salmon aquaculture specifically. Consequently, a depiction of standard usage will follow, including definition, types and benefits it hold among the given actors. Last, it will assess schemes and orientations of standard utilized within the aquaculture industry. Together, all parts will constitute the theoretical framework deemed necessary for the analysis chapter.

2.1 Global Food Supply

UN's annual report of World Economics and Social Survey in 2011 made it clear: global food production would need an increase of 70 to 100 percent in order to provide food to an expected world population of 9.3 billion people in 2050 (United Nations 2011). Multiple reports have hailed fish (general term 'fish' used here includes fish, mollusks, and crustaceans consumed by humans) and fishery products as a viable source to bolster food security, given their great potential of supplying protein, essential amino acids and minerals. World marine catch allegedly hit near limit size in the 1990s with a high of 86 million metric tons followed by a substantial decline since. A downturn explained by the combination of size in resource base, overfishing and changes in ocean climate (Pontecorvo & Schrank 2012). This brought attention to the correlation between fish populations, climate and fisheries, and the necessity to control it under the banner of sustainable management. However, aquaculture blossomed in the wake of marine fishery decline and had a sufficient growth in new output per capita, making the field up today quite promising in term of counter the challenges of food production.

Food and Agriculture Organization (FAO) have estimated maximum potential of marine fisheries to stay at 80 million metric tons (2010), but climate changes makes this approximation unstable as climate change is expected to change future fisheries production patterns by either shifting production as species move to new habitats (Cheung et al. 2009). On the other hand, aquaculture has expanded 12 times since 1980s, becoming in a relative short amount of time the fastest growing food production industry. Farmed fish species hit an all-time high in 2010 with 60 million metric tons. Combined with aquatic plants and non-food products the numbers increase to 79 million metric tons, constituting 47 percent of the global fish food consumption (FAO 2012). Technological innovation and adaption makes aquaculture a viable fish provider that comply with consumer demand and compete with conventional fishing in mass. Nevertheless, the question remains if aquaculture can provide enough fish for the current

population growth. Merino et al. (2012), who based on realistic FIFO rate estimations combined with UN projections on human population size for consumption rates, conclude with one positive take on the question. Merino et al. argues that effective and sustainable management in fisheries and aquaculture has the potential to sustain a reasonable projected increase in per capita consumption levels on a global scale. To achieve this, fisheries needs institutional change and greater commitment to address governance weaknesses. In aquaculture, key factors are further technological change and policies that encourage improved environmental standards (ibid.). Right now the global human population is growing at 1.7 percent annually which aquaculture currently outpace by a rate of 1.4 percent - growing 3.1 percent annually (Marine Harvest Group 2012b). However, to preserve this vital synergy, keen management is crucial to assess the value of fish and to comply with much needed and demanded environmental and sustainable criteria.

2.2 Aquaculture

Knowledge and commercial proficiency of aquaculture was limited until mid-20th century, and consisted of a worldwide production of 1 million tons in the 1950s with few to none university courses associated with fish culture. The interest in fish farming slowly began to emerge in the 1960s and finally flourished in the 1970s. Most publications of fish culture before this period consisted of literature not published commercially, but after initiatives from international development agencies looking for new protein sources that could sidestep gloomy prospects in fisheries and problems in traditional agriculture. Along came an information growth that evolved exponentially and developed into the complex multidisciplinary science known today (Tidwell 2012), causing increased productivity through further control of biological production processes (Asche 2008). In the 1970s, aquaculture contributed less than 4 percent of total seafood production, by 2008 it contributed more than 47 percent (FAO 2006) with an annual growth rate since the 1970s of 6.6 percent (FAO 2010).

2.2.1 World Aquaculture Production

In the world of aquaculture production Asia comes out on top with 89 percent. China is the preeminent contributor with more than 60 percent of global aquaculture production in volume (FAO 2012). Norway, the largest aquaculture producer in Europe and of farmed salmon in the world, comes relatively short in comparison. However, as described by Hall et al. (2011), despite aquaculture dominance in Asia, aquaculture is an important economic activity in most continents. Again exemplified by Norway holding salmon aquaculture is the third biggest

industry (FAO 2012). Nonetheless, since 2010 the top ten producing countries, shown in *Table 1*, accumulated 87.6 percent by quantity and 81.9 percent by value of the total farmed food fish in the world.

Table 1: World aquaculture production (FAO 2012)

Global	Tons	Percentage
China	36.7	61.35
India	4.6	7.76
Vietnam	2.6	4.46
Indonesia	2.3	3.86
Bangladesh	1.3	2.19
Thailand	1.2	2.15
Norway	1.0	1.68
Egypt	919 585	1.54
Myanmar	859 697	1.42
Philippines	744 695	1.24
Other	7.3	12.35
Total	**59.8**	**100.00**

Aquaculture have a wide range in terms of species raised, and a great composition variety of individual species based on tons, as seen in *Table 2.*

The number of species and specie groups recorded in aquaculture production is according to FAO (2012) the total of 541, whereupon 327 are finfishes (5 hybrids), 102 molluscs, 62 crustaceans, 6 amphibians and reptiles, 9 aquatic invertebrates and 35 algae. According to Duarte et al. (2007) approximately 97 percent of the species presently in aquaculture have been domesticated since the start of the 20th century, among them 19.6 percent have been domesticated up till 2007.

Table 2: World aquaculture production (FAO 2012)

Species	Tons	Percentage
Freshwater fishes	33.7	56.4
Molluscs	14.2	23.6
Crustaceans	5.7	9.6
Diadromous	3.6	6.0
Marine fishes	1.8	3.1
Other aquatic animals	814 300	1.4
Total	**59.8**	**100.00**

2.2.2 Aquaculture Compared to Conventional Fishing

Compared with traditional fishing and farming, aquaculture is quite reliable source of protein. Weather or territorial disputes is a bigger threat for fisheries and make fish farming in comparison much more stable, less dangerous and vulnerable to seasonal junctures.

Conventional fishing also relies on few species while aquaculture can successfully harvest thousands. In addition, aquatic domestication rates is around 100 times faster than the rates on plant and animal species from land, even over the period when domestication to be considered fastest (Duarte et al. 2007).

2.2.3 Market Trend for Aquaculture Fish Products

A recent interest in fish and fish products has emerged within the food market. The international meat market experienced an enormous price raise between 2004 and 2005, which pushed consumers towards alternative protein sources, such as fish. A dire change, which independent on the increase in human population, has led to an increase in consumption rates. Global per capita fish consumption has increased over the past four decades, rising from 9.0 kg/person in 1961 to an estimated 17.1 kg/person in 2008 (FAO 2010). A demand expected to increase 10 million tons per year by 2020 (Diana 2009). FAO projections estimate fisheries and aquaculture productions to reach about 172 million tons in 2021, outrunning the global production of beef, pork or poultry. This is a rapid development mainly driven by aquaculture with a rise of 33 percent compared fisheries with 3 percent in the same period (FAO 2012).

2.3 Salmon Aquaculture

Salmonids, which include salmon, trout, chars, freshwater whitefishes and graylings, spawn in fresh water and often migrate to sea to access a larger food supply. The most important global salmon species is Atlantic salmon, holding a share of 77.9 percent in 2010 (Asche et al. 2013b). Norway is the biggest exporter of Atlantic salmon, whereby Marine Harvest is the largest producer.

2.3.1 Development of Commercial Salmon Aquaculture

Since ancient time, humans have regarded salmonids as a viable food source. In the western world, 14th century France entities began experimenting to understand salmonid life cycles, and more advanced testing occurred late 18th century Germany. In mid-19th century however, true growth took place with experimenting of artificial fertilization, incubation of salmonid eggs and transport of Scotland (Laird 1996). Salmonid hatcheries soon established in Europe and North America, and the most common specie was salmons as it had proved itself a quite successful. By the end of 19th century, 18 salmon hatcheries existed in Scotland with similar progression in North America and Japan (ibid.). However, the focus with salmonid culture was

mainly to restore depleted natural stocks, and to introduce salmon and trout into new parts of the world (Tidwell 2012).

In the 1950s, Norwegians began cultivating programs of seawater trout and continued until fish farmers switched to Atlantic salmon mid-1960s for profitable reasons. In 1965, A/S Mowi (later to fuse into Marine Harvest) created the world's first salmon cage farm in Norway. Other countries also had by 1990 a notable Atlantic salmon production such as Canada, United States, Scotland, Australia (Tasmania), Chile and the Faroe Islands. Currently, four countries produce 95 percent global farmed salmon, namely Canada, Chile, Norway and the UK (Asche et al. 2013a). However, few compare to the Norwegian amount and development, holding 51 percent in 2010 (Asche et al. 2013b). Marine salmon cages in Norway produced 171 metric tons in 1973, 151 000 tons in 1990 to 1 232 094 tons in 2012 (Tidwell 2012; Sentralbyrå 2013).

2.3.2 Salmon as a Successful Specie

Worldwide aquaculture production of Atlantic salmon has had a tremendous increase since the 1970s, and is considered one of the most successful species within aquaculture, simply demonstrated through the great productivity and production growth (Asche 2008). Expansion of salmon aquaculture have come to the point of replacing wild salmon in production and markets, but in light of other seafood categories, Atlantic salmon is still marginal when for instance compared with Whitefish, having a ten times larger production and number of species (Marine Harvest Group 2012b). Nevertheless, salmon aquaculture has an incredible efficiency rate in term of output from the set of inputs, explained by the cost decrease in feed and smolt, and with less need in labour through technical improvement and efficiency change (Asche et al. 2013a).

Salmon have great portion of marine omega-3 polyunsaturated fatty acids such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), serve as excellent nutritional source, provide high quality protein and a wide variety of vitamins and minerals, including vitamins A and D, phosphorus, magnesium, selenium and iodine. In a world of grain limitations, farmed salmon also prove an excellent source for animal protein. A typical method to measure efficiency of different protein productions is the representative feed conversion ratio (FCR). It explains the necessary kilograms of feed to increase an animal's bodyweight by one kg. For fish in general, amount of feed necessary to produce a ton of fish is much more economical compared with pork or beef, and equally matched with chicken. Four kilograms of feed are

required for each kilogram of pork and seven for each kilogram of beef. For fish and chicken, only two kilograms of feed to produce one kilogram is necessary. More specifically, 1 kg of farmed salmon have a FCR rate of 1.15. Compared with the other three species, cattle comes out worst with 8.0. Other circumstances also apply for wild salmon with a FCR of approximately 10.0 (Marine Harvest Group 2012b). The main reason why salmon convert feed to body weight so efficiently is that by being cold blooded they do not have to use energy to heat their bodies. In addition, the consumption levels works in favor of fish due to less growth energy used into bones when supported by water.

2.4 Sustainable Development and Aquaculture

The Brundtland Commission defined the concept of sustainable development as *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED 1987: 8). In 1998, the Holmenkollen Guidelines approached the definition of Sustainable Aquaculture with both ecological and social elements and limits considered, endorsing: (1) Rio-Declaration of 1992 that considered inter-relations between biological, technological, socio-economic and ethical aspects; (2) precautionary principles, to meet uncertainties with scientific knowledge and strategies to reduce environmental harm; (3) human equity (Sundli 1999). This reflected that the idea of sustainability had become prevalent, thus increasing the demand for environmental sound, animal health and welfare and social responsible concerned practices in aquaculture. As a response, the industry began utilizing labels and associated private certification schemes addressing such affairs. A key aspect that distinguish certification schemes these activities, making it possible to establish and uphold them, are the specific aquaculture standards underneath. Furthermore, these standards have become a central market mechanism for aquaculture companies by influencing consumers, becoming an important feature for market based incentive programs (McLaren 2011).

2.5 Identified Issues in Salmon Aquaculture

Many standards and certification schemes have emerged within the aquaculture industry addressing key sustainable issues. These issues have been highlighted by several instances, with the Norwegian Ministry for Fisheries and Coastal Affairs (FKD) as a notable one. FKD formulated and reported in 2009 a national "strategy for environmentally sustainable aquaculture industry" (FKD 2009), reflecting an overarching ambition for sustainable development to one of Norway's key industries. The strategy focus on five main areas of

environmental impacts caused by the industry, and addressed them accordingly to obtain sustainable farming:

- Diseases
- Feed and feed ingredient
- Genetic interaction with wild counterparts and escapees
- Pollution and effluents
- Use of area

As a part of the strategy to achieve sustainability, FDK recognized the use of environmental labelling in the aquaculture industry, explaining that in order to provide credible information and guidance in sustainable development, it becomes necessary to have clear criteria and chain traceability, something made more accessible through climate and eco-labeling. Reviewing the aquaculture standard of focus there is several of FDK's issues covered:

- ASC Salmon Standard contain seven identified areas of key potential negative impacts: feed, escapes, nutrient loading and carrying capacity, benthic impacts and siting, disease and parasite transfer, chemical inputs, labor and community impacts. An extensive set of requirements intends to address the negative impacts by focusing on smolt and grow-out stages of production (ASC 2012).
- GLOBALG.A.P Aquaculture Module sets criteria to address key issues in food safety, worker occupational health and safety, animal welfare, and environmental and ecological care (GLOBALG.A.P. 2013).
- BAP Standards for Salmon Farms address key issues within environmental and social responsibility, animal welfare, food safety and traceability. Expressed as in environmental responsible use of land, nutrients and other resources for aquaculture production, to be good neighbors within local communities and to cooperate with rightful users of land and water to minimize conflicts, and to meet necessary food safety requirements (BAP 2011a).

Summarized, though GLOBALG.A.P and FDK is not salmon specific, the standards cover key issues present in salmon aquaculture. *Table 3* describes the main issues and impacts undertaken by FDK and the aquaculture standards with key references discussing the topics.

Table 3: Short description of selected issues related to salmon aquaculture

Issues	Activity / Life Cycle Stage	Possible impacts	References
Feed	Forage fish fisheries Crop production for feed	1. Overfishing of forage fish for fish meal and fish oil 2. Impacts originating from crop production (vegetable crops, wheat) to feed	1. (Pelletier et al. 2009), (Deutsch et al. 2007) 2. (Pelletier & Tyedmers 2007)
Effluents	Grow out phase	1. Nutrient leakage 2. Pesticide and disinfectant leakage 3. Antibiotic leakage	1. (Boyd 2003) 2. (Burridge et al. 2010) 3. (Burridge et al. 2010), (Cole et al. 2009)
Invasive species	Larvae production and grow out phase	1. Escapes of non-native species	1. (Skilbrei et al. 2014), (Skaala et al. 2013a)
Diseases	Hatchery and grow out phase	1. Spread of diseases and parasites to wild populations	1. (Johansen et al. 2011)
Habitat alteration	Conversion of coastal zones	1. Biodiversity loss/change	1. (Diana 2009), (Skaala et al. 2013b)
Social acceptability	Stakeholder conflict	1. Conflicts among local resource users	1. (Tiller et al. 2012), (Chu et al. 2010)
Animal Welfare	Husbandry	1. Infliction on physiological, health, and behavioral status	1. (Olesen et al. 2011)

2.6 Theory of Standard Application

Applying process and product standards can offer a set of powerful business and marketing tools for organizations of all sizes, to fine-tune performance and risk management, increase productivity and innovative efficiency as well pushing towards sustainability. Companies can with ease demonstrate the quality of a product to customers, allow faster uptake of innovative solutions and enhance the economic value of research and innovation projects. De Vries (2003) described standards as solutions that rise from repeatedly and continuously use in a certain period of time and in substantial numbers, to finally advance this purpose. They are narrative methods to sort and organize the world and our reality towards it, supplemented by Busch (2011) which explains it accordingly: *"Standards are about the ways in which we order ourselves, other people, things, processes, numbers, and even language itself"* (Busch 2011: 3). Standards have numerous forms and cover everything from technical to environmental matters. Their usages accumulate extensive portions of value, and both the private and public sector investment billions into standard creation, resulting in unique standards counting hundreds of thousands.

2.6.1 Definition of Standards

The International Standardization Organization (ISO) has the most recognized definition of a standard, and in which the thesis adheres to, describing it as:

> *"A document established by consensus and approved by a recognized body that provides for common and repeated use, rules, guidelines, or characteristics for activities or their results, aimed at the achievements of the optimum degree of order in a given context" (ISO/IEC Guide 2, 2004: definition 3.2).*

The ISO definition is based upon a 'building block' system – three separated but independent and interlinked 'pillars' of knowledge which supposedly essential for participation in international trading (ISO 2008). The broad definition opens up for actors to develop their own standards after their own rationale, based upon the fundaments of the ISO standard. Notable examples are the Technical Barriers to Trade (TBT) agreement made by the World Trade Organization (WTO). Other existing definitions, as the one from EU Commissions practical guide to Standard and Standardization, can be closely interlinked the ISO definition:

> *"Formal standards are standards that are approved or adopted by one of the National, Regional or international standards bodies, whilst informal standards are published by other Standards Development Organizations (SDOs). Private standards are developed for internal use by companies" (European Commission 2013b: 1.5).*

The ISO definition can include everything from company specific codes of conduct and sector specific standards and labels, to generic international standards that apply to product specifications, safety concerns and issues of process organization covering social, environmental and ethical concerns (Nadvi 2008).

2.6.2 Product and Process Standards

Standards and the certification schemes developed to assess conformity can regulate either the process through which a product is produced or the product itself (Corsin et al. 2007). Process certification influence the quality of the product, but process certification does not provide any guarantee about the quality of the product. Nadvi and Wältring (2004) have epistemological elaboration of the name i, and assume only two categories: product or process standards. Management systems standards, meta-standards and additional sub-categories such as rules,

codes of conduct, guidelines and labels will for simplification fall within these respective classifications.

Product Standards

Product standards, sometimes referred to as technological standards, include specific designs, technical characteristics and attributes to a given product. It is mostly concerned with product service, and fitness for purpose. Product standards include sector specific technical standards and product safety standards. Such standards are of critical importance, especially as they maintain well-functioning global production networks and structure and functions of globally dispersed supply chains (Nadvi 2008). These standards functions as a key component for technical innovation in product design as they are driven by self interest in enhancing and capturing value, as well based on rivalry between competing firms in struggle for market control (Coe & Hess 2007).

Process Standards

As systems and organization has become more complex, it has become important to move outside the boundaries of technical standards towards standards contributing *"bridge the gap between people and things"* (Busch 2011: 36). Process standards refers to conditions whereby products and services are produced, packaged or refined, and combined with a standard for system management supporting the given organization and business to manage their operations in term of issues relating to environmental, quality assurance, social and labour. At the same time process standards have, as observed within aquaculture, evolved into distinctive policy routines acquiring separate challenges, standard setting systems and monitoring (Nadvi 2008). Process standards main function is to form the frameworks in which the requirements for product and process standards shall adhere. To ensure the desired process reach compliance with a particular set of conditions necessary for a given product to receive credit for quality or characteristic. A process standard aim is to optimize relevant processes along the production line, whereby *Figure 1* illustrate a typical production line within aquaculture.

2.6.3 Public and Private Standard Developers

Standard setting have different motives depending on which networks it relies on, as indicated in *Table 3*. Involved actors are nonetheless representing two distinctive processes identified by the European Commission (2013b) as: (1) the formal, a processes operating through national representation; (2) the informal which is represented by individual organization. To simplify,

the article will merge formal aspects into the category of 'public' and informal into 'private', becoming the only two sections of focus. Most standards are characterizes by its encapsulation petitioned by the actors in focus, either from the public or private sphere. As indicated in *Table 4*, public standards compared to private are distinctive in use of terminology.

Table 4: Private and public standards difference in terminology

Private		Public	
C =	Code	**CS** =	Certification Scheme
CS =	Certification Scheme	**D** =	Directive
G =	Guideline	**G** =	Guideline
L =	Label	**L/A** =	Legislative / Act
S =	Standard (S)	**R (S)** =	Regulation
		S =	Standard (S)

Public standards

Public standards shape after standardization requests to elaborate solutions for compliance with a legal provision. In this setting, it is normal to adopt existing standards in support for current policies and legislations, and ideally most stakeholders and interested parties are to be involved in the process. Such a request provides guidelines that requested standards must respect to meet the essential requirements or other provisions of relevant legislations. If a company wishes to harmonize with public standards the relevant services or processes must comply with relevant legislation (European European Commission 2013a). The use of standards is voluntary and the means to achieve it are various. Compared with private, most public standards are associated with legislations or injunctions.

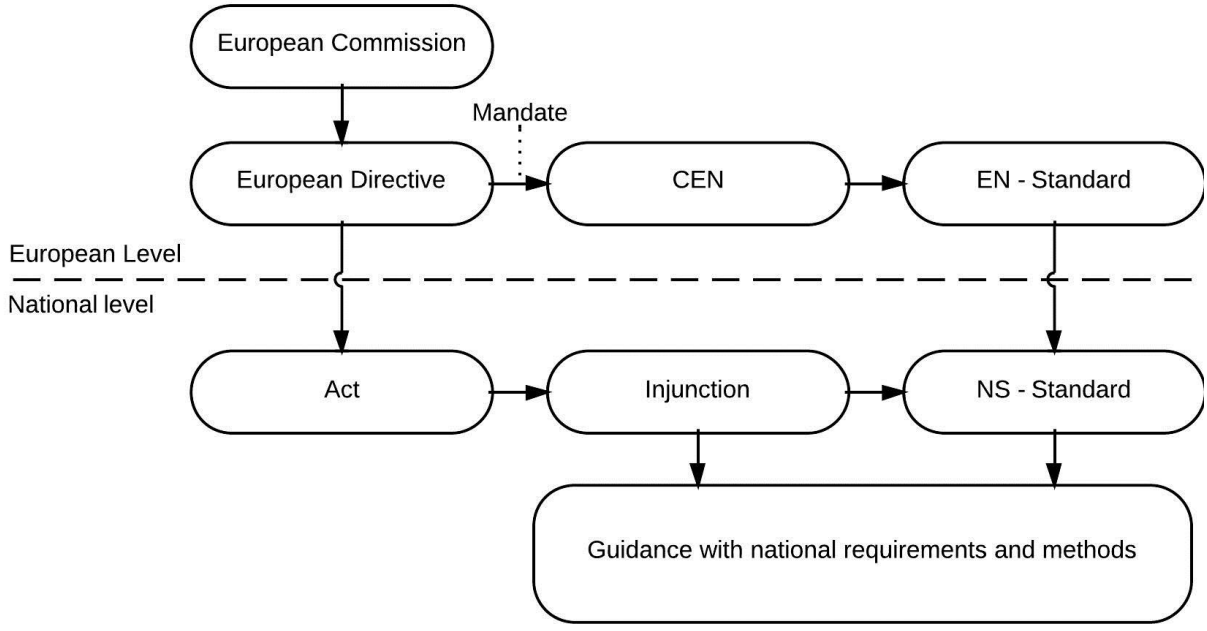


Figure 3: Relationship public demand - public standard development (SINTEF 2009)

Private Standards

When a standard is developed for internal use by private entities such as companies, NGO's or multi-stakeholder coalitions, it is considered to be a private standard (European European Commission 2013b; International Trade Center 2012). These standards and related certifications has become a significant feature in many fields and markets, especially aquaculture, a trend explained by the increased demand and pressure for companies to differentiate themselves and their products within markets affected by globalizing competition (Coe & Hess 2007). Another main reason is the widely spread perception that public standards or regulatory frameworks fails to achieve given outcomes in process related issues such as sustainability, responsible fisheries management, food safety assurances, and traceability to differentiate or even enhance certain products or operators in the market. The creation of private standards is therefore for instance linked to private firms' corporate social responsibility (CSR) strategies rather than existing legislations, but not totally as a certain degree of compliance is necessary to protecting corporate reputations from negative publicity driven by civil society (Washington & Ababouch 2011). Private standards serve multiple purposes wherein adherence to certification schemes to verify compliance with government-mandated requirements for firms to introduce – HACCP as an example, is quite common. Labels also constitute a key aspect because it can ensure requirement fulfillment and company identification.

2.7 Benefits of Using Standard in the Industry

Businesses can utilize standards to cohere multiple elements, to assure quality, conformity of a process or production method. Furthermore, to prove such adherence to a label can be attached to the product and directly illustrate the information of the standard. This can be a beneficial element in customers buying decisions. In case of aquaculture, strong standards can prove a major competitive advantage. Expressed by the European Commission, which allegedly offer good quality products that respect strict environmental sustainability, animal health and consumer protection standards can "constitute a major competitive advantage for EU aquaculture" (European Commission 2013b: 2).Committing to standards, such as the ASC may also have a pre-competitive advantage when several companies aim to be fully certified by 2020. The ultimate goal is then to make the industry more sustainable.

2.7.1 Managing Complexity with Standards

One of the main assets with successful standardization is to create order in a given context. A standard may bolster stabilization and closure to definitions and boundaries, and enforce order

into a system context. It is about defining complexity and come up with a solution on how to manage it (Hanseth et al. 2006). Here complexity refers to most elements from human and nonhuman, to technological and no technological. According to Cilliers (1998) complexity operate in a system which therein consists of a certain number interacting elements in both linear and dynamic fashion. These factors create recurrent patterns and loops that include both positive and negative feedback, making it difficult to define the borders between a given system and others. Standard may clarify this aspect, as well responding beneficially to information given locally. A corresponding definition is made by Law and Mol (2002) that describe complexity as things that relate but don't add up, events that do not occur within the process of linear time and phenomena's that share a space but cannot be mapped in terms of a single set of three-dimensional coordinates.

As these vast definitions indicate, even grasping the aspects of complexity is challenging. To efficiently govern the unfolding dynamics, the independent actors aligning with different but traverse actor networks, standards have been applied to create order in more complex cases where order and universality cannot be achieved with classic approached (Hanseth et al. 2006). Another relation between standards and complexity is that the latter leads to reflexiveness (i.e., the combination of self-reinforcing and self-destructive) processes. Due to this, the process of bringing order to one factor may harvest disorder to another. Standard can support a higher degree of interconnectivity and provisional practices forming a better ontological arrangement (Law & Mol 2002). However, a problem with standardization is that changes may come gradually, and in a modern world with fast-paced technological innovation and development, this aspect could instead accumulate undesired consequences in term of further embroilment. The fate and benefits of standards revolves around different variables and their numbers; types of component, types of links and the speed of change of the system (Schneberger & McLean 2003). Depending on size and care, handling a system like this would need a great amount of attention and involvement. Standards may be of great advantage and may lead to further efficiency, which again could harvest a number of positive outcomes. Alas, it depends on the type of standards and certification scheme and level of involvement.

2.7.2 Globalizing Effects on Trade

Globalization has led to a transformation in the movement of goods, services and ideas across national borders, affected the landscape of trade that have additionally formed the very conception of standards and their appliance. In aquaculture, the shift to standards with

globalizing appeal is according to Nadvi (2008) dependent on two factors: (1) a decline of national actors – national regulatory bodies, monitoring agencies and labour inspectorates; (2) regional and international actors, both public and private, becoming more important in the process of standard formulation and monitoring. The liberalization of trade has also led to policy shift from import substitution to export-led growth strategies, and by larger amount of contact with producers in export activities and global or regional value chains, compliance with standards can determine trade competitiveness (International Trade Center 2012).

Globalization have also highlighted issues that before was absent, such as environmental concern, animal welfare, work ethics and higher quality products. Firms and companies needs to consider these encompassing issues to survive in markets that exposes to the whole world. In addition, transnational companies, private actors and global brands rest upon complex and dispersed value chains. As nations lose their foundations in the aquaculture field, it favors private actors that replace their dependency on legislations with standards 'soft law' nature. Individual companies have started to proliferate and expand on their own codes of conduct and specialized sector specific codes and standards (Nadvi & Waltring 2004). This can have several types of consequences. One, it further confusion for actors trying to navigate among the high quantity of standards, (see *APPENDIX E*). Two, it can lead to increased specialization and competitiveness.

2.7.3 Profit on Product and Process Standards

Both product and process standards can reduce coordination needs and inflict better governance. However, the codification of process standards is less apparent due to their vague function and outcome that may result in some challenges. Desirable result from process standards are, as observed in the field of aquaculture, dependent on the standard itself and the form of compliance it will effectuate. For instance, large retailers such as IKEA only chose certain standards and labels into their supply chain, meaning international drivers often function as the main reason behind the rapid proliferation of standards (Frankic & Hershner 2003). National regulatory bodies can also be a key driver behind the implementation of globalized standards within national borders. Standards that address worldwide-recognized issues, for instance sustainable practices, can for this reason reduce costs in energy use, open up new markets and improve reputation. It can be a good investment as it involves a shift from defensive behaviour towards more active exploration of the opportunities sustainability can present (Kielstra 2008). In today’s market, social and environmental issues are not going away—and

are likely to involve a redefining of relations between business and society. If firms do not get involved in the latter, it will hurt their own finances, as well as the environment and social conditions worldwide.

2.8 Use of Standards in Industries

Use of standards often involves uncertainties and confusion, sometimes even skepticism surrounds the matter. Process standards are typical examples of this, which seldom harvest direct and tangible results. Nonetheless, all standards, from technical to environmental concerned have proven their value. Typical examples of this are increased modulation by technical standards or further compliance with process standards into markets pressured by stronger international demand or public regulations. A wide-ranging global survey conducted by Kielstra (2008) on sustainability and business found that 40 percent of the business leaders participating agreed that additional regulation is necessary for handling social and environmental challenges. About the outcomes, however, a persistent question remains and this is how profitable can standards be? Is it possible measure the benefits? Blind and Jungmittag (2008), shown in *Table 5*, argues that considering the desired characteristic of a standard and comparing degree of impacts against each other can indicate the positive outcomes of a implementation.

Table 5: Types of standards and their impacts on growth (Blind & Jungmittag 2008)

Characteristic	Positive impacts	Negative impacts
Compatibility and interface Standards	Physical networks based on compatibility standards are the basis for most service industries	Restricted diffusion in case of proprietary standards
Minimum quality and safety standards	Foster development of new markets and high quality segments of existing markets, which are decisive sources for growth Safety standards are means to restrict negative externalities damaging health and the environment	Misuse by small groups of suppliers in order to raise rivals' costs and allows them to behave like monopolists Too restrictive quality and safety standards hinder the development of markets
Variety-reducing standards	Foster the exploitation of economies of scale A necessary condition for the development of new technologies and markets in order to reach critical masses attractive for entering companies and customers	Restrict the choices for customers Foster concentration within a market to a smaller number of suppliers misusing their market power on the other hand

According to Garud et al. (2009), a tactic for achieving market dominance has been the controlling prevailing, prominent standards (Garud et al. 2009). The aspiration comes from their characteristic, and as further elaborated in the following sections, their key aspects for attaining progress.

2.8.1 Time- Reduction and Efficiency

One central feature with standards is to improve and optimize the supply chain. Management systems, category rules for carbon footprinting, these acts are time savers. Operating a company, small or large, often include an advanced supply and value chain. Inter firms, business collaboration and moving abroad will increase the level of complexity in communication and transaction, thus making systematization more crucial. Standards help to codify complex forms of information that can reduce transaction costs (Nadvi 2008). In term of time efficiency, a standard could save time by skipping certain steps already determined in the specifications, such as the interface and appliance, and thereby leaping directly into the implementation phase (ibid.). Product standards are typical examples of this, but a higher fixation on processes may also harvest better long-term relationship with suppliers, improved products and better control over volume and price, resulting in a substantial reduction of time.

2.8.2 Qualitative Study on Cost Benefits by Standards Usage

The qualitative contribution standards may have on company operations is often hard to evaluate and measure as research lack quantitative specifics. Nonetheless, research such as the survey done by Kielstra (2008) show that 57 percent of executives stated that they experienced benefits by pursuing sustainable practices. Translated it means that the profit outweighed the costs, even though eight out of ten expected profit changes to be minor. Unfortunately, qualitative information alone is not persuading enough, but clear-cut economic advantages of standards are difficult to assess as they are utilized by different organizations and business environments with diverse methodologies, objectives and the struggle in getting companies to talk (ISO 2013). Those claiming positive results is often high influencing actors utilizing macroeconomic perspective on standards and standardization, drawing the result of standard contribution based on the performance indicators of a country's GDP growth and productivity increase (ISO 2013).

2.8.3 Quantitative Study on Standards Economic Benefits

Main issues stressed by companies considering standard involvement is potential for profit and hardness in displaying direct income, but most standards do not possess such quality short after its implementation. A typical example is environmental standards, wherein the criteria are considered as redundant assets. In order to transmit the value of environmental and social criteria, certain conditions must apply. The ISO Methodology (2013) elaborate on two distinct methods.

Method 1: Return-On-Investment (ROI)

A typical method to assess the value of standards is to consider the matter in term of the ROI formula, as expressed below.

$$ROIpercent = (benefit - cost)/cost$$

If a company wants an accurate product or process standard for a given context, the company needs to implement an existing standard already created, or participate in a development of a new one. Considering the latter, the development process of a standard will need an expert from the given field of focus. The expert needs, except salary, to attend committees, conferences and other meetings. This will include costs of travel expenses, phone bills, web service, food et cetera. Time is relevant here, as most cases of developing a standard may take several months. Developed or bought by a company, the implementation process of the standard will suffice another post of expenditure. Implementation could need system restructuring, training of employees, acquisition of computers, software systems *et cetera*.

Actors need to address the following questions for beneficial standard investment: (1) what the employees and experts involved with the standards could have worked on instead; (2) how a company measure factors such as customer satisfaction, competitive edge, market leadership, value of mergers, reputation, service to industry, local community and numerous of other stakeholders. A clear definition along with a thorough business code of conduct will determine the benefit of standard; (3) the potential of the standard to decrease the time-to-market ratio of production and efficiency; (4) if the standard can meet future demands and requirements from customers and governmental institutions.

Method 2: Value Chain Approach

Another method is to consider the value chain approach and conduct a quantitative measurement on economic benefits of standards. A value chain consists of sequences of activities that generate a certain output, a product or a service. The output of the work passes through all the activities of the chain in a given order adding value at each stage.

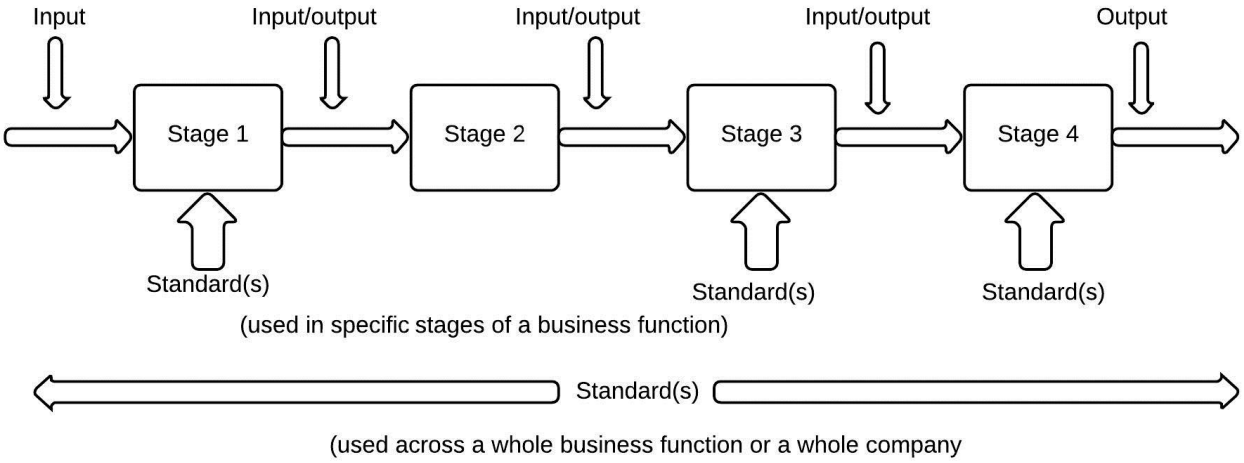


Figure 4: A simple value chain with standard implementation (ISO 2013)

The core questions addressed by the ISO Methodology are what the quantitative contribution of standards to the creation of value by an organization, how can companies maximize the value contributed by standards and to which areas of a company operation could additionally benefit from the use of standards (ISO 2013). Then the identification all operational indicators and principles to enable calculation, that is by finding all relevant inputs to the value chain along with a system assessment (see *Table 6*).

Table 6: Assessment of an organization

1	2	3	4
Understand the value chain	Identify the impact of standards	Determine the value drivers and key operational indicators	Measure the impacts of standards
Clarify industry boundaries Analyze the company value chain Identify the most relevant business functions	Identify impacts deriving from standards for the main business functions and the activities associated with these functions Select relevant indicators to identify major impacts of standards	Identify value drivers to focus the assessment on the most relevant standards impacts Derive for each value driver metrics (key performance indicators, KPIs) that can be translated in cost or revenue terms	Quantify the most relevant standards impacts Calculate EBIT impact for each standard impact Consolidate the results and aggregate impacts on the company level

When all relevant inventory is identified ISO Methodology argues between the following approaches to measuring standard impact (2013): (1) before-after comparison; (2) comparing concurrent conditions–projects; (3) what-if comparison. All methods would indeed generate relevant insight and information to most businesses, but the problem is not the assessment itself, it is the process of collecting data. Case studies on the matter cannot embrace all aspects, and maybe be time-consuming.

2.9 Certification Schemes and Standards within Aquaculture

Certification is applied to assess conformity to specific requirements for a product or process, and the requirements are generally expressed as Standards. Each standard is normally based on a set of statements declaring the desired outcome of the product or process, and these statements, typically expressed as Principles, is the philosophical basis. This study has three standards of focus used by Marine Harvest in salmon aquaculture, namely ASC Salmon Standard, GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standard. These standards constitute the core of its respective certification scheme, created to grasp a wide range of issues relevant in the industry.

2.9.1 Type of Schemes

As modern aquaculture experience tremendous growth, similar trends have emerged in the development of associated certification schemes. Initiating factors can be globalization that emancipate multinational companies from inconvenient national regulations (Vandergeest & Unno 2012), rising levels of international trade (O'Brien & Leichenko 2000), or the creation of complex ties between globally dispersed suppliers and global lead firms (Nadvi 2008). Therefore, according to Corsin et al. (2007), when considering certification schemes it is crucial to consider who benefits, avoid misinterpretation and barriers to the effective marketing of the given aquaculture product. A list of schemes considering these aspects is shown in *Table 7*. Key aspects to identify is emphasized or neglected parts, descriptive as in explaining the utilized management system, or if they are business-to-business or business-to-consumer (McLaren 2011).

Table 7: Range of schemes used in the aquaculture industry (Corsin et al. 2007)

Schemes in the Aquaculture Industry	
Schemes promoted by retailers	Retailers, like most traders, use quality standards to purchase the products they trade. Responding to the requirements of consumers and NGOs, a number of retailers have begun developing standards aimed at ensuring that the production of products marketed follows processes aimed at improving the sustainability of production of specific products. In order to reduce the cost of auditing and certification, and therefore the overall cost of the product so as to ensure continued competitiveness throughout the production chain, in some cases groups of retailers have joined forces and developed standards applicable to all the retailers joining the scheme.
Schemes promoted by the aquaculture industry	The aquaculture industry has an interest in promoting aquaculture products in general; better performing practices can serve as a good example for the industry. It is the more organized groups of producers who can agree on and establish industry-led certification schemes.
Schemes promoted by governments	Governments in exporting countries in particular have a clear interest in promoting a sustainable aquaculture industry and in promoting it among buyers in both their national markets and other countries. Often the requirements in importing countries are different from the exporting countries' regulations and therefore it is necessary to have certification schemes for export products.
Schemes promoted by NGOs	Non-governmental organizations (NGOs) often promote and active participate in the development of private standards and related certification schemes, specifically for farmed fish and seafood. Formed on the interests of conservation, environment, social responsibility, fair-trade *et cetera*, to improve and create a sustainable alternative to wild captured fish and to reduce key impact categories. NGO-established schemes often considered as the 'real' third party schemes, though depending on scheme structure, but do have less conflict of interest. Most work to improve management practices concerned salmon and shrimp due to their high commodity value and importance as the most traded fish and seafood products (Washington & Ababouch 2011).
Organic schemes	Many of the voluntary certification issues originate from the organic movement. In some countries, consumers still think about organic certification when they hear talk about certification. The International Federation of Organic Agriculture Movements (IFOAM), established in 1972, is a global grassroots umbrella organization and has 750 member organizations. • Government-promoted organic programs • European Union • United States of America
Fair-trade schemes	The fair-trade movement started in the second half of the twentieth century to promote fairer trade by providing producers with fair prices for their products especially in developed countries. The fair-trade movement became very popular with the introduction of fair-trade labeled products. Currently there are no fair-trade schemes for aquaculture products but there are fair-trade elements in some schemes.
Animal welfare and 'free-range' schemes	Especially in the salmon industry, there has been a focus on animal welfare. However, there has been some effort to establish animal welfare schemes for shrimp production as well. Most of these products are only available in European supermarkets.

2.9.2 Codes of Conduct and Good Aquaculture Practices

An aquaculture standard consist of principles whereby each can include a set of criteria meant to provide guidance for addressing relevant issues. Furthermore, the principles derive from Codes of Conducts (CoC) that cover the issues generally for the whole sector, and Codes of Practice relevant for goods and services (Corsin et al. 2007). The development of sustainable aquaculture standards can for instance emerge by defining conditional framework based on practices and procedures for environmental and socially responsible aquaculture operations being CoC. They are seen as a proxy for standard development, and often called guidance tools among producers or industry associations within countries lacking regulations or the ability to monitor and enforce environmental and social standards (World Wildlife Fund (WWF) Switzerland and Norway 2007). Generally, CoCs and CoPs are voluntary and followed by many individual operators, thus not implemented or subject to independent third-party verification and enforcement procedures. However, producers seeking product certification or enabling certain market participation may need to follow when they serve as the basis for the development of specific certification programs.

2.9.3 Issue Categories of Aquaculture Standards

FAO (2011) have identified five categories that aquaculture standards typically fall into: (1) Food Safety; (2) Food Quality; (3) Environment; (4) Social Responsibility; (5) Animal Welfare. Among the categories, Environment, Animal Welfare, and Social Responsibility often describes to Sustainable standards. On the other hand is standards concerned with safety and quality of the product. These types of standards if further discussed in the following subchapters.

Environmental

Ecolabels are market-developed tools developed to inform customers about sustainable usage of natural resources, thus a product ‘seal’ to prove and ensure less environmental impacts than other products. It is typically formed as a tag or label, dispensing information of the environmentally approach in previous supply chain stages or management procedures. This means a focus and link on where the fish and seafood are farmed and harvested rather than the aspects of the product itself (Washington & Ababouch 2011). To attain most ecolabels, it needs to be a certification process based on environmental or under the banner of sustainable standards. These standards vary in depth and covering aspects, measured for compliance and at last certification. Once attachment to an ecolabel, it can provide conformance to the customer.

This facet makes it also fruitful for relating organizations or companies to promote the label despite not being self-produced, but as it can promote the sufficient recognition and demand for green practice, and choosing environmentally friendly products. A relevant example of this is the ASC Salmon Standard.

Animal Health and Welfare

According to Olesen et al. (2011), welfare of animals refer to the mental/emotional and physical health of the individual animal or the animal's condition while coping with the surrounding environment. This includes behaviour, physiological and immunological factors as well health in how it can resist negative environmental influences. In general, the animal's 'well-being', not just absence of suffering or disease. As the article further discuss, the same sentiment should apply to fish, allowing them to have relatively natural lives.

The public concern for fish welfare has grown, with a notable verdict in salmon aquaculture leading producers to carefully select fish that may attain favorable disease resisting traits (Grimsrud et al. 2013). Such selections often derive from economic driven agendas. The domestication process of Atlantic salmon have led to an adaption for growth performance, in which calm and less aggressive and presumably less stressed animals were selected due to their sufficient feed intake and faster growth (Olesen et al. 2011). Non-economic aspects also linger within aquaculture deterioration traits may be in conflict with animal welfare goals and not be socially acceptable despite being profitable for the individual farmer. As illustrated in the paper of (Olesen et al. 2010), the Willingness To Pay (WTP) by consumers among fish products marketed and labelled in having good fish welfare practices is extant. Similar finding by Grimsrud et al. (2013) correlates, that Norwegian households WTP for farmed salmon with vigorous breeding traits is desirable.

Social Responsibility

In 2009, the Norwegian ministry of foreign affairs developed a whitepaper on social responsibility, defining it as *"the responsibility of companies towards people, society and the environment that are affected by their activities"* (UD 2009: 7). According to ISO (2010) and UD (2009), social responsibility extends beyond the obligations to comply with national legislation, especially when legislation is not properly enforced by local authorities. When a company fails to meet compliance with its own standards on social responsibility, it is common to consider it a deficiency from the business objectives or consumer expectations, from

investors or the local community. In the aquaculture industry, globalization has pressured business to evaluate their practices for tolerance of mistakes, and differ the mistakes less accepted from others, therefore making social responsibility an important part for success, that is among many factors reflected through their CSR strategies (Washington & Ababouch 2011).

Food Safety and Quality Standards

Numerous certification and labelling programs for aquaculture products mainly encompass food quality criteria, ensuring a guarantee that products fulfil stringent quality standards. According to Standard Norway (2007), quality is the capability to satisfy requirements by customer demand. A quality product shall meet specified requirements to meet the needs and expectations from the customer. Implementing quality elements in production and manufacturing shall correct mistakes before it becomes a product. It should make certain that actions and precautions such as inspection, review, monitoring, routine control, standard implementations are present. These quality-oriented certification programs address product food safety, hygiene measures, freshness, color, size, texture, taste and other qualitative traits, but typically not environmental or social criteria for the aquaculture production process.

The world food market, mainly in industrialized countries, experience customer pressure and demand for good practice with no exception for aquaculture industry, making fish farmers turn to compliance with food safety and quality standards (Washington & Ababouch 2011). For large companies and retailers, such standards can increase their bargaining power above competing firms in the supply chain, requiring suppliers to be rightfully certified (Corsin et al. 2007).

One notable example of schemes embracing safety and quality standards are those concerned with organic issues. Organic aquaculture certification programs, leading to consumer labels directly identifying the finished product at the point of sale, is developed by several private, governmental organic standardization bodies, and farming organization across the globe, and is widely based on principles apprehended from organic agriculture. In contrast to conventional certification programs providing a broad basis for the implementation of sound practices, organic has more of a niche production model (World Wildlife Fund (WWF) Switzerland and Norway 2007). This is mainly due to consumer demand in combination with awareness of health, social equality, and the obvious connection between environmental problems and industrial production, resulting in an increased specialization.

3 METHODOLOGICAL FRAMEWORK

To assess the challenges and potential of the ASC Salmon Standard, it is necessary to conduct a thorough research on the basics and status of aquaculture standards, and elaborate the value creation they have on the aquaculture industry at large. A thematic literature review with an interdisciplinary approach covers this part. Next step is to analyze the aquaculture standards of focus through a comparative design. This part uses the approaches of comparative study on control points, by using external indicators, a GAP analysis and through a qualitative assessment. Last part of the methodological framework chapter ends with discussing reliability and validity of the study and to which degree it is repeatable and trustworthy. Personal knowledge, contacts and a thorough internet search forms the basis of all examinations and analysis of standards.

3.1 Literature Review

According to Bryman (2012), literature review is by conducting a critical examination of research relevant to the given phenomena of interest or theoretical ideas. A thorough literature review will set up the theoretical foundation for the quantitative and qualitative analysis. The research developed a thematic framework to provide structure for the collection of replicable, scientific and transparent information both published and unpublished. This consisted of the following:

1. Position and value of aquaculture food production, in that salmon aquaculture.
2. Definition of standards and important distinctions, how it is used and benefits it hold.
3. Certification schemes and standard orientations existing and utilized within the aquaculture industry.

Extensive desk-based research forms the basis of the literature review, and aim to reside on comprehensive and comparable aspects. Principal sources found outside scientific search engines were through the contact person in Marine Harvest - the case company - and student groups working on project papers closely related to the topic. Data from previous work by the author from the position as student assistant and project assignment is used to strengthen the theoretical framework, such as the fragmented overview of standards relevant for salmon aquaculture in *APPENDIX E*. The literature search used the following databases: ScienceDirect, JSTOR and Google Scholar. Notable search words used and matched together: aquaculture, salmon (farmed salmon, Atlantic salmon and *Salmo Salar*), standard (product, process, private

and public standard), certification scheme (environmental, sustainable, animal health and welfare and social responsibility).

3.2 Quantitative Analysis

The research utilize a comparative design – studying contrasting cases using identical methods - to recreate knowledge from existing information (Bryman 2012). Furthermore, it perform a quantitative analysis based on numerical values used to enable benchmarking, which is according to Andersen and Pettersen (1996) all about predefined positions which is used as a reference point for taking measures against. A benchmark looks at how something performs a certain process and learn from those that have achieved higher performance. The utilized type of benchmark is strategic that is compared against generic processes. Generic benchmarking is about transferring knowledge of one industry to another, to identify new technologies or practices that will lead to breakthrough in performance outcome. Therefore, the following research consists of a comparative analysis by setting corresponding elements from the aquaculture standards upon each other to achieve desired results.

Control Points

First benchmark assumes defined indicators deriving from criteria and indicators as control points, each aligned to the respective categories assembled in *Table 14*. The control points compiles into three separate entities representing the given aquaculture standard, as illustrated in *Figure 5*. Time constraint have led the analysis to only focus on one standard from each certification scheme, thereby not considering all mandatory components necessary to attain full compliance

External Indicators

Second benchmark analyses if each aquaculture standard of focus addresses an external set of indicators based on central issues within the aquaculture industry. These indicators, developed by WWF Switzerland and Norway define a numerical rating and matching system. The outcome of the standard analysis will show how well a standard performs and measures up to the benchmark defined – delivering an indicator for the matching level of a standard with the defined benchmark criteria.

The score reflects the matching level of a standards-specific criteria against the external set of benchmark criteria, and the score system range within four levels along a numerical scale from

0 – 3. For each single criterion, the maximum score is 3 (see *Table 8*). Total of all scores results in Total Maximum Score for each category and sub-category within the benchmarking criteria, referred to as Relative Score (RS). Indicators of no relevance subtracts from the overall score, referred to as Non-Applicable Criteria and Applicable Score (AS). The level of the total maximum score of each category and sub-category is no indicator for the overall importance of the referring category or sub-category.

Table 8: Matching and score levels in benchmark

Matching Level	Definitions	Score
Full	Standard fully covers the defined criterion. The criteria in full compliance with the defined benchmark by the standard's regulatory framework.	3
Medium	Standard does meet the defined criterion, but has some shortfalls. The criterion still sufficiently addressed by the standard's regulatory framework.	2
Low	Standard only meets the defined criterion and has serious shortfalls / lacks essential regulation. The criteria insufficiently addressed by the standard's regulatory framework.	1
None	Standard does not meet the defined criterion. The criterion is not subject to the standard's regulatory framework	0

GAP Analysis

A GAP analysis is about identifying 'gaps', a rather simple yet possible complex tool depending on the data to be amassed. Explained in a formula (MBASkool 2008):

$$GAP = Current\ Performance - Desired\ Performance$$

GAP analysis is a tool used various ways as exemplified through QFINANCE's (2010) definition of using GAP analysis in finance *"a method of improving a company's financial performance by analyzing the reasons for the gap between current results and long-term objectives"*. However, by comparing the aquaculture standards this study is less directly associated with the companies itself, but rather about the strategic choices in how they steer efforts and resources. Therefore, the applied analysis is Strategic GAP that *"helps identify performance gap with respect to the strategy the company follows to achieve its goals, whether the performance is aligned with the mission and vision of the company. This leads to resource optimization through the sages of determination, writing and application"* (MBASkool 2008), and in formula:

$$Strategic\ GAP = what\ the\ firm\ is\ doing - what\ the\ firm\ must\ do$$

The intention by utilizing GAP analysis is to illustrate performance based on ASC Salmon Standards control points according to the overarching focus of environmental and social aspects within salmon aquaculture. The ASC Salmon Standard is allegedly a strong candidate to address such topics, and for identifying 'gaps' it is used as a fundament whereby GLOBALG.A.P and BAP are compared upon.

The analysis only consider the principles from 1 to 7, excluding section 8 concerning smolt. This is because GLOBALG.A.P and BAP lack at this current moment sufficient coverage explicitly addressing it, and would affect how the results later are presented. Numerical scale used in the GAP analysis consist of the following values:

0.0	No counterpart
0.5	Barely, but still associated to ASC indicator
1.0	Partly relevant to ASC indicator
1.5	Same as the ASC indicator
2.0	Relevant to ASC indicator, but more specified

3.3 Qualitative Assessment

An efficient depiction of the aquaculture standards utilized by Marine Harvest is to perform a qualitative assessment. This approach can uncover subtleties behind numbers through gathering information yielding results not easily measured or translated into numbers, but still can create a point of reference for further benchmarking. The assessment describe the standards based on a set of descriptors reflecting the aquaculture industry at large. A descriptor is entities in form of a word or characteristic feature to describe or identify items such as a subject or document (Marriam-Webster 1999). Methodology and descriptors was adapted from FAO initiated quantitative assessment of standards and certification schemes applied in aquaculture conducted by Corsin et al. (2007). The descriptors builds on a framework including issues highlighted among several scientific papers, most which is still relevant in today's aquaculture industry. However, while Corsin et al. also focused on certification schemes, the analysis only use the separate standards ASC Salmon Standard, GLOBALG.A.P Aquaculture Module and BAP standard for Farmed Salmon. The indicators, developed in 2007, they have undergone a complete reevaluation against the descriptors to grasp changes and updates made and added into contemporary versions. Additional subchapters conduct a document analysis of Marine Harvest's annual report of 2013 to explore their efforts to become a sustainable company, and

last a thorough analysis of audits reports from current ASC certified farms and their non-conformities.

3.4 Case Study

A great amount of research is based on the decision from Marine Harvest to implement the standards of GLOBALG.A.P, BAP and not least ASC, thus anchoring the thesis to the company. Schramm define a case study as the following *"The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or a set of decisions: why they were taken, how they were implemented, and with what results" (Schramm in Yin 2009: 16).* Manifestation to which level the research apply Marine Harvest as a case company is:

- Collaboration through direct communication and document inputs from contact person in Marine Harvest.
- Qualitative and quantitative assessment of main aquaculture standards focused on topics concerned sustainability implemented and used in production facilities of Marine Harvest around the globe.

Relevant research questions guiding the case study is *how* and *why*, added to contemporary events in committing to the ASC certification program. A case study has a distinctive place within evaluation research, which the thesis abide to by using comparative and theoretical based analysis. How can the ASC Salmon Standard bring change and benefits to Marine Harvest? A question examined through extensive literature review and semi-quantitative results. Why did Marine Harvest implement the standard? Such questions, though not directly addressed as such, will constitute the holistically case study, and will continually analyze and discuss in light of Marine Harvest.

3.5 Reliability and Validity

Both the qualitative and quantitative methods used to benchmark three aquaculture process standards utilized by Marine Harvest was based on an interdisciplinary approach. This included a careful integrating of a diverse field of data, methodology and knowledge. Concerning this, a word of caution needs to be called for, as most scientific studies shall add value to society by providing reliable and valid research. Reliable results means repeatable. Validity concerns the integrity of the conclusions. The content shall reflect the intended purpose. Validity presumes reliability, and it content is not reliable it cannot be valid (Bryman 2012). This is essential

elements for establishing a rigid framework for research, and shall be considered when conducting the analysis.

4 DATA

The analysis use three central standards used within salmon aquaculture, namely ASC Salmon Standard, GLOBALG.A.P Aquaculture Module and BAP Salmon Standard. Following subchapters include a description of each standard and a concentrated overview of principles, criteria and indicators they contain, given in *Table 10*, *Table 11* and *Table 12*. The private aquaculture standards, shown in *Table 13* is structured after the categorization used by the ASC standard). *Table 9* mentions general key aspects held by each standard.

Table 9: General information of the aquaculture standards

General Information	ASC	GLOBALG.A.P.	BAP
Stages covered	Smolt, grow-out stage; feed; (Chain of Custody certification)	Broodstock, seedlings and feed suppliers to farming, harvesting and processing	Hatchery, grow-out stage, harvest, transport, slaughter, and processing (separate Feed mill BAP certification).
Scope	Salmon specific: Environment and social responsibility	General aquaculture: Food safety, worker occupational health and safety, animal welfare, environmental and ecological care	Salmon specific: Environment, animal health and welfare, and food safety, social/labour
Commerce Transaction	B2C	B2B	B2C
Label	Yes	No	Yes
Applicable	Farm-level	Farm-level	Farm-level
Launched	April 2013	February 2012	June 2011

4.1 The ASC Salmon Standard (ASC)

The development of the ASC Salmon Standard began in 2004 through the WWF initiated Salmon Aquaculture Dialogue. Original standard version developed, approved and launched in June 2012 by the 'round tables' steering committee, and handed to the Aquaculture Stewardship Council along with Audit Manual and auditors trained to assess farms against the standard (ASC 2012).

The ASC Salmon Standard is a package believed to include requirements representing important steps in defining environmentally and socially responsible production of aquaculture salmon, and to manage key negative impacts while being economically viable and contain the achievable potential for the industry to optimizing the overall performance. ASC believe in the potential of change as it entails continuous improvement by utilizing collected data of best available scientific knowledge, management practices and technologies.

The principles - with corresponding criteria, indicators and requirements – will need 100 percent fulfillment. However, the requirements demand improvements for higher level of transparency around farm-level data and monitoring of a number of key indicators. Key potential negative impacts identified by the ASC Salmon Standard is: feed, escapes, nutrient loading and carrying capacity, benthic impacts and siting, disease and parasite transfer, chemical inputs and social impacts (i.e., labor and community impacts). The focus of the Standard is on production and the immediate inputs to production.

Table 10: Overview of ASC Salmon Standard

ASC Salmon Standard		
Principle	**Criteria**	**Indicators**
Principle 1: Comply with all applicable national laws and local regulations	1	4
Principle 2: Conserve natural habitat, local biodiversity and ecosystem function	5	19
Principle 3: Protect the health and genetic integrity of wild populations	4	15
Principle 4: Use resources in an environmentally efficient and responsible manner	7	20
Principle 5: Manage disease and parasites in an environmentally responsible manner	4	24
Principle 6: Develop and operate farms in a socially responsible manner	12	27
Principle 7: Be a good neighbor and conscientious citizen	3	8
Section 8: Standards for suppliers of smolt	9	35
SUM	**45**	**152**

4.2 GLOBALG.A.P. Aquaculture Module (GAP)

In 1997, the Euro-Retailer Produce Working Group (EUREP), a private sector body driven by a group of British and European retailers, developed EurepGAP, a standard for good agricultural practices. Eurep was in late 2004 the first to develop an Integrated Aquaculture Assurance Standard in addition to code of practice and specific criteria for salmonids, tropical shrimp, pangasius and tilapia. In late 2007, it changed to GLOBALG.A.P, in text referred to as GLOBALG.A.P, to have a more international appeal, hosted and owned by FoodPLUS GmbH; a non-profit industry owned and governed organization. The Integrated Farm Assurance Standard includes an overall base of requirements for all farms and a specific rubric of standards for crops, livestock and aquaculture (Washington & Ababouch 2011).

The Integrated Aquaculture Assurance Standard establishes the GLOBALG.A.P Integrated Farm Assurance Standard (for agriculture) and has the modular composition, which enables farmers to combine multiple products into one single audit. The aim is to ensure integrity, transparency and harmonization of global aquaculture standards. The standard includes issues such as worker health, safety and welfare, environmental and animal welfare. The standard is

quite popular in developing countries due to allowing certifications at the cooperative level rather than separate certifications for each operator.

The GLOBALG.A.P standard has equal partnership of producers and retailers, provides standards and framework for the independent, recognized third party certification of farm production processes based on EN45011 or ISO/IEC Guide 65. Feed operators and farms certify must reach a certain level of compliance relying on three different levels of compliance: Major Must, Minor Must and Recommended. A 100 percent compliance with Major Musts is necessary for certification and 95 percent of the Minor Musts. Approved Certification Bodies must audit all control points.

The GLOBALG.A.P Aquaculture Module, later used in the analysis in subchapter *5.2*, grasp a wide range of issues: treatment of salmons shall avoid pain, stress, injury, and disease, and drugs only used in accordance with applicable regulations. Water contamination must be prevented, it require food quality manual and written hygiene plan, effective waste management, location of facilities to ensure safe production of food, feed quality, and contamination controls. Hygiene standards based on Hazard Analysis and Critical Control Points (HACCP). It require identification and monitoring of potential environmental impacts, but it does not mention requirement for mitigation of impacts. The standard require an action plan to prevent contamination and salinization of water, it restricts wild seeds. Requirements to minimize escapees and an implementation of an Environmental Impact Assessment (EIA). Worker health and safety is also addressed by prohibiting forced labor, allowing freedom to associate and that wages must meet legal or industry minimum (Parkes et al. 2010).

Table 11: Overview of GLOBALG.A.P. Aquaculture Module

GLOBALG.A.P. Aquaculture Module		
Principle	**Criteria**	**Indicators**
AB 1. Site Management	2	6
AB 2. Reproduction	7	22
AB 3. Chemicals	3	13
AB 4. Occupational Health and Safety	2	5
AB 5. Fish Welfare, Management and Husbandry	11	63
AB 6. Harvesting	*2*	*6*
AB 7. Sampling and testing	3	3
AB 8. Feed Management	3	14
AB 9. Pest Control	1	1
AB 10. Environmental and biodiversity Management	4	23
AB 11. Water Usage and Disposal (Cross-reference with the Environmental Management Plan - AB 10.1.5)	2	8

AB 12. Post-Harvest – Mass Balance and Traceability (performed by same legal entity or ownership as the farm)	6	18
AB 13. Post-Harvest – Operators (performed by same legal entity or ownership as the farm)	6	15
AB 14. Social Criteria	1	1
SUM	**53**	**198**

4.3 Best Aquaculture Practice Salmon Standard (BAP)

In 2000, the Global Aquaculture Alliance (GAA) developed The Responsible Aquaculture Program as a voluntary improvement program for guiding the industry towards environmentally and social responsible practices. Based on this, GAA created Best Aquaculture Practices standards (BAP) for certification schemes concerning fish and shellfish species. Being achievable, science-based and continuously improved according to global performance standards for the aquaculture supply chain, they shall assure healthy food production through environmentally and socially responsible means (BAP 2011a).

GAA provide one of the most significant aquaculture schemes in terms of volumes and global coverage. It aligned with the non-governmental body Aquaculture Certification Council (ACC) to develop a certification for aquaculture production processes, and the result was Best Aquaculture Practices (BAPs) Standards applying into certification system that combines site inspections and effluent sampling with sanitary controls and traceability. Certified producers are entitled to use the BAP certification mark, a label attached to products from certified fish farms. Standards cover a range of considerations such as food safety, traceability, animal welfare, community and social welfare, and environmental sustainability. Both farms and processing facilities have certification potential (Washington & Ababouch 2011).

Seafood facilities participating in the BAP certification must apply best management practices in every phase of their operations. GAA promotes environmentally responsible use of land, water, nutrients and other resources for aquaculture production, while assuring culture animals are treated humanely to ultimately meet world food needs (McLaren 2011).

Table 12: Overview of BAP Salmon Standard

BAP Salmon Standard		
Principle	**Criteria**	**Indicators[1]**
BAP 1. Community - Property Rights and Regulatory Compliance	6	
BAP 2. Community - Community Relations	7	
BAP 3. Community - Worker Safety and Employee Relations	26	
BAP 4. Environment - Sediment and Water Quality	8	
BAP 5. Environment - Fishmeal and Fish Oil Conservation	6	
BAP 6. Environment - Control of Escapes	8	
BAP 7. Environment - Predator and Wildlife Interactions	9	
BAP 8. Environment - Storage and Disposal of Farm Supplies	12	
BAP 9. Animal Health and Welfare - Health and Welfare	12	
BAP 10. Animal Health and Welfare - Biosecurity and Disease Management	14	
BAP 11. Food Safety - Control of Potential Food Safety Hazards	8	
Traceability: Record-Keeping Requirement	1	
SUM	**117**	**0**

4.4 Structure of the Standards

The aquaculture standards have unique structures, and to be able to compare them it is necessary to apply certain harmonizing features based on the ASC Salmon standard in *Table 10*.

Table 13: Structure of the ASC standard

Structure	Definition	Non-aquaculture example	Aquaculture example
Impact	The problem we want to minimize	Overweight	Water pollution
Principle	The guiding principle for addressing the impact	Maintain a healthy weight	Conserve and protect water resources
Criteria	The area to focus on to address the impact	Food consumption*	Effluents*
Indicator	What to measure in order to determine the extent of the impact	Calories	Nitrogen concentration in the effluent
Requirement	The number and/or performance level that must be reached to determine if the impact is being minimized	< 10 calories/pound of body weight/day	4 mg/L total nitrogen in effluent

[1] No defined 'indicators' for comparison, and 'criteria' refer to BAP categorized 'standards'

5 ANALYSIS

The analysis will compare indicators and control points drawn from three salmon aquaculture standards used by Marine Harvest, which cover process related performances. The purpose is to elaborate the positioning that ASC Salmon standard strive to attain by illustrating objectives for later evaluation in light of the case company. The intention is not to induce changes in the standards of use, but rather inform about the status they currently withhold in the market.

5.1 Choosing the Aquaculture Standards

All standards of focus have been central in specific Marine Harvest's aquaculture operations, though BAP utilization is mainly obtained amid Marine Harvest's Canadian salmon farms (The Global Aquaculture Alliance 2012). GLOBALG.A.P. is currently the most common standard, and is applied in most farming units. As expressed by ASC's standard director Bas Geerts, many farms, especially in Norway, already uphold a high performance level and rest close to a ASC certification (Undercurrent News 2013). Several actors followed this prospect, among them Marine Harvest that expressed commitment to the ASC Salmon Certification Program in May 2013 (ASC 2013).

5.2 Quantitative Analysis

All standards of focus exist in order to grasp relevant issues common in aquaculture activities and operations, but different set of stakeholders and driving forces have affected the standard development, resulting in distinct compositions and focal points. Following methods use quantitative content analysis to compare ASC Salmon Standard, GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standards. Analysis methods use control points, external indicators and GAP analysis based on ASC standard indicators with the intention to produce semi-quantitative results, and illustrate the ideal applicable context to each standard.

5.2.1 Control Point Analysis

The analysis use defined requirements defined as control points, and compile them into measurable stacks representing each respective standard, as illustrated in *Figure 5*. *Table 15* shows all standards and code of conducts necessary to get full compliance with the given certification scheme, and highlights which standard the analysis has considered. The issues have merged into six categories, giving a clear indication of their focal point.

Table 14: Overview control points within categories addressed by the standards

Issues	ASC	GLOBALG.A.P.	BAP
Social Responsibility	40	13	39
Food Safety	0	63	8
Fish Health and Welfare	0	45	26
Environment	67	62	43
Feed	10	15	1
Smolt	35	0	0
SUM	**152**	**198**	**117**

Table 14 show the amount of control points placed within each category and how this levels with each aquaculture standard. The assembled stacks in *Figure 5* illustrate the aforementioned table.

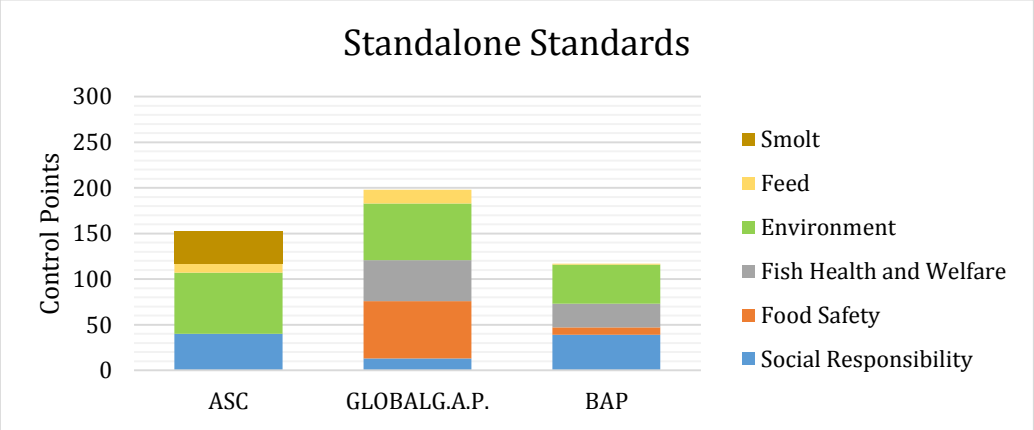


Figure 5: Separate standard control points isolated

ASC does not explicitly address Fish Health and Welfare or Food Safety, but demonstrate strong commitment in the categories of Environment and Social Responsibility as well further consideration along the value chain with specific smolt supplier inclusion. GLOBALG.A.P. hold in comparison to ASC a larger amount of control points spread among the given categories. The issues covered by BAP, although less abundant, also has a focus on Environment and Social Responsibility, but Fish Health and Welfare as well.

Table 15: Procedures for certification

Standards to achieve certification scheme	
ASC	**1. ASC Salmon Standard - Mandatory** 2. Supplier Certification (CoC) - Mandatory 3. Certifier Accreditation - Mandatory
GLOBALG.A.P.	1. All Farm Module - Mandatory **2. Aquaculture Module - Mandatory** 3. The GLOBALG.A.P. Chain of Custody (CoC) – voluntary 4. GRASP add-on - voluntary
BAP	**1. BAP Salmon Farm Standards - Mandatory** 2. ICES Code of Practice transfer organic 2005 – Mandatory if species farmed is not native or not already farmed 3. Sponsored: Integrated Operating Module (IOM) - Voluntary

5.2.2 External Indicator Analysis

A sufficient performance assessment is possible through a benchmark based on an external set of indicators. Together with the main objective - analyzing environmental and social impact of the given salmon aquaculture standards - a suitable collection of criteria would need alignment with relevant and up-to date issues, trends and dilemmas within the aquaculture industry. Unfortunately, time estranged the possibility to create a private batch of criteria, therefore making it fruitful to adapt and apply benchmarking criteria made by World Wildlife Fund (WWF) Switzerland and Norway (2007). A multi-stakeholder dialogue created the indicators, whereby the team collaborated with the aquaculture industry, conservation organizations, governmental bodies and research institutions. The criteria grasp most facets that show the stature of each standard, and applied with only few modifications[2]. For full overview, see *APPENDIX A* and *APPENDIX B*.

ASC Salmon Standard

In light of the comparison made on control points, the ASC salmon standard perform stronger in the categories of Animal Health, and is close to achieve total score in the remaining categories. WWF's criteria are not for the glorification of ASC, but illustrate a comprehensive range covered, addressing paramount issues of sustainability. However, if the focus of food safety, product hygiene and product quality were to be included, the result changes would be remarkable. In addition, ASC score higher for having an elaborated use of numerical metrics instead of measurable criteria, and for not having to face further fish welfare indicators.

[2] Three indicators was replaced and modified:
A.1.3. Air-Freight for Shipment, replaced by GHG climate change.
A.3.3. Modified to suit salmon aquaculture
D.2.2. Updated indicators with current accreditations standards

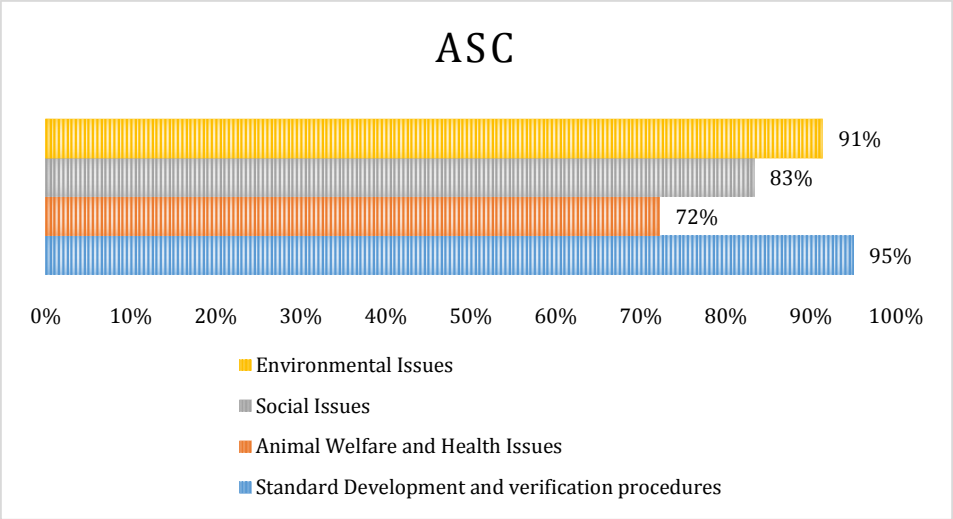


Figure 6: ASC External Indicator Benchmark

GLOBALG.A.P. Aquaculture Module

Control points of GLOBALG.A.P comprise what is regarded as minimum requirements, and do not encircle the WWF indicators accurately in categories of Environmental and Social issues.

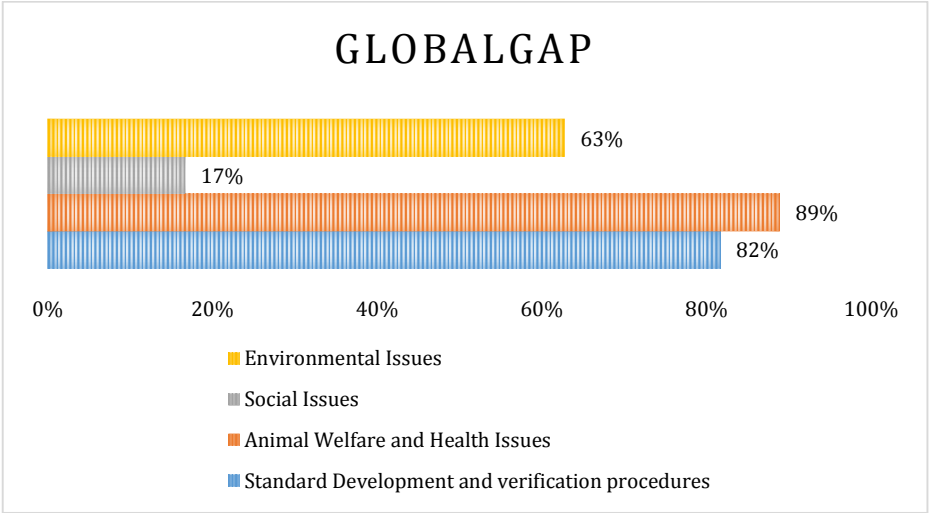


Figure 7: GLOBALG.A.P External Indicator Benchmark

BAP Salmon Standard

Similar to GLOBALG.A.P, BAP do not contain specific numerical specifications and values, and therefore comes short in Environmental issues and Standard Development and verification procedures, but obtain full score in Animal Health and Welfare.

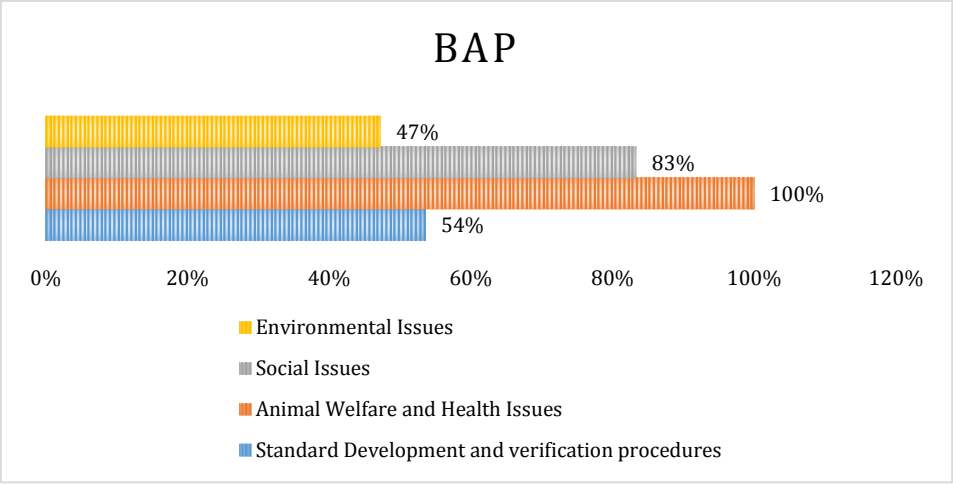


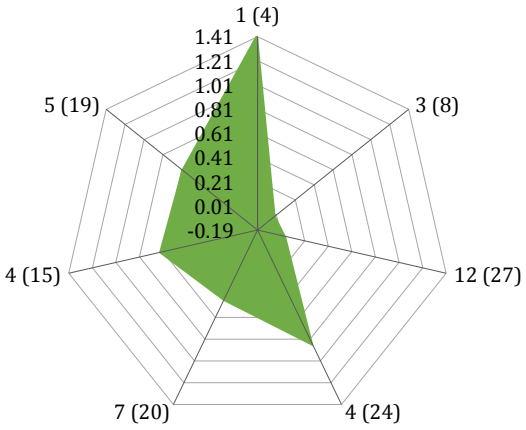
Figure 8: BAP External Indicator Benchmark

5.2.3 GAP Analysis

A GAP analysis can show the disparity between GLOBALG.A.P and BAP when measured upon the ASC standard, and the study have performed an outright attempt to link the various parts to its corresponding counterparts in ASC. The study only use the aquaculture specified standards, excluding additional standards and code of conducts necessary for full compliance. See *APPENDIX C* and *APPENDIX D* for detailed description.

GLOBALG.A.P. Aquaculture Module

A clear perspective appears by performing analysis through a radar diagram. In *Figure 10*, the 'outer' area, which is in this case consists of ASC criteria, have a certain coverage rate by GLOBALG.A.P. Principle 1 and 5 closely links to the aims of ASC, while Principle 6 and 7 is cipher.



GLOBALG.A.P. compared to ASC			
Principles	Criteria/Indicators	Total	%
1	1 (4)	1.44	96.3 %
2	5 (19)	0.61	40.8 %
3	4 (15)	0.65	43.1 %
4	7 (20)	0.46	30.5 %
5	4 (24)	0.88	58.5 %
6	12 (27)	0.05	3.5 %
7	3 (8)	0.00	0.0 %

Figure 9: GAP Analysis between GLOBALG.A.P, and ASC

The ‘gaps’ become apparent in the analysis, and clearly express the characteristics of ASC Salmon Standard. However, amount of unique criteria that found a counterpart in the ASC standard is low, reflecting a key difference in structure and intention. Nevertheless, with less unique criteria used, some fits in multiple places.

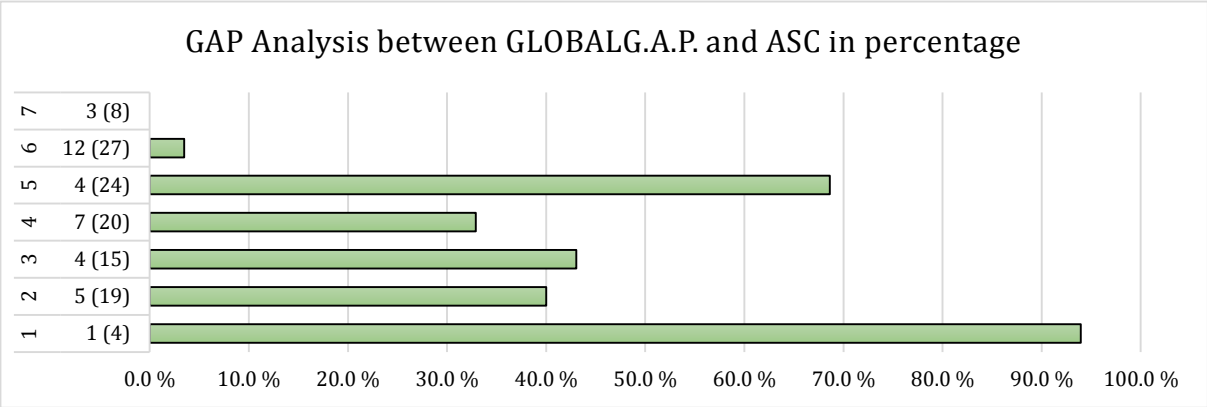


Figure 10: GAP Analysis between GLOBALG.A.P and ASC in percentage

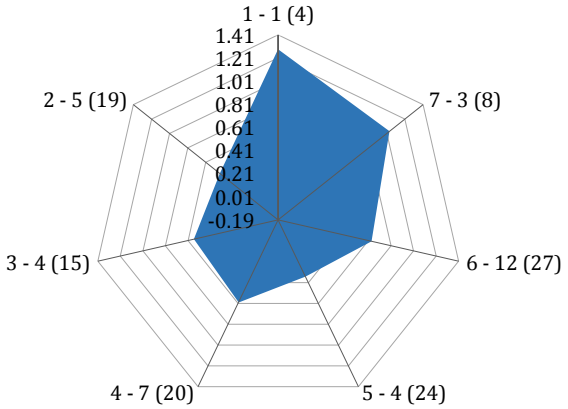
Table 16 summarize the general use of GLOBALG.A.P indicators the directly used in the GAP analysis against ASC Salmon Standard.

Table 16: Criteria covered by GLOBALG.A.P.

Overview of GLOBALG.A.P. use		
Unique GG used	69	34 %
GG not used	129	65 %
SUM	198	100 %
ASC indicators covered by GG	41	35 %
ASC indicators left	76	65 %
SUM	117	100 %
General GG used in ASC	97	

BAP Salmon Standard

Compared with GLOBALG.A.P, the BAP Salmon Standard performs stronger in the categories of social responsibility such as Principle 6 and 7, but notably worse in with disease management in Principle 5. This is mainly due to the lack of metrics and variables that constitute most parts of the ASC standard. In general, BAP is less specific when it comes to Principle 2 - 6.



BAP compared to ASC			
Principle	Criteria/Indicators	Total	%
1	1 (4)	1.29	85.7 %
2	5 (19)	0.46	30.4 %
3	4 (15)	0.56	37.1 %
4	7 (20)	0.60	40.0 %
5	4 (24)	0.35	23.5 %
6	12 (27)	0.64	42.5 %
7	3 (8)	1.04	69.4 %

Figure 11: GAP Analysis between BAP and ASC

The use of unique criteria is slightly higher than GLOBALG.A.P, explained by a higher frequency of matching counterparts.

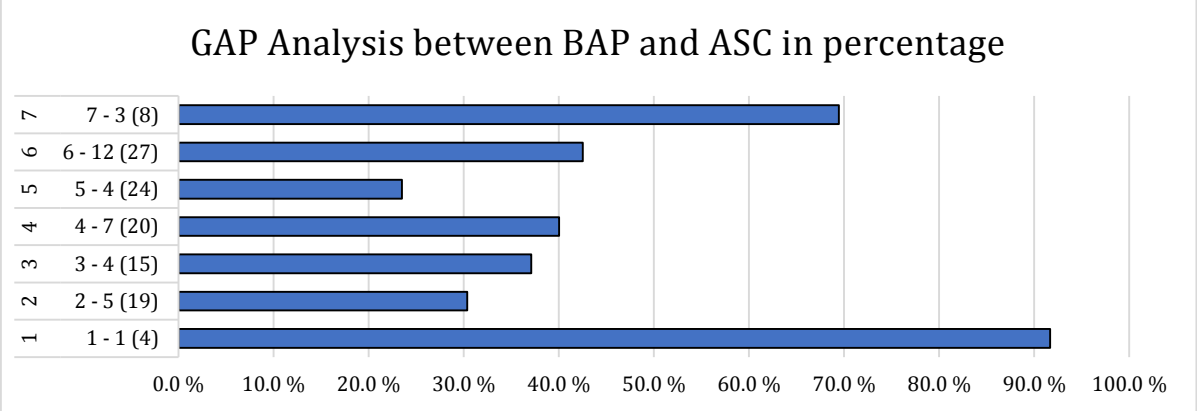


Figure 12: Analysis between BAP and ASC in percentage

Table 17 summarize the BAP indicators the directly used in the GAP analysis against ASC Salmon Standard.

Table 17: Criteria covered by BAP

Overview of utilized BAP		
Unique BAP used	53	45 %
BAP not used	64	55 %
SUM	117	100 %
ASC indicators covered by BAP	48	41 %
ASC indicators left	69	59 %
SUM	117	100 %
General BAP used in ASC	70	

5.3 Qualitative Assessment

To uncover subtleties and features of the aquaculture standards beyond numbers, the aquaculture standards undergo a qualitative assessment through a comprehensive document analysis. First part perform a descriptive analysis by reviewing standard documents belonging to ASC Salmon Standard, GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standards. This will eventually lead to an extensive comparison based on a large set of indicators. Next part do not aim to compare, but rather to examine Marine Harvest annual report of 2013 and available documents at the ASC website for material relating to their ambition to remain sustainable. Last subchapter briefly explore final audit reports from ASC certified farms and assess conformities and non-conformities currently present within the facilities.

5.3.1 Descriptive Analysis

Descriptors developed and adopted from Corsin et al. (2007) will, as shown in *Table 18*, give a general overview of coverage among the standards. Total amount of descriptors adopted is 84. Two descriptors were added concerning sustainable feed ingredients and greenhouse gases (see descriptor 64 and 63). All descriptors can be assorted into the following groups: Standard structure and development (24), inspection process (2), General points standard development (5) General coverage of standards (5), Food Safety (10) Environment (18), social responsibility (5), Animal Health and Welfare (15). Intention is not to produce numerical values or numbers but to find an analytical pathway by identifying key aspects of each aquaculture standard of focus.

Table 18: Descriptors used to assess the aquaculture standards

#	Standard structure and development	ASC	GLOBALG.A.P.	BAP
1	ISEAL member	Yes	No	No
2	Scheme makes reference to international standards	Yes, ILO, ISEAL, TBT, ISO/IEC Guide 59 and other ISO standards	Yes, ISO 17025, ISO/IEC Guide 65, ISO/IEC 17021:2006	Yes, ISO, ILO, FAO, IFFO, ICES, NS, USDA
3	Is there available documents from the standard development and revision procedure?	Yes	Yes, slightly	Yes
4	Was all major stakeholder groups involved in the development/revision of the standard?	Yes	Little in aquaculture module	Not extensively, 2th comment session lacking
5	Is there a process for reviewing the standards regularly?	Yes slightly	Yes	Yes, slightly
6	Is input from stakeholders directly impacted (especially disadvantaged groups) actively sought?	Yes, among 500 stakeholders conservationists and aboriginal people	No	No
7	Did principles of consensus form the basis of the standard development process?	Yes, but a nine-person Steering Committee (SC) makes final decision	Yes, but GAP committee has final say	Yes, slightly
8	Is there a documented process to address complaints with failures in following the	Not yet	Yes	Yes, however unclear when second comment session will occur

	process for standard development and revision?			
9	Standards publicly available for implementation (even if including reasonable fee)	Yes	Yes	Yes
10	Standards based on measurable/precise criteria	Yes	Yes	Yes, slightly
11	Product or process standards	Process	Process	Process
12	Target of the label: consumer or food chain operators	Consumer	Food chain operator	Consumer
13	Link between standard development and certification organizations	Mild	Mild	Strong
14	Implemented through Third Party Certification	Yes	Yes	Yes
15	Certification body accredited by internationally recognized accreditation organization or accredited to ISO 65	Yes, by Accreditation Services International GmbH (ASI)	Yes, ISO/IEC 17065	Yes, ISO/IEC Guide 65, to become ISO/IEC 17065 within 2015
16	Free access to accredited CBs	Yes	Yes	Yes
17	Enable group certification	Yes	Yes	Yes
18	Competent stakeholder representation in standard development process	Yes	Yes	Yes, but not rigidly defined
19	Scheme has standards for producers	Yes	Yes	Yes
20	Scheme has standards for traders	No	Yes	No
21	Scheme has standards for processors	Yes	Yes	Yes
22	Scheme has standards for seed suppliers	Yes smolt s are included in the ASC	Yes	Yes
23	Scheme has standards for feed	Yes	Yes	Yes
24	Requires compliance to scheme throughout the supply chain	Promoted	Yes, excluding early stages	Promoted
#	**Inspection Process**	**ASC**	**GLOBALG.A.P.**	**BAP**
25	Inspection by CB includes water testing/environmental testing	Yes	No	Yes
26	Inspection by CB includes consultation with local communities/assessment of off-site impact	Yes	No	Yes
#	**General points standard development**	**ASC**	**GLOBALG.A.P.**	**BAP**
27	Clearly stated principles	Yes	Yes	Yes
28	Quantity of compliance points	High-Medium	High	Medium
29	Quantity of written documents required	High	High	Medium
30	Validity period of certificate/frequency of inspection	3 years / 1 year	3 years / 1 year	1 year / 1 year
31	Require records for (minimum time)	Current production cycle /some criteria for a min period of 6 months before 1st audit	2 years (5 years for feed)	1 year
#	**General coverage of standards**	**ASC**	**GLOBALG.A.P.**	**BAP**
32	Compliance to law	Yes	Yes	Yes
33	Internal audit	No, but record keeping	No, but record keeping	No, but record keeping
34	Performance monitoring	Yes	Yes, growth, residues, health	Yes, FCR, sediment, health
35	Performance improvement over time	Yes, every three to five years	Not necessary	Partly, from first certification and after 5 years
36	Staff training	Yes	Yes	Yes
#	**Food Safety**	**ASC**	**GLOBALG.A.P.**	**BAP**
37	Development of food safety policy and manual/system	No	Yes, also have contingency plan	Yes
38	Use of HACCP approach	Yes	Yes	No
39	Food safety through site selection	No	Yes	No
40	GMO	Yes, no GM fish allowed. GM feed usable	Yes, slightly, no GM fish allowed. GM feed usable.	Yes, no GM fish allowed
41	Prohibit use of protein and fat from some species	Not directly, but require strict sourcing	Yes	Not directly, but maybe through compliance to law
42	Preharvest food safety	Not directly, but require strict sourcing and traceability	Yes	Yes
43	Pest control	Yes	Yes	Yes

44	Traceability	Yes	Yes	Yes
45	Product testing	No	Yes	Yes
46	Post-harvest food safety	No	Yes	Yes, slightly
#	**Environment**	**ASC**	**GLOBALG.A.P.**	**BAP**
47	Requires environmental risk/impact assessment	Yes, GHG assessment for feed, fish farm and smolt supplier; biodiversity assessment	Yes	Not directly
48	Environmental protection during farm siting	Yes	Yes	Yes
49	Loss of mangrove and sensitive habitats	Yes	Yes	Yes
50	Environmental impact considered during farm design and construction	Yes, AZE	Yes, in relevance to EIA and ERA	Yes, slightly
51	Stocking density	No	Yes, accordance to legislative requirements, max density not exceeded.	Yes, not normally exceed 25 kg/m3 but may be allowed to rise higher for up to 5 percent
52	Demand on wild stocks for seed/broodstock	Yes	Yes	No, but maybe through law
53	Stocking of exotic species	Yes	No, but maybe through law	No, but maybe through law
54	Water exchange/abstraction	No, but maybe through law	Yes, but dependent on law	No, but maybe through law
55	Requires testing/record keeping of water quality	Yes	Yes	Yes
56	Provides water quality standards to be complied with	Yes	Yes, water quality management plan	Yes
57	Water effluents	Yes	Yes, but dependent on law	Yes, collecting and testing of water
58	Solid waste management	Yes	Yes, waste management plan	Yes, Materials Storage, Handling and Waste Disposal Plan (MSHWDP)
59	Chemical/drug disposal	Yes	Yes, waste management plan	Yes, Materials Storage, Handling and Waste Disposal Plan (MSHWDP)
60	Escapees	Yes (it limits to a max of 300/production cycle).	Yes, Contingency plans	Yes, suspended if three or more escapes with more than 500 fish from individual cages over two consecutive production cycles, or exceeding 5,000 fish
61	Cumulative impact of multiple operations	No	Partially, maybe through law	Not directly, but maybe through law
62	Sustainable Feed Ingredients	Yes (FFDRm and FFDRo limits. FM and FO from certified sources, certifies soya).	Yes, CFM standard	Yes (Fish IN:Fish Out ration <2)
63	Climate Change (GHG)	Yes (GHG assessment for feed, fish farm and smolt supplier)	No	No
64	Energy efficiency, use and consumption	Yes	Yes, slightly, only recommended	No
#	**Social Responsibility**	**ASC**	**GLOBALG.A.P.**	**BAP**
65	Development of farmers' group	Yes	Not directly, but allow group certification	Not directly
66	Other resource users/local communities	Yes	Only use of resources	Yes, require consultation
67	Workers' welfare	Yes, health and work conditions	Yes, health, living and living conditions	No, only in All Farm Module
68	Forced labour	Yes, ILO	Yes indirectly through law	Yes, ILO
69	Child labour	Yes, ILO	Yes indirectly through law	Yes, ILO
#	**Animal Health and Welfare**	**ASC**	**GLOBALG.A.P.**	**BAP**
70	Animal welfare (stress, etc.)	Not directly, but includes water quality and health indicators	Yes, husbandry, water quality, harvesting	Yes, water quality, health, slaughter, stocking density
71	Protection from wild animals and predators	Yes, bird nets can be used until 2015, ADDS used as long as	Yes, subject to risk assessment	Yes, according to law and WIP

		less than 40 percent of the time		
72	Application of non-lethal, or humane, methods of predator control	Yes	Yes	Yes
73	Farm preparation to prevent health problems	Yes	Yes	No
74	Farm biosecurity	Yes	Yes	Yes
75	Responsible use of drugs and chemicals	Yes	Yes, prescribed by veterinarian	Yes, allowed by fish health professional
76	Antibiotic use	Yes, limit of 3 antibiotic treatments per production cycle	Yes, list of non-allowed antibiotics	Yes, antibiotics or chemicals banned in the producing or importing country prohibited
77	Control on additional not-banned substances	Yes, documented	Yes, product inventory documented	Yes, through record keeping
78	Quality/health status of seed	Yes	Yes, and through VHP	Yes slightly, only concerning hatchery eggs
79	Farm management to prevent health problems	Yes	Yes	Yes
80	Feed quality	Yes, FishSource, FFDRm and FFDRo limits, FM and FO from certified sources, certifies soya	Yes, CFM standard	Yes, but not directly
81	Overfeeding/FCR	Yes, FCR is requested	Yes, records of feed conversion and feed monitor system and accordance to appetite	Yes, FCR of 2.0
82	Monitoring of animal health	Yes	Yes, by veterinarian	Yes, welfare overseen by fish health professional
83	Disease spread to other farms during culture	Yes, ABM requested	Yes, and authority notification	Not directly, but maybe through law
84	Disposal of mortality	Yes	Yes	Yes

5.3.2 Sustainability and Marine Harvest

Marine Harvest launched in March 2013 their vision *"leading the Blue Revolution"* (Marine Harvest Group 2012a: 7). Goal is to become the leader in three key areas – salmon feed, salmon farming and in meeting the needs of the market. The vision rests on four guiding principles to ensure sustainable growth from an environmental, social and financial perspective, and consist of Profit, Planet, Product and People. Guiding principles of Planet, which is of relevance to the content of the thesis, have induced a commitment to Global Salmon Initiative (GSI). This initiative aims to support and work towards sustainable use of feed, biosecurity, compliance with quality standards. Another aspect is the fruits from the established cooperation since 2008 between Marine Harvest and WWF-Norway that have focused on sustainability and the environment (WWF-Norway 2013). In 2013, Marine Harvest committed to become 100 percent ASC certified by 2020. The reasoning was to take responsibility for sustainable development, to limit discharge, use responsible managed feed raw materials and reduce impacts on wild salmon (Marine Harvest Group 2013b).

As of May 2014, Marine Harvest managed to achieve two ASC certified fish farms, namely the facilities of Buksevika and Tarmvikodden (Løvland 2014). In addition, Marine Harvest has five

new farms in Norway and two in Canada under assessment (ASC 2014). According to the audit reports from the ASC certified farms, Marine Harvest Norway AS already had a well-developed Quality Management System (QMS) well implemented throughout the organization, allowing the company to comply with the industry`s legal requirements. In addition, before ASC they had GLOBALG.A.P, ISO 9001, 14001 and 18001 certifications for all fish farming activities.

5.3.3 Current Conformities and Non-Conformities in Salmon Aquaculture

As of June 2014, the total number of salmon farms becoming ASC certified counts nine with two located in Australia and seven located in Norway. *Table 19* gives an overview of all farms in Norway as well all documented minor and major non-conformities among them.

Table 19: General minor and major non-conformities from ASC certification audit reports

Non-Conformities from ASC implementation						
Principle	**Criteria**					
Location	Marine Harvest Buksevika and Tarmvikodden	Lerøy Arøya	Lerøy Gourtesjouhka	Lerøy Solheim	Lerøy Midt	Villa Organic
Source	(DNV 2014a; DNV 2014b)	(Bureau Veritas 2013a)	(Bureau Veritas 2013b)	(Bureau Veritas 2013c)	(DNV 2013)	(IMOswiss AG 2013)
Principle 1: Comply with all applicable national laws and local regulations						
Principle 2: Conserve natural habitat, local biodiversity and ecosystem function	2.1.2	2.1.1, 2.1.2, 2.1.3, 2.4.2, 2.5.1	2.1.1, 2.1.2, 2.1.3, 2.5.7	2.1.1, 2.1.2, 2.1.3, 2.5.7	2.1.2, 2.1.3	2.1.1, 2.1.2, 2.1.4, 2.2.1, 2.2.2
Principle 3: Protect the health and genetic integrity of wild populations					3.1.1, 3.1.3, 3.1.4, 3.1.6, 3.4.1, 3.4.2, 3.4.3	3.1.6
Principle 4: Use resources in an environmentally efficient and responsible manner		4.1.1. 4.3.1, 4.3.2, 4.3.3, 4.4.1, 4.4.2, 4.6.2, 4.7.3, 4.7.4	4.1.1, 4.3.2, 4.3.3, 4.4.1	4.1.1, 4.3.2, 4.3.3, 4.4.1	4.7.1,	4.2.2
Principle 5: Manage disease and parasites in an		5.2.1			5.1.4, 5.1.5, 5.1.6,	5.1.6, 5.1.7, 5.4.2,

environmentally responsible manner					5.2.1, 5.2.5	
Principle 6: Develop and operate farms in a socially responsible manner	6.4.1, 6.6.2	6.5.2, 6.5.3	6.5.1, 6.5.2, 6.7.2	6.5.1, 6.5.2, 6.7.2	6.2.2, 6.4.1, 6.6.2, 6.3.3, 6.7.2, 6.8.1, 6.10.1	6.7.2
Principle 7: Be a good neighbor and conscientious citizen	7.1.1				7.1.1, 7.1.3	7.1.1
Section 8: Standards for suppliers of smolt	8.4, 8.20	8.3.2, 8.4.6		8.3, 8.7, 8.11, 8.12, 8.19, 8.20, 8.21	8.2, 8.3, 8.4, 8.9, 8.10, 8.18, 8.21	8.4, 8.7

6 RESULTS

All benchmarks presents control points from only one standard, and do not consider all mandatory components necessary to attain full compliance with the given certification scheme. As this approach may have several limits, it also cohere with the inclination towards uniformity and harmonization of one strong standard single handedly containing most necessary aspects. Following sections address the results from both the quantitative and qualitative analysis.

6.1 Control Point Analysis

First benchmark use defined requirements from each aquaculture standard of focus, typically categorized under criteria and indicators, and compile the units referred to as control points into thematic stacks in order to enable measurable parameters.

The results from the control point comparison show that the ASC Salmon Standard has a high quantity within its focus areas of Environment and Social Responsibility. It also score well in Smolt and Feed relate criteria. GLOBALG.A.P and BAP do not cover these topics to the same extent. In addition, smolt control points could be divided into the other categories but is not due to the nature of the analysis. The single GLOBALG.A.P standard Aquaculture Module performs well in quantity within Environment, Food Safety and Fish Health and Welfare, but not in Social Responsibility as it refers this part to the GRASP Module, or Smolt, probably due to not being salmon aquaculture specific. Concerning Environment, the amount of 62 criteria is almost similar to ASC's 67, but the content may vary in term of requirements demanding specific values, as mentioned in External Indicator and GAP analysis. BAP's approach to specify requirements is text based with few measurable indicators. Details that appear to be requirements in the implementation section is not mentioned in the standards. It also heavily redirect the certifier to rely on local regulations and 'international laws'. Nonetheless, BAP has a moderate amount of control points in Environment, Social Responsibility and Fish Health and Welfare, having a general coverage of central topics within the industry.

6.2 External Indicators Analysis

Second benchmark use a set of external indicators gathered and developed by WWF Switzerland and Norway. The external indicators function as a common joint to assess each standard, formed in consensus and with several stakeholders. In 2007, when the indicators were developed, may be outdated in today's salmon aquaculture industry, but the indicators are

believed to still grasp most aspects and issues relevant. Analysis with external indicators exclude the focus of food safety and quality, narrowing the study onto sustainability issues.

First out is ASC which score high Environmental- and Social Issues, and in Standard Development and verification procedures. The Aquaculture Stewardship Council has expressed that Animal Welfare are covered in the salmon standard by water quality and disease related requirements. Due to not specifying this kind of requirements, the ASC Salmon Standard do not perform correspondingly well in the category of Animal Welfare. However, as standard demand numerical metric and specific values, the performance is above average both for environmental and social responsibility criteria.

Next is GLOBALG.A.P Aquaculture Module, excluding All Farm Module and Code of Conduct. Compared with WWF's indicators, Global GAP scores under average in Environmental- and Social Issues, but GLOBALG.A.P has the largest quantity of control points probably affecting its strong performance in Animal Welfare and Health and Standard Development and verification procedures. Despite the amount, the control points contain what is regarded as minimum requirements, often relying on local regulation with many recommendations and few mandatory. Last points is probably also explained by not being salmon aquaculture specified, with not having full coverage of sea lice and open net pen salmon.

BAP scores above average in Social Issues and achieves full score in Animal Health and Welfare. This reflects a certain level of coverage of main issues that the external indicators focus on. However, as discussed in the control point benchmark, BAP addresses key environmental impacts but not setting specific numerical targets and rely on legal requirements, and swiftly elaborate the firmness in standard development and verification procedures. This led to lower scored in Environmental Issues and Standard Development and verification procedures. BAP occasionally move beyond existing regulations such as the coverage of fishmeal and fish oil conservation and FIFO limits.

6.3 GAP Analysis

Third benchmark uses indicators from ASC Salmon Standards as foundation to perform a GAP analysis. Each indicator from the ASC standard is matched to a corresponding indicator or criteria in the standards of GLOBALG.A.P and BAP. This method may illustrate the disparity

between the single aquaculture standards. Intention behind the analysis is to identify the ‘gaps’ between the different standards to give a clearer picture of their standing.

GLOBALG.A.P Aquaculture Module has a high coverage Principle 1, compliance with laws and regulations, and Principle 5 on environmental responsible management of diseases and parasites. It scores slightly below in Principle 2 conserving natural habitat, biodiversity and ecosystem, and Principle 3 in protecting health and genetic integrity of wild populations. Principle 4 (use of resources in an environmental responsible manner) scores way below average with 32.9 percent. Most notable coverage is in Principle 5 wherein numerous control points assorted to ASC’s indicators. While GLOBALG.A.P Aquaculture Module is no salmon aquaculture specific, it is a highly applicable standard addressing key issues within general aquaculture farm production. However, it scores lower when compared to indicators requiring numerical values and records, and thereby in the categories of environment and social responsibility stressed by the ASC Salmon Standard. Another aspect not clear from the GAP analysis and radar diagram is control points concerning food safety and quality, and animal health and welfare. The GAP analysis reflects a key difference in structure and intention of the standard, and that the distinct focus between the two standards. GLOBALG.A.P had 75 unique matching counterparts in the ASC standard consisting of 38 percent.

BAP has a strong coverage in Principle 1 and Principle 7, latter concerning community engagement. It scores below average in Principle 3, 4 and 6, last on concerned social responsibility. It scores low in Principle 2 and 5. Again, BAP’s general appliance towards central issues in noteworthy, reflected in how the standard find 53 unique counterparts in the indicators of ASC Salmon Standard consisting of 45 percent, and those counterparts used totally 70 times. A coverage slightly higher than GLOBALG.A.P. It is however important to emphasize that the BAP standards have a different structure from ASC and GLOBALG.A.P in not categorizing requirements into indicators, thus the analysis used the ‘standards’ that is organized in a similar fashion. BAP is organized to apprehend salmon fish farming, but due to the lack of metrics and for not addressing specific issues relevant in salmon aquaculture, it does not achieve full coverage in ASC’s focus on environmentally and socially responsible processes.

6.4 Descriptive Analysis

A set of descriptors enabled a qualitative assessment of the aquaculture standards used in Marine Harvest's production facilities, showing their unique features and characteristic. The descriptors were based on a framework that has identified wide range of issues relevant for aquaculture, but also applicable for salmon farming. The final overview clearly show certain traits held by each standard if they for instance are 'yes' being an ISEAL member,. Nonetheless, the true strength with qualitative analysis is to uncover through comparison the few notable infrequencies between the standards

6.5 Sustainability and Marine Harvest

An examination of Marine Harvest's annual report of 2013 and documents available at ASC website show a clear commitment to address environmental and sustainable issues through their guiding principles of Planet. Notable initiative is the co-founding of Global Salmon Initiative (GSI) and commitment to become 100 percent ASC certified within 2020. Marine Harvest have currently two ASC certified fish farms in Buksevika and Tarmvikodden, and have five farms in Norway and two in Canada under assessment. Before the ASC certification, they already had GLOBALG.A.P, ISO 9001, 14001 and 18001 certifications and well-developed Quality Management System (QMS) implemented throughout the organization.

6.6 Current Conformities and Non-Conformities in Salmon Aquaculture

A review of all final audit reports from ASC certified farms in Norway give a certain picture of current implementation processes. Following is three selections of ASC principles with non-conformities among farms from different companies that have been audited so far:

Principle 2, all farms have some level of minor and major discrepancies. Further examination show that root cause is lack of submission of results from environmental tests, ranging from requisition of redox potential (common ground for all farms), benthic index scores, risk assessment of each lethal incidents, taxonomic composition of macro fauna and documented procedures of obtaining the results. However, main reason is that result were not finished during audit, or not sent in time to ASC.

Principle 6 has non-conformities among all farms. Issues ranged from lack of assessment and lists of risk and health hazards in workplace such as missing fire extinguisher and monthly check of the lifeboats. Also noted was lack of employee training and policies regarding

discrimination, identifying known hazards such as chemicals and social compliance with suppliers and contractors. In addition, some farms had shortcomings related to basic needs wage calculations, specification of overtime and job descriptions and treatment of worker grievance. Similar to Principle 2, most discrepancies relates to proper documentation routines.

Principle 4, almost all farms have non-conformities. Issues relates to verification of obtaining audit reports from relevant feed producers, or if audit firms or CAB being ASC-acknowledged. Other non-conformities was if FishSource fulfil ASC requirements, evidence of third party verified chain of custody for the fishmeal and fish oil, and for all species used. Other non-conformities relate with feed suppliers sourcing policies, or if information about use of copper antifoulants or greenhouse gas emissions on the farm sent not to ASC.

7 DISCUSSION

A critical question is why someone should and should not implement a given aquaculture standard? If moderating the question so it fits within the narrow context of the thesis, why should Marine Harvest commit to additional standard, in this case the ASC Salmon Standard, and what is the challenges and potential of doing so? Two separate parts address these questions. First part discusses the application of aquaculture standards in general and how they will affect the industry at large. Second part is concerned with the ASC Salmon Standard, and discusses how it aligns with Marine Harvest's ambition of ensuring a sustainable growth. Next is a part discussing reliability and validity of methodologies used and to which extent they contribute to this research. Last is a short summary of the discussion.

7.1 Trait Determent and Benefits from Aquaculture Standards

Decision-making for choosing an aquaculture standard highly rest upon the specific traits it hold. If a company wants to attain market assurance for having food products encompassing quality sound procedures, they could ingrain quality and safety standards and practices. If a company want to attain a profile for being environmental responsible, they could adopt eco-labels and associated certification schemes acknowledged by the market. Different standards apprehend such traits, discussed in subchapter *2.9*, which could help the guidance towards favorable outcomes. Today's market is a dynamic playfield, an arena of constant development craving resourceful adaptions. A vast amount of literature state that nowadays a larger focus on sustainability has settled in the market. It is even a global trend (see *2.7.2*) discussed to affect key actors in numerous businesses, among them the aquaculture industry. As mentioned in section *2.1*, challenges may occur from the cacophony of global food production, increased world population and threat from climate change. Such factors have an influence on policy makers, embedding key aspects into the development of standards and certification schemes. From these changes, within the field of aquaculture, a cluster of standards has emerged considering these issues, such as ASC Salmon Standard, GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standards. As previous analysis from the thesis show, these standards mark themselves as strong contributors in the categories of environment and social responsibility, animal welfare, food safety and quality. Furthermore, the ASC Salmon Standard clearly inserts contemporary features such as GHG assessment and energy consumption assessment. It thereby hold traits in forefront with environmental sound practices aligned with globalizing tendencies and overarching sustainable concern. However, the ASC standard

document does not explicitly address certain areas covered by other standard such as food safety and quality, nor is it elaborating on the topic of animal welfare. A combination of different standards would be the best option to cover all relevant areas, but this approach have also proved challenging due to the great variety of existing aquaculture standards and associated certification schemes. A great proliferation of eco-labels may lead to confusion among producers to consumer, but is nonetheless an important aspect in competition. Except choosing a specific aquaculture product or process standard, getting involved with one that is an acknowledged and stringent may bring additional costs and time consumption.

Before getting involved into a certification scheme by implementing a process standard such as the one provided by ASC, it is necessary to perform a thorough examination of benefits and drawbacks. Several beneficial reasons such as including environmental externalities and social concerns, and to fill an information vacuum. This by following international guidelines, support smallholders, stimulate trade and not block it, demonstrate improvement, enhance competitive advantage and innovation, provide governance, transparency and accountability. However, choosing the right standard unbarring these advantages can be a challenge. Is the effort worth the outcome? A development argued to aid the navigation through to the great variation of aquaculture standards and the information they project is adhering to international standards. ASC Salmon Standard, GLOBALG.A.P Aquaculture and BAP Salmon Farm Standards are already highly distributed throughout the market, bringing a higher degree of uniformity. By adhering to international guidelines, standards also undergo increased harmonization. Uniformity and harmonization may bring positive effects into the overall market, as well negative. A correct selection of standards endorsing contemporary issues can make a company prevail above other in term of efficiency and market access. Fewer, more widespread aquaculture standards and certification schemes could also ease the comprehension in key terms and concepts that the industry entangle. There are ongoing efforts to make different standards uniform, like the memorandum of understanding between ASC, Global GAP and BAP.

7.2 Aligning Sustainability Targets of Marine Harvest with ASC Scope

In Marine Harvest's annual report of 2013, the company set environmental responsibility as a key aspect in leading the blue revolution. In addition, to ensure sustainable development of the industry at large, they co-founded the Global Salmon Initiative (GSI) in order to work together with peer-companies in addressing a range of immediate and longer-term environmental challenges (Marine Harvest Group 2013a). Specified, they express the intention of becoming a

front-runner in environmental responsibility by *"supply a growing population with outstanding food resources without hampering our planet"*, further stating that a *"healthy planet and healthy business performance are mutually reinforcing and, as such our long-term business success depends on protecting the environment for future generations"* (Marine Harvest Group 2013a: 52). The ASC Salmon Standard allegedly embody several aspects of the sustainable goals, and is therefore a key step in realizing them. As a result, it is fruitful to discuss the standard's potential of doing exactly so.

Firstly, the degree of 'commitment to overall environmental responsibility'. Free, functioning market economics is discussed to depend on perfect information to consumers, thus on proper labelling (Jacquet & Pauly 2008). As indicated by the previous results, the ASC Salmon standard may contain environmental and social indicators considered 'strict' in the current market. No content in the thesis aims to discuss the meticulous degree of the requirements set to cover the issues in the standard, but recognize that compared to GLOBALG.A.P Aquaculture Module and BAP Standard for Farmed Salmon, two established process aquaculture standards, it performs well. Worth to note is that consensus based standard development including a wide range of stakeholders is challenging and time consuming. Another point asserted by Jack Rensel during the first comment session of the BAP Salmon Standard (BAP 2011b), it may be tempting to have a single set of protocols and standards for a worldwide use in salmon farms. It is however problematic due to biological obstacles and fundamental differences in physical circulation, water chemistry and biology throughout all existing ecoregions in salmon-farming regions worldwide. While BAP committee refined several specifics, the ASC employ regardless of different jurisdictions and local hydrographic numerical values and specifics. By committing to the ASC Salmon Standard, Marine Harvest do adhere to a strong environmental and social standard in term of equivalent private standards currently utilized within the aquaculture industry and the company itself. Secondly, full compliance with the ASC certification scheme will enable use of associated label. Product assurance is a central component for sustainable development. Thirdly, as mentioned in subchapter *2.8.2* and *2.8.3*, level of engagement into environmental and social responsible practices is hard to measure for both the company in term of performance and tangible results, and the public concerning their confidence to affirmation. The ASC certification scheme requires a third-party verification that ideally will confirm labeling claims. The standard development also got supported, and later recognized by strong organizations such as WWF and ISEAL. An acknowledged label can, as discussed in subchapter *2.9.3*, demonstrate concerns for public interest and environmental protection by

improving transparency and public involvement in the industry. Important to note is that the ASC Salmon Standard and label may prove responsible practices, but it is still a new element in the market. Amount of worldwide salmon aquaculture farms certified do not count many, and is yet not a widespread product label in term of quantity. In this respect, it is interesting to see the forthcoming development on this matter. IKEA (2013) have declared all salmon product to come from ASC certified sources within 2015 in addition to other large-scale retailers, a fact that definitely will amplify the advancement.

Regulatory strictness is not a concern or barrier for the Norwegian aquaculture industry as Norwegian aquaculture producers already internalize environmental concerns into their production decisions. The government also participates in research and development, an example being the aquaculture strategy discussed in subchapter *2.5*, to ensure a socially desirable level of innovative activities in areas the industry unlikely will address. Environmental and sustainable awareness and concern is therefore arguably strong in Norway, a matter that could for instance affect the marketing of a product. Adhering to a recognized standard and label could assure environmental and social sound practices, of whom the ASC Salmon Standard is a strong candidate. ASC label is nevertheless a newcomer in the market, and it remains to see how it attracts customers to choose certified products. One fact worth considering in this respect is the worldwide increased demand for fish products and awareness for climate change. Combined, a notable interest and demand for private and public standards concerned with sustainable issues have increased, discussed in subchapters *2.2.3* and *2.6.2* accordingly. Compliance with global trends and strict standards may have positive market results also within the Norwegian market, but it also depends if the actual compliance is achievable.

Currently, seven farms have become ASC certified in Norway with five new under assessment, but a central question is how the implementation process will continue. Adhering to a strict standard can bring additional challenges. In a general sense, is it possible for all farms to comply with the requirements of the ASC standard? In light of current non-conformities identified in subchapter *5.3.3*, is seems that most discrepancies were due to insufficient time. Typical comments were statements such as not being ready at audit, environmental samples not finished in time or requirements not understood. This reflects a premature full-scale implementation stage as the industry needs to adapt.

7.3 Reliability and Validity

Scientific, technical and peer-reviewed literature used in the thesis originate from a diverse field of disciplines, but is interpret after best of knowledge. Multidisciplinary approaches may however be affected by lack of essential knowledge, thus leading to few inaccuracies in how the data is comprehended. A possible scenario can be the insufficient explanations of topics in the theory part. The field of aquaculture is in constant development, and numerical values could for instance change dramatically over the current of one year, making those mentioned not to be up-to date. An additional scenario is missteps in correlating or categorizing indicators between the aquaculture standards in the analysis. Concerning the specific methodologies, one important aspect to consider is that most indicators in External Indicators and Descriptive Analysis comes from older research papers, thereby developed by the respective authors the year they were published. Therefore, to insert a degree of validity these indicators have undergone a reevaluation to suit an analysis of the contemporary standards for salmon farming. Degree of reliability may also vary as replication could lead to different outcomes. The GAP analysis could for instance lead to alternative conclusions in term of results, making it the least reliable part of the thesis. This method match control points to corresponding control points, though with certain conditions such as not including ASC standard's Smolt section. This procedure could be liable for subjectivity.

All research is a 'desktop' study, and do not include any on-site evaluations. In addition, it did not establish any direct contact with producers, relevant inspection auditors or certification bodies. Little is therefore valuable from the analysis in term of practical benefits at the field level. Nonetheless, the applicable part is the thorough assessment of information about aquaculture standards, how they can benefit the industry and create positive results. Furthermore, the qualitative and quantitative methods used have analyzed three major aquaculture standards and explored their distinctive traits and value. The analysis is not meant to create explicit or literal results. This would require more accurate, in-depth evaluations from the applied methodologies and more time than is available within the context of the semester. Especially if one were to include all standards and code of conducts necessary to achieve full compliance with the relevant certification schemes mentioned in subchapter *5.2*. Main point is to use the analysis as instruments and tools for the attempt to illustrate features of the aquaculture standards of focus, maybe to contribute in decision-making, thus not highly depending on exact and unmistakable data.

7.4 Summary of Discussion

Certain aquaculture standards hold traits addressing key issues and concerns in the industry, that be environmental or food security. Globalization affects and rearranges market mechanics, which the aquaculture industry among many should abide. Aquaculture process standards can embrace environmental and social concerns by following international guidelines, stimulate trade, demonstrate improvement, enhance competitive advantage, innovation, and provide governance, transparency and accountability. A proliferation of standards and certification schemes have emerged within aquaculture, with a selected few prevailing and utilized by large seafood producers such as Marine Harvest. To ensure sustainable development Marine Harvest has committed to the ASC Salmon Certification Programme. Compared to GLOBALG.A.P Aquaculture Module, BAP Salmon Farm Standard and ASC Salmon Standard has defined and specific environmental and social indicators and requirements. WWF and ISEAL recognize the ASC standard, and IKEA among many large retailers have incorporated ASC products into their supply chain. The ASC Salmon Standard may partake achieving control and to create public trust, but being a new actor in the market, it remains to see how customer demands evolve. The thesis has used a multidisciplinary approach in reviewing scientific literature and conducting analysis. Few inaccuracies may be the result. All research is desktop-based study with no direct field evaluations. Applicable part of study is therefore assessment of information about aquaculture standards, illustration of their features and value through qualitative and quantitative analysis.

8 CONCLUSION

Aim of research is to analyze and illustrate the content of ASC Salmon Standard, and uncover key features by comparing it to GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standards, and review it in light of an extensive theoretical body concerning aquaculture standards. Ultimately, all research will assess challenges and potential of ASC standard implementation and relate the results to the case company Marine Harvest.

8.1 Addressing the Problem Description

To be a liable global food producer and to counter future challenges with climate change, the aquaculture industry needs effective and sustainable management. This can be achieved by using aquaculture standards based on principles addressing key issues in the industry, and guide companies towards sustainable sound practices. Standards can also manage complexity, thereby reduce costs and energy, and determine trade competitiveness. Proliferation of process standards and certification schemes concerned with sustainable issues has emerged within aquaculture, including the salmon farming industry. Marine Harvest, world largest producer of Atlantic salmon, utilize GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standards, and have recently committed to get 100 percent ASC certified by 2020. ASC Salmon Standard embodies Marine Harvest's ambitions to remain sustainable, and hold a high quantity of control points concerned with environment and social responsibility. The control points cover a broad set of issues relevant in the aquaculture industry, and demand numerical metric and specific values in order to achieve compliance. Compared to GLOBALG.A.P Aquaculture Module and BAP Salmon Farm Standard, it perform above average in environmental and social matters by including indicators for energy consumption, greenhouse gases and strict numbers for escapees. However, according to the analysis the ASC standard score lower in categories such as animal welfare and food safety as it does not specifically address this. Standards of GLOBALG.A.P and BAP contain a larger extent what is regarded as minimum requirements and dependency on local regulation. In this sense, the ASC standard, as the core in ASC certification program, is a strong candidate to increase environmental and social responsible practice in the salmon aquaculture industry and firmly aligns with Marine Harvest's sustainable ambitions. The ASC Salmon Standard is, however, a new component in the food market, and it remains to see how consumers receive it.

8.2 Further research

As a conclusive remark, the thesis would recommend the ASC certification program and associated salmon standard as a viable scheme to address future challenges in term of environmental and social issues, and to guide the salmon aquaculture industry towards sustainable development. Effects of the ASC Salmon Standard could also need analysis in a context broader than the thesis, such as including all control points within the certification scheme, in-situ evaluations or cost-benefit analysis. Methodologies used intended to illustrate and indicate features of the aquaculture standards, not to produce explicit or literal results. For a precise assessment, it would require further research with accurate, in-depth evaluations, making the thesis only a preliminary study.

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APPENDIX A – BENCHMARK WITH EXTERNAL INDICATORS

Comparison on external indicators						
Benchmarking Criteria				**Analysis of Standards**		
A. ENVIRONMENTAL ISSUES				**Total Maximum Score: 66**		
Issue	**Relevancy**	**Indicator**	**Criteria**	**Matching level**	**Score**	**Compliance**
				Applicable Score: 54 (66)		
Use of Natural Resources						
A.1. Energy				**Total Maximum Score: 9**		
A.1.1. Energy Efficiency	Efficiency by which process energy (electricity, fuel, gas, and heat) is converted into final production is a suitable and reliable indicator for sustainable use of energy. Energy efficiency is also relevant for climate protection.	Total Energy Use per Volume of production (e.g. kWh/tons)	Standard establishes and includes measures, guidelines and benchmarks for energy efficiency by defining achievable, acceptable and measurable total energy use per volume of production taking into account all steps of production.	Full	3	ASC
				Medium	2	
				Low	1	GLOBALG.A.P
				No	0	BAP
A.1.2. Source of Energy	Source and type of energy used in the process is of relevance in regard of overall ecological impact of an operation. Non-renewable energies shall be limited and if possible replaced by renewable energies.	Use of renewable energy and limitation for non-renewable energy sources.	Standard promotes the use of renewable energy and mandates a continuous reduction in all non-renewable energy use.	Full	3	
				Medium	2	ASC
				Low	1	GLOBALG.A.P
				No	0	BAP
A.1.3. Greenhouse Gases	Carbon emissions, namely greenhouse gases is one of the root causes for climate change. Aquaculture make a minor but significant contribution to GHG throughout the supply chain, and should be reduced for FAO2013	Energy use assessment and GHG accounting.	Standard require that GHG emissions must be recorded using recognized methods, standards and records.	Full	3	ASC
				Medium	2	
				Low	1	
				No	0	GLOBALG.A.P, BAP
A.2. Feed				**Total Maximum Score: 9**		
A.2.1. Efficiency of Feed Conversion	Aquaculture of fish and crustaceans, specifically of carnivorous species, often result in a net-loss of aquatic animal protein. Reduction in fishmeal use and high efficiency in feed use are important criteria for sustainable aquaculture.	Feed Conversion Efficiency (FCE) or Feed Conversion Ratio (FCR) FCE: ((FCR x % Fishmeal in feed)) + (FCR x % Fish oil in feed)) x CF Low 1 CF: Fish-Meal: 4,5 CF: Fish-Oil: 12	Standard defines species-specific FCE (carnivorous species) and constantly works towards measurable improvement of feed conversion efficiency. Alternatively, limitations of FCR (Feed Conversion Ratio) are defined for each species/cultivation system.	Full	3	ASC, BAP
				Medium	2	
				Low	1	GLOBALG.A.P
				No	0	
A.2.2. Source of Fish-Meal and Fish-Oil	The use of fishmeal / -oil in aquaculture as feed ingredients may directly lead to further depletion pressure on marine resources. Most of the fishmeal used in today's aquaculture originates from industrial fishmeal-fisheries or detrimental by-catch.	Ecological sound procurement source of Fish-Meal and Fish-Oil	Standard restricts fishmeal /-oil to byproducts from fisheries for human consumption (cut-offs and trimmings) or to products from sustainable certified fisheries that are exploiting fish stocks not-suitable for human consumption (e.g. MSC-Certification).	Full	3	ASC, BAP, GLOBALG.A.P
				Medium	2	
				Low	1	
				No	0	
A.2.3. Source of other Feed Ingredients	Other feed ingredients, specifically such intending to substitute fishmeal and -oil (e.g. Soy-Beans) may be produced by environmentally detrimental practices (e.g. large scale deforestation of rain forests).	No use of feed ingredients that are produced by environmentally detrimental practices.	Standard does encompass regulation on the source of feed ingredients and safeguards that no ingredients from environmentally detrimental production practices are used as feedstuffs.	Full	3	ASC
				Medium	2	BAP
				Low	1	GLOBALG.A.P
				No	0	
A.3. Water				**Total Maximum Score: 9**		
A.3.1. Depletion of Freshwater	Freshwater is a key-resource in aquaculture and is worldwide considered one of the most essential natural resources. Aquaculture should not lead to long-term depletion of local freshwater bodies nor be subject to local water use conflicts.	Efficiency of water use and type of freshwater sources	Efficiency measures for water use are encouraged (e.g. definition/reduction of water exchange rate), restriction for water use from non-renewable sources (fossil groundwater) or in case of limited availability of water. Adherence to national legislation.	Full	3	GLOBALG.A.P
				Medium	2	ASC
				Low	1	BAP
				No	0	
A.3.2. Degradation of Freshwater by Salinization	The farming of marine species in terrestrial freshwater habitats may lead to serious degradation and salinization of freshwater bodies and soil by infiltration of saline water.	Prevention measures against salinization	Inland culture of marine species not allowed or clear regulations for inland farming of marine species are defined (e.g. implementation of BMP's to prevent salinization, verification that salinization does not occur). Adherence to national legislation.	Full	3	n.a.
				Medium	2	n.a.
				Low	1	n.a.
				No	0	n.a.
				Full	3	ASC, GLOBALG.A.P

A.3.3. Disturbance of Hydrology	Improper design, construction and operation of aquaculture sites may adversely affect local hydrology and lead to long-term disturbance of natural water bodies (surface and groundwater).	Proper site selection, design, construction and operation of aquaculture farms	Standard encompasses considerations and BMP's for proper site selection, planning, design, construction and operation of aquaculture farms that prevent disturbance of local hydrology (surface and groundwater bodies). Adherence to national legislation.	Medium	2	
				Low	1	BAP
				No	0	
A.4. Land and Soil				**Total Maximum Score: 6**		
A.4.1. Land use	Unplanned, inappropriate and illegal use of location for land-based aquaculture operations may lead to degradation of land, land abandonment and multiple land use conflicts.	Legal, appropriate and efficient use of land taking into account the carrying capacity of a given area for aquaculture activities.	Standard addresses legal use of land, appropriate siting and design of farms / efficient use of land. New aquaculture development needs to address the carrying capacity of a specific area for aquaculture activities. Adherence to national legislation.	Full	3	n.a.
				Medium	2	n.a.
				Low	1	n.a.
				No	0	n.a.
A.4.2. Soil Disturbance and Degradation	Inappropriate farm design and planning, construction and operation may lead to serious soil disturbance and degradation (e.g. erosion, disturbance of soil integrity, salinization)	Proper site selection, design, engineering, construction and operation of land based aquaculture farms	Standard encompasses regulatory measures to prevent soil degradation and erosion (e.g. no construction of farms on sandy soils, prevention of seepage and erosion, minimization of disturbance of acid-sulfate soils). Adherence to national legislation.	Full	3	n.a.
				Medium	2	n.a.
				Low	1	n.a.
				No	0	n.a.
Ecosystem Impacts and Biodiversity						
A.5. Ecosystems and Biodiversity				**Total Maximum Score: 33**		
A.5.1. Habitat Sensitivity and Habitat Conversion	Potential negative impacts of aquaculture operations strongly depend on sitespecific ecological sensitivity of habitats. Habitat damage shall be prevented in the realm of any aquaculture operation.	Exclusion and restrictions for aquaculture operations in highly sensitive habitats. Minimization of detrimental habitat conversion.	No new operations in highly sensitive habitats. Environmental Impact Assessment (EIA) must be conducted in planning phase of any new operation when sensitive areas may be affected. Habitat damage must be prevented. Adherence to national legislation.	Full	3	ASC, GLOBALG.A.P
				Medium	2	
				Low	1	BAP
				No	0	
A.5.2. Deforestation	Large-scale deforestation of sensitive areas (e.g. Mangroves) for installation of aquaculture operations lead to significant disruption of the ecosystems function and local biodiversity loss.	No deforestation of sensitive habitats for aquaculture operations.	Highly sensitive habitats must not be deforested. Limited deforestation of other habitats must be assessed by EIA. Operations on previously cleared sensitive areas might not be accepted and/or are subject to reforestation plan (based on time limit for clear-cutting). Adherence to national legislation.	Full	3	n.a.
				Medium	2	n.a.
				Low	1	n.a.
				No	0	n.a.
A.5.3. Discharge of Effluents	Discharge of farm effluents such as organic matter (solid and dissolved) and nutrients (N+P) cause ecological hazards such as eutrophication, anoxia, benthic habitat disruption and general decrease of water quality in the surrounding water bodies.	Measures to prevent and minimize discharge of organic matter and nutrients. Performance based metrics for acceptable discharge of effluents.	Regulatory measures/performance metrics for prevention/minimization of organic/nutrient effluents by proper operation/treatment/ recycling procedures (feeding, low exchange systems, sedimentation, artificial wetlands). Adherence to national legislation.	Full	3	ASC
				Medium	2	GLOBALG.A.P
				Low	1	BAP
				No	0	
A.5.4. Use, Handling and Discharge of Chemicals and Hazardous Goods	Discharge and/or improper handling of hazardous goods (e.g. chemicals, fuels, lubricants, fertilizers) may lead to multiple detrimental effects through bio concentration or accumulation affecting ecosystems, worker health and final product quality.	Restrictions for toxic and persistent chemicals and measures for proper handling, use and discharge of hazardous goods and chemicals.	Use of toxic / persistent chemicals prohibited (e.g. POP's, TBT, Malachite Green) Proper handling of all hazardous goods mandatory. Use of toxic compounds is limited/regulated and subject to inspections and enforcement. Adherence to national legislation.	Full	3	GLOBALG.A.P
				Medium	2	ASC, BAP
				Low	1	
				No	0	
A.5.5. Introduction of New Species	The introduction of new, non-native species is associated with multiple potential large scale risks for ecosystems.	Restrictions for (new) introduction of non-native species. Preferable use of indigenous species.	New introduction of non-native species not allowed. Products may be certifiable if non-native species are already present in the wild. Preference for indigenous species. Escapes must be prevented (A.5.7.). Adherence to national legislation.	Full	3	ASC, BAP
				Medium	2	
				Low	1	GLOBALG.A.P
				No	0	
A.5.6. Spreading of Pathogens and Parasites into the Wild	Through intensive farming activities, pathogenic organisms and parasites can be spread out into the environment and harm wild populations of farmed species (e.g. Sea Lice, Viral Diseases).	Prevention measures and minimization of spreading of disease and parasites.	Prevention strategies for spreading of diseases / parasites (e.g. closed containment systems, proper site selection, limited stocking densities, physical barriers between culture systems and surrounding environment). Adherence to national legislation.	Full	3	ASC, GLOBALG.A.P, BAP
				Medium	2	
				Low	1	
				No	0	
A.5.7. Escape of cultured Species into the Wild	Cultured species genetically differ from their wild relatives being present in the cultivating habitat. Escaped cultured species may genetically interfere with wild populations threatening long-term survival and genetic diversity.	Prevention measures and minimization of escapes of cultured species into the wild.	The risk of escaped species for wild populations needs to be assessed prior to any operation. If a risk is present, escape prevention strategies need to be implemented to keep escapees on a minimum level. Adherence to national legislation.	Full	3	ASC, BAP
				Medium	2	GLOBALG.A.P
				Low	1	
				No	0	

A.5.8. GMO as cultivated Species	Genetically modified organisms (GMO) used in aquaculture as cultivating species can escape into the wild and may lead to serious multiple ecological hazards.	No GMO as culture species in aquaculture.	The standard excludes the introduction of any kind of genetically modified species for use in aquaculture.	Full	3	ASC, GLOBALG.A.P, BAP
				No	0	
A.5.9. GMO in Feed from Agricultural Crops	Genetically modified organisms (GMO) used as agricultural crops may lead to serious multiple ecological hazards.	No GMO agricultural feedstuffs for aquaculture feed.	The standard excludes plant-derived GMO-feedstuffs for use in aquaculture feed. Feed ingredients such as Enzymes and Vitamins produced by GM microorganisms in contained systems are excluded from this requirement.	Full	3	ASC
				No	0	BAP, GLOBALG.A.P
A.5.10. Brood stock and Seedlings	Sourcing of brood stock / juveniles in the wild can seriously harm the ecosystem if (a) species is over-fished / endangered or (b) harmful extraction method is used (e.g. destructive fishing gear) or (c) if extraction volumes exceeds carrying capacity.	Minimization of dependency on wild brood stocks. Use of domesticated brood stock. No harmful extraction methods.	Dependency on wild caught brood stock is to be minimized. Sourcing in the wild is only allowed if (a) species in not overfished / endangered, (b) no harmful extraction methods are used and (c) if there is no negative effect for wild populations.	Full	3	GLOBALG.A.P
				Medium	2	ASC
				Low	1	BAP
				No	0	
A.5.11. General Impacts on local Wildlife	Aquaculture might have negative impacts on wildlife such as reduction of foraging grounds, disruption of migratory routes and spawning areas, acoustic deterrents, entanglements in nets or cages, regular shooting of birds and/or mammals.	Prevention and minimization measures for negative impacts on local wildlife.	Aquaculture activity must be conducted in a way that preserves natural ecosystem functions. Negative impacts on local wildlife are to prevented and minimized. No lethal measures for predator control. Adherence to national legislation.	Full	3	ASC, BAP
				Medium	2	GLOBALG.A.P
				Low	1	
				No	0	
B. SOCIAL ISSUES				**Total Maximum Score: 12**		
B.1. Labour				**Total Maximum Score: 3**		
B.1.1. Labour Rights	Sustainable aquaculture must encompass social responsibility. International labour rights must be recognized (forced labour, child labour, worker safety and health, discrimination, discipline, working hours, freedom of association, wages).	Compliance with basic internationally acknowledged labour rights and standards.	The standard addresses labour rights on all steps of production incl. processing. Minimum workplace norms of the ILO (International Labour Organization) are mandatory. Certification to SA8000 should be encouraged. Adherence to national legislation.	Full	3	ASC, BAP
				Medium	2	
				Low	1	GLOBALG.A.P
				No	0	
B.2. Community Impacts and Livelihoods				**Total Maximum Score: 9**		
B.2.1. Land Conflicts and Land Rights	Illegal / inappropriate land tenure for aquaculture operations may displace local communities that depend on land for cultivation of crops to sustain their livelihoods, often leading to social conflicts.	Existing community rights and land tenure must be recognized and respected. Conflicts shall be prevented and minimized by consultation and resolution procedures.	Standard recognizes role of community land rights. New operations should be planned involving existing communities, respecting tenures/rights. Operations should not encroach on land that is subject to customary use. Adherence to national legislation.	Full	3	ASC, BAP
				Medium	2	
				Low	1	
				No	0	GLOBALG.A.P
B.2.2. Access to natural Resources and Resource Rights	Local communities depending on subsistence activities may loose access to vital resources for their livelihoods (e.g. water bodies, wetlands, agricultural land or forests) through aquaculture facility and installations.	Access of communities to natural resources must not be prevented. Communities' resource rights must be recognized.	Aquaculture operations must not block or interfere local communities' access to traditional natural resources for subsistence activities. Existing community rights must be acknowledged and respected. Adherence to national legislation.	Full	3	ASC, BAP
				Medium	2	
				Low	1	
				No	0	GLOBALG.A.P
B.2.3.Economic Benefits of Smallholders and Access to Certification Programs	In many areas aquaculture is a traditional activity involving many smallholders. Sustainability does encompass economic profitability and viability and therefore aquaculture certification must also allow smallholder participation and economic benefits.	Smallholders access to certification programs must be allowed and improved. Economic benefits of aquaculture shall be mutually beneficial for all stakeholders and communities.	Standard addresses the issue of economic benefits of smallholders and communities in developing countries and allows/improves/facilitates access to certification program by training and capacity building. Group certification must be allowed.	Full	3	
				Medium	2	
				Low	1	
				No	0	ASC, GLOBALG.A.P, BAP
C. ANIMAL WELFARE AND HEALTH ISSUES				**Total Maximum Score: 18**		
C.1. Animal Welfare				**Total Maximum Score: 9**		
C.1.1. Husbandry System and Handling Procedures	Husbandry systems that do not allow natural expression of species behaviour may lead to higher stress, aggressive behaviour, susceptibility to diseases and mortalities. Excessive handling practices may also induce stress and lead to diseases.	Species specific and adapted husbandry systems. Stress prevention and minimizing strategies in the production process.	Standard foresees husbandry systems allowing expression of natural behaviour and minimizing stress. Over-crowded / artificial non-species adapted conditions should be prevented. Physical disfigurement of cultured species shall not be allowed.	Full	3	BAP
				Medium	2	ASC, GLOBALG.A.P
				Low	1	
				No	0	
C.1.2. Stocking Densities	Excessive, non-species and non-local environment adapted stocking densities may lead to increased stress levels and higher incidence of disease, threatening animal welfare and sustainability of aquaculture.	Stocking densities / performance metrics related to species specific behaviour, stress-reduction, health and local environmental conditions.	Standard defines species-specific stocking densities and/or performance metrics related to natural behaviour, health and site specific environmental conditions. Stocking densities must not threaten specie's health and eco-system integrity.	Full	3	BAP
				Medium	2	ASC, GLOBALG.A.P
				Low	1	
				No	0	
C.1.3. Slaughtering				Full	3	GLOBALG.A.P, BAP

	Improper killing methods increase stress of animals, reduce product quality and may result in decreasing consumer acceptance.	Proper methods and proceedings for killing.	Standard foresees upon harvesting appropriate and instant killing procedures resulting in no further harm and suffering of the animals, allowing maximum product quality and same time safeguarding ethical and animal welfare values.	Medium	2	
				Low	1	
				No	0	ASC
C.2. Disease, Prevention and Medication				**Total Maximum Score: 9**		
C.2.1. Disease Prevention and Biosecurity	Disease outbreaks can be minimized by proper site selection, planning, installation and operation procedures and professional health management during operation. Biosecurity measures should be installed for transportation (e.g. quarantine).	Proper disease prevention, biosecurity measures and an integrated health management plan on all steps of production are essential elements.	Disease prevention and biosecurity measures encompassing proper siting, design, construction and operation including transport of live animals. A health management plan should be mandatory, focusing on prevention rather than on treatment.	Full	3	ASC, GLOBALG.A.P, BAP
				Medium	2	
				Low	1	
				No	0	
C.2.2. Treatment and Medication	Diseases need to be treated professionally without harming the cultured stock, endangering the surrounding ecosystems or threatening food-safety of the final product.	Proper, legal and professional treatment of diseases.	Diseases are handled by professionals or well instructed responsible persons. The standard regulates the use and withdrawal times of pharmaceuticals and defines personal responsibilities and documentation procedures. Adherence to national legislation.	Full	3	ASC, GLOBALG.A.P, BAP
				Medium	2	
				Low	1	
				No	0	
C.2.3. Use of Antibiotics	Inappropriate use of antibiotics in aquaculture may lead to discharge into the environment, leading to buildup of microbial resistances. Antibiotics may be present in final products threatening consumer health / marketability.	Legal use of Antibiotics. No prophylactic use. For treatment of disease only. No use of Antibiotics as growth promoters in feed.	Antibiotics are allowed for treatment of disease only. No use for prophylactic measures / growth promotion. Use of antibiotics has to be prescribed by authorized professionals and strictly regulated and documented. Adherence to national legislation.	Full	3	ASC, GLOBALG.A.P, BAP
				Medium	2	
				Low	1	
				No	0	
D. STANDARDS DEVELOPMENT AND VERIFICATION PROCEDURES				**Total Maximum Score: 45**		
D.1. Standard Development, Governance and Criteria				**Total Maximum Score: 24**		
D.1.1. Procedures for Standard Development and Review Process	Documented procedures for the process under which a standard is developed shall form the basis of all activities of a standard-setting organization.	Documentation of standard development procedures, also applies to regular standard review processes	The standard-setting organization has a documentation / work-flow scheme of the process of standard development and regular review procedures being open to the public and transparent to all interested parties.	Full	3	ASC, BAP
				Medium	2	
				Low	1	GLOBALG.A.P
				No	0	
D.1.2. Stakeholder Involvement, Consultation and Public Review Process	The development process of a standard's regulatory framework should be based on a meaningful multi-stakeholder and consultation process, also including a public review process allowing different interest groups to participate within the process.	Multi-stakeholder involvement and consultation process. Regular public review process.	Standard development / review process has been/is subject to multi-stakeholder involvement/consultation/public review procedures. Standard strives for consensus among a balance of interested parties; no particular group shall dominate/be dominated.	Full	3	ASC
				Medium	2	BAP
				Low	1	GLOBALG.A.P
				No	0	
D.1.3. Openness of Governance	Governance of the standard setting body should be open and transparent in order to allow equal participation of various stakeholder and interest groups on the standards strategic and operational procedures.	Open governance board for various stakeholders and interest groups. Transparent to the public.	Various stakeholder groups (e.g. industry, conservation institutions, research, and market actors) can be part and equally contribute to a standard's governance process, which is being handled in a transparent manner.	Full	3	ASC
				Medium	2	BAP
				Low	1	GLOBALG.A.P
				No	0	
D.1.4. Complaint Resolution during Development and Reviews	The standards development procedures shall contain a complaint resolution mechanism for the impartial handling of any procedural complaints that may occur during process of new development of a standard or during regular review process.	Implementation of a complaint resolution mechanism into the standard's development and review procedures.	The standard's development procedures do encompass a mechanism for complaint resolution, which all interested parties have access to. Resolution mechanism shall apply both to new development of a standard as well as to regular review processes.	Full	3	
				Medium	2	ASC
				Low	1	BAP
				No	0	GLOBALG.A.P
D.1.5. Independency of Standard Creation Body and Standard holding Body	An entity that is operatively managing a certification program should not be directly in charge of the creation and development process of the referring standard.	Firewall between standard creation body and standard holding body.	Standard creation body and standard holding body are not the same entity.	Full	3	ASC, GLOBALG.A.P
				Medium	2	
				Low	1	BAP
				No	0	
D.1.6. Definition and Formulation of	A standard shall be defined and expressed in terms of a combination of process-, management- and performance-	Performance based metrics for key criteria, rather than descriptive and process oriented.	Key criteria in regard of environment are defined by performance-based metrics. Combination of process-, management and performance-oriented criteria.	Full	3	ASC
				Medium	2	GLOBALG.A.P
				Low	1	BAP

Criteria and Performance Metrics	criteria, rather than be mainly descriptive. Environmental key criteria must be metric-based and measurable.			No	0	
D.1.7. Effectiveness, Relevancy and Verifiability	Standard criteria shall effectively contribute to achievement of stated objectives. The criteria therefore should be of relevancy and a standard should provide indicators and benchmarks for constant improvement and effective verifiability.	Relevant and verifiable criteria complemented by objective indicators and benchmarks for improvements.	The standard does encompass most relevant criteria for all key-components under consideration for achievement of the stated objectives. Criteria are verifiable. Indicators and benchmarks are defined for constant improvement.	Full	3	ASC, GLOBALG.A.P
				Medium	2	
				Low	1	BAP
				No	0	
D.1.8. Accessibility and Applicability	Application to, and participation in a certification program shall be broad and open to all potential applicants. Specific focus should be paid on enabling participation of small-scale producers in developing countries.	Open access to standard. Broad applicability of criteria. Suitability for small-scale producers in developing countries. Adaptability to various local conditions.	Standard criteria / participation in certification program is open to all potential applicants. Participation of smallholders is specifically facilitated (e.g. training/capacity building/group certification). Standard can be adapted to local conditions.	Full	3	GLOBALG.A.P
				Medium	2	ASC, BAP
				Low	1	
				No	0	
D.2. Conformity Assessment and Verification				**Total Maximum Score: 15**		
D.2.1. Inspection Bodies	Inspections shall be conducted by independent and officially accredited third party bodies. Inspection bodies directly linked / accredited by the standard holding body itself are not credible and may be biased.	Third party inspection body. Accreditation of Inspection Bodies	Inspection of operations are conducted by officially accredited, independent third party bodies.	Full	3	ASC, GLOBALG.A.P, BAP
				Medium	2	
				Low	1	
				No	0	
D.2.2. Certification Bodies	Certification of products / operations should be conducted by independent third party and officially accredited certification bodies (CB).	Third party certification body. Accreditation of Bodies operating Certification of Products (ISO Guide 65/ISO/IEC 17065)	Certification of products is conducted by independent and officially accredited third party bodies according to ISO Guide 65/ISO/IEC 17065	Full	3	ASC, GLOBALG.A.P, BAP
				Medium	2	
				Low	1	
				No	0	
D.2.3. Inspection Procedures	Inspections should be conducted on a regular basis and not be pre-arranged with the operators / operations subject to inspection. Effective and credible inspections check for compliance on randomly chosen time/date.	Regular inspection frequency (min. annually) on an unannounced basis.	All inspections are conducted regularly (minimum annually) on a random and unannounced basis.	Full	3	ASC, GLOBALG.A.P
				Medium	2	BAP
				Low	1	
				No	0	
D.2.4. Corrective Measures	Producers and farming operations deliberately not following the standards guidelines are threatening the standards credibility, public acceptance and quality / food safety of the product.	Corrective measures and procedures. Complaint resolution process.	The standard defines a system of corrective measures in case of violation of guidelines. Corrective measures, sanctions and procedures are clearly defined and outlined. A mechanism for complaint resolution does exist.	Full	3	BAP
				Medium	2	ASC, GLOBALG.A.P
				Low	1	
				No	0	
D.2.5. Complaint Resolution during Assessment Process	Clients of a certification program as well as different stakeholders directly affected by the operation under certification should have the opportunity for issuing complaints or offering formal comments during the certification process.	Opportunity for comments and complaints by different stakeholders directly affected by the operation.	The standard does provide the opportunity of offering comments and complaints in the realm of ongoing inspection and certification procedures.	Full	3	ASC
				Medium	2	GLOBALG.A.P
				Low	1	
				No	0	BAP
D.3. Subject of Standard and Chain of Custody				**Total Maximum Score: 6**		
D.3.1. Subject of Certification program	An environmental / social aquaculture certification program shall cover all relevant steps of the production process where environmental and social impacts may occur.	All relevant steps of aquaculture production and processing are covered by the standard and subject to inspection and certification.	Certification program covers all relevant steps of production where environmental and/or social impacts may occur. This includes broodstock sourcing, hatcheries, feed mills, procurement of feed ingredients, farms and processing facilities.	Full	3	ASC, GLOBALG.A.P
				Medium	2	BAP
				Low	1	
				No	0	
D.3.2. Chain of Custody	A certification program shall establish a system of guarantee to ensure that certified products will not be mixed with non-certified products or otherwise be manipulated along the supply chain to the final consumer.	Chain of Custody Certification (CoC) for all operators along the supply chain.	All operators along the supply chain must be assessed and CoC-certified for having implemented adequate tracking /handling system to ensure that certified products are not mixed with noncertified products. CoC is subject to annual audits.	Full	3	ASC, GLOBALG.A.P
				Medium	2	
				Low	1	BAP
				No	0	

APPENDIX B – EXTERNAL INDICATOR SCORE

Maximum Score		
Category	**Sub-Category**	**Maximum Score**
A. Environmental Issues	Energy	9
	Feed	9
	Water	6
	Land and Soil	0
	Ecosystem and Biodiversity	30
		54
B. Social Issues	Labour	3
	Community Impact and Livelihoods	9
		12
C. Animal Welfare and Health Issues	Animal Welfare	9
	Disease, Prevention and Medication	9
		18
D. Standard Development and verification procedures	Development, Governance and Criteria	24
	Conformity Assessment and Verification	15
	Standard Subject and Chain of Custody	6
		45

GLOBALG.A.P			
A. Environmental Issues	Score	AS	RS
Energy	2	9	22 %
Feed	5	9	56 %
Water	6	6	100 %
Land and Soil		0	
Ecosystem and Biodiversity	22	30	73 %
Sum	**35**	**54**	**63 %**
B. Social Issues	Score	AS	RS
Labour	1	3	33 %
Community Impact and Livelihoods	0	9	0 %
Sum	**1**	**12**	**17 %**
C. Animal Health and Welfare	Score	AS	RS
Animal Welfare	7	9	78 %
Disease, Prevention and Medication	9	9	100 %
Sum	**16**	**18**	**89 %**
D. Standard Development and verification procedures	Score	AS	RS
Development, Governance and Criteria	14	24	58 %
Conformity Assessment and Verification	13	15	87 %
Standard Subject and Chain of Custody	6	6	100 %
Sum	**33**	**45**	**82 %**

BAP			
A. Environmental Issues	Score	AS	RS
Energy	0	9	0 %
Feed	8	9	89 %
Water	2	6	33 %
Land and Soil		0	
Ecosystem and Biodiversity	20	30	67 %
Sum	**30**	**54**	**47 %**
B. Social Issues	Score	AS	RS
Labour	3	3	100 %
Community Impact and Livelihoods	6	9	67 %
Sum	**9**	**12**	**83 %**
C. Animal Health and Welfare	Score	AS	RS
Animal Welfare	9	9	100 %
Disease, Prevention and Medication	9	9	100 %
Sum	**18**	**18**	**100 %**
D. Standard Development and verification procedures	Score	AS	RS
Development, Governance and Criteria	13	24	54 %
Conformity Assessment and Verification	11	15	73 %
Standard Subject and Chain of Custody	2	6	33 %
Sum	**26**	**45**	**54 %**

ASC			
A. Environmental Issues	Score	AS	RS
Energy	8	9	89 %
Feed	9	9	100 %
Water	5	6	83 %
Land and Soil		0	
Ecosystem and Biodiversity	28	30	93 %
Sum	**50**	**54**	**91 %**
B. Social Issues	Score	AS	RS
Labour	3	3	100 %
Community Impact and Livelihoods	6	9	67 %
Sum	**9**	**12**	**83 %**
C. Animal Health and Welfare	Score	AS	RS
Animal Welfare	4	9	44 %
Disease, Prevention and Medication	9	9	100 %
Sum	**13**	**18**	**72 %**
D. Standard Development and verification procedures	Score	AS	RS
Development, Governance and Criteria	22	24	92 %
Conformity Assessment and Verification	14	15	93 %
Standard Subject and Chain of Custody	6	6	100 %
Sum	**42**	**45**	**95 %**

APPENDIX C – GAP ANALYSIS WORKSHEET

The ASC Criteria		ASC Indicators	Global GAP Standard	New rating	BAP Standards	New rating
Principle 1: comply with all applicable national laws and local regulations	Criterion 1.1 Compliance with all applicable local and national legal requirements and regulations	1.1.1 Presence of documents demonstrating compliance with local and national regulations and requirements on land and water use R: Yes	AB 1.1.1	1.5	BAP 1.1	1.5
			AB 11.2.1	1.5		
		1.1.2 Presence of documents demonstrating compliance with all tax laws R: Yes		0	BAP 1.2	1.5
		1.1.3 Presence of documents demonstrating compliance with all relevant national and local labor laws and regulations R: Yes	AB 1.1.1	1.5	BAP 3.2	1.5
			AB 1.1.2	1.5		
		1.1.4 Presence of documents demonstrating compliance with regulations and permits concerning water quality impacts R: Yes	AB 11.1.1	1.5	BAP 4.1	1.5
			AB 11.1.2	2	BAP 4.2	2
			AB 11.1.3	2	BAP 9.5	0.5

			AB 11.1.4	1.5	BAP 9.8	0.5
The ASC Criteria		**ASC Indicators**	**Global GAP Standard**	**New rating**	**BAP Standards**	**New rating**
Principle 2: Conserve natural habitat, local biodiversity and ecosystem function	Criterion 2.1 Benthic biodiversity and benthic effects	2.1.1 Redox potential or sulphide levels in sediment outside of the Allowable Zone of Effect (AZE), following the sampling methodology outlined in Appendix I-1 R: Redox potential > 0 millivolts (mV) OR Sulphide ≤ 1,500 microMoles / l	AB 10.1.6	1		0
		2.1.2 Faunal index score indicating good to high ecological quality in sediment outside the AZE, following the sampling methodology outlined in Appendix I-1 R: AZTI Marine Biotic Index (AMB) score ≤ 3.3, or Shannon-Wiener Index score > 3, or Benthic Quality Index (BQI) score ≥ 15, or Infaunal Trophic Index (ITI) score ≥ 25		0		0
		2.1.3 Number of macro faunal taxa in the sediment within the AZE, following the sampling methodology outlined in Appendix I-1 R: ≥ 2 highly abundant taxa that are not pollution indicator species		0		0
		2.1.4 Definition of a site-specific AZE based on a robust and credible modeling system R: Yes, within three years of the publication of the ASC Salmon Standard		0		0
	Criterion 2.2 Water quality in and near the site of operation	2.2.1 Weekly average percent saturation of dissolved oxygen (DO) on farm, calculated following methodology in Appendix I-4 R: ≥ 70%	AB 5.2.12	1		0
			AB 13.1.3	0.5		
		2.2.2 Maximum percentage of weekly samples from 2.2.1 that fall under 2 mg/liter DO R: "5%"		0		0
		2.2.3 For jurisdictions that have national or regional coastal water quality targets, demonstration through third-party analysis that the farm is in an area recently classified as having “good” or “very good” water quality R: Yes		0	BAP 4.6	1.5
		2.2.4 For jurisdictions without national or regional coastal water quality targets, evidence of weekly monitoring of nitrogen and phosphorous levels on farm and at a reference site, following methodology in Appendix I-5 R: Yes	AB 10.1.4	1		0
			AB 5.2.12	0.5		
			AB 11.2.1	1.5		
		2.2.5 Demonstration of calculation of biochemical oxygen demand (BOD) of the farm on a production cycle basis R: Yes	AB 10.1.4	1.5		0
	Criterion 2.3 Nutrient release from production	2.3.1 Percentage of fines in the feed at point of entry to the farm (calculated following methodology in Appendix I-2) R: < 1% by weight of the feed		0		0
	Criterion 2.4 Interaction with critical or sensitive habitats and species	2.4.1 Evidence of an assessment of the farm’s potential impacts on biodiversity and nearby ecosystems that contains at a minimum the components outlined in Appendix I-3 R: Yes	AB 10.4.2	0.5	BAP 6.7	1.5
			AB 10.1.4	2	BAP 7.2	1.5
			AB 10.1.5	1	BAP 7.3	1.5
			AB 10.1.6	1	BAP 7.4	1.5
			AB 11.1.3	1.5		
			AB 10.4.5	1.5		
			AB 10.4.6	1.5		
			AB 10.4.7	1.5		
		2.4.2 Allowance for the farm to be sited in a protected area or High Conservation Value Areas (HCVAs) R: None	AB 10.4.1	1.5		0

			AB 10.4.2	2		
			AB 10.4.3	2		
			AB 10.4.4	2		
	Criterion 2.5 Interaction with wildlife, including predators	2.5.1 Number of days in the production cycle when acoustic deterrent devices (ADDs) or acoustic harassment devices (AHDs) were used R: 0, within three years of the date of publication of the ASC Salmon Standard		0		0
		2.5.2 Prior to the achievement of 2.5.1, if ADDs or AHDs are used, maximum percentage of days in the production cycle that the devices are operational R: ≤ 40%		0		0
		2.5.3 Number of mortalities of endangered or red-listed marine mammals or birds on the farm R: 0	AB 10.4.2	0.5		0
		2.5.4 Evidence that the following steps were taken prior to lethal action against a predator: 1. All other avenues were pursued prior to using lethal action 2. Approval was given from a senior manager above the farm manager 3. Explicit permission was granted to take lethal action against the specific animal from the relevant regulatory authority R: Yes	AB 10.2.4	1.5	BAP 7.5	1.5
					BAP 7.6	1.5
		2.5.5 Evidence that information about any lethal incidents on the farm has been made easily publicly available R: Yes		0	BAP 7.7	1
		2.5.6 Maximum number of lethal incidents on the farm over the prior two years R: < 9 lethal incidents, with no more than two of the incidents being marine mammals		0		0
		2.5.7 In the event of a lethal incident, evidence that an assessment of the risk of lethal incident(s) has been undertaken and demonstration of concrete steps taken by the farm to reduce the risk of future incidences R: Yes	AB 10.2.3	1.5	BAP 7.2	1.5
			AB 5.2.9	1	BAP 7.9	1.5
The ASC Criteria		**ASC Indicators**	**Global GAP Standard**	**New rating**	**BAP Standards**	**New rating**
Principle 3: Protect the health and genetic integrity of wild populations	Criterion 3.1 Introduced or amplified parasites and pathogens	3.1.1 Participation in an Area-Based Management (ABM) scheme for managing disease and resistance to treatments that includes coordination of stocking, fallowing, therapeutic treatments and information- sharing. Detailed requirements are in Appendix II-1. R: Yes		0	BAP 10.1	1.5
					BAP 10.12	1.5
					BAP 2.6	1.5
					BAP 2.7	1.5
		3.1.2 A demonstrated commitment to collaborate with NGOs, academics and governments on areas of mutually agreed research to measure possible impacts on wild stocks R: Yes		0	BAP 4.7	1
					BAP 10.11	1
		3.1.3 Establishment and annual review of a maximum sea lice load for the entire ABM and for the individual farm as outlined in Appendix II-2 R: Yes		0		0
		3.1.4 Frequent on-farm testing for sea lice, with test results made easily publicly available within seven days of testing R: Yes		0		0

		3.1.5 In areas with wild salmonids, evidence of data and the farm's understanding of that data, around salmonid migration routes, migration timing and stock productivity in major waterways within 50 kilometers of the farm R: Yes		0		0
		3.1.6 In areas of wild salmonids, monitoring of sea lice levels on wild out-migrating salmon juveniles or on coastal sea trout or Artic char, with results made publicly available. See requirements in Appendix III-1. R: Yes		0		0
		3.1.7 In areas of wild salmonids, maximum on-farm lice levels during sensitive periods for wild fish.46 See detailed requirements in Appendix II, subsection 2. R: 0.1 mature female lice per farmed fish		0		0
	Criterion 3.2 Introduction of non-native species	3.2.1 If a non-native species is being produced, demonstration that the species was widely commercially produced in the area by the date of publication of the ASC Salmon Standard R: Yes		0	BAP 6.8	1.5
		3.2.2 If a non-native species is being produced, evidence of scientific research completed within the past five years that investigates the risk of establishment of the species within the farm's jurisdiction and these results submitted to ASC for review R: Yes, within five years of publication of the ASC Salmon Standard		0		0
		3.2.3 Use of non-native species for sea lice control or on-farm management purposes R: Yes		0		0
	Criterion 3.3 Introduction of transgenic species	3.3 Use of transgenic salmon by the farm R: None	AB 2.2.2	1.5	BAP 6.8	0.5
	Criterion 3.4 Escapes	3.4.1 Maximum number of escapees in the most recent production cycle R: 300		0		0
		3.4.2 Accuracy of the counting technology or counting method used for calculating stocking and harvest numbers R: ≥ 98%		0.5		0
		3.4.3 Estimated unexplained loss of farmed salmon is made publicly available R: Yes	AB 10.3.1	0.5	BAP 6.6	0.5
			AB 10.1.4	0		
		3.4.4 Evidence of escape prevention planning and related employee training, including: net strength testing; appropriate net mesh size; net traceability; system robustness; predator management; record keeping and reporting of risk events (e.g., holes, infrastructure issues, handling errors, reporting and follow up of escape events); and worker training on escape prevention and counting technologies R: Yes	AB 5.7.2	2	BAP 6.3	1.5
			AB 5.7.3	1.5		
			AB 5.11.1	1.5		
			AB 10.3.3	1.5		
			AB 10.3.4	1.5		
			AB 10.2.1	1		
			AB 10.2.2	1.5		
			AB 10.2.3	1.5		
The ASC Criteria		**ASC Indicators**	**Global GAP Standard**	**New rating**	**BAP Standards**	**New rating**
Principle 4: Use resources in an environmentally efficient and responsible manner	Criterion 4.1 Traceability of raw materials in feed	4.1.1 Evidence of traceability, demonstrated by the feed producer, of feed ingredients that make up more than 1% of the feed. R: Yes		0	BAP 5.2	1.5
					BAP 5.4	1
					BAP 5.5	1.5

					BAP 5.6	1.5
Criterion 4.2 Use of wild fish for feed	4.2.1 Fishmeal Forage Fish Dependency Ratio (FFDRm) for grow-out (calculated using formulas in Appendix IV- 1) R: 1.35		0		0
	4.2.2 Fish Oil Forage Fish Dependency Ratio (FFDRo) for grow-out (calculated using formulas in Appendix IV- 1), OR Maximum amount of EPA and DHA from direct marine sources (calculated according to Appendix IV-2) R: FFDRo < 2.95 or (EPA + DHA) < 30 g/kg feed		0		
Criterion 4.3 Source of marine raw materials	4.3.1 Timeframe for all fishmeal and fish oil used in feed to come from fisheries certified under a scheme that is an ISEAL member and has guidelines that specifically promote responsible environmental management of small pelagic fisheries R: < 5 years after the date of publication of the ASC Salmon Standard		0		0
	4.3.2 Prior to achieving 4.3.1, the FishSource score, for the fishery(ies) from which all marine raw material in feed is derived R: All individual scores ≥ 6, and biomass score ≥ 8		0		0
	4.3.3 Prior to achieving 4.3.1, demonstration of third-party verified chain of custody and traceability for the batches of fishmeal and fish oil which are in compliance with 4.3.2. R: Yes		0		0
	4.3.4 Feed containing fishmeal and/or fish oil originating from by-products or trimmings from IUU catch or from fish species that are categorized as vulnerable, endangered or critically endangered, according to the IUCN Red List of Threatened Species R: None	AB 8.1.2	1.5		0
Criterion 4.4 Source of non-marine raw materials in feed	4.4.1 Presence and evidence of a responsible sourcing policy for the feed manufacturer for feed ingredients that comply with recognized crop moratoriums and local laws R: Yes	AB 8.2.1	0.5	BAP 5.1	0.5
		AB 8.2.2	0.5		
		AB 8.2.3	2		
		AB 8.2.4	2		
	4.4.2 Percentage of soya or soya-derived ingredients in the feed that are certified by the Roundtable for Responsible Soy (RTRS) or equivalent R: "100%", within five years of the publication of the ASC Salmon Standard		0		0
	4.4.3 Evidence of disclosure to the buyer of the salmon of inclusion of transgenic plant raw material, or raw materials derived from transgenic plants, in the feed R: Yes, for each individual raw material containing > 1% transgenic content		0		0
Criterion 4.5 Non-biological waste from production	4.5.1 Presence and evidence of a functioning policy for proper and responsible treatment of non-biological waste from production (e.g., disposal and recycling) R: Yes	AB 10.1.1	1.5	BAP 8.1	1.5
		AB 10.1.2	1.5		
		AB 10.1.4	1.5		
	4.5.2 Evidence that non-biological waste (including net pens) from grow-out site is either disposed of properly or recycled R: Yes	AB 10.1.1	0.5		0
		AB 10.1.2	0.5		
		AB 10.1.4	1		
		AB 5.3.8	1		

	Criterion 4.6 Energy consumption and greenhouse gas emissions on farms	4.6.1 Presence of an energy use assessment verifying the energy consumption on the farm and representing the whole life cycle at sea, as outlined in Appendix V- 1 R: Yes, measured in kilojoule/mt fish/production cycle	AB 10.1.4	1		0
		4.6.2 Records of greenhouse gas (GHG) emissions on farm and evidence of an annual GHG assessment, as outlined in Appendix V-1 R: Yes	AB 10.1.4 AB 10.1.5	0.5 1		0
		4.6.3 Documentation of GHG emissions of the feed used during the previous production cycle, as outlined in Appendix V, subsection 2 R: Yes, within three years of the publication of the ASC Salmon Standard		0		0
	Criterion 4.7 Non-therapeutic chemical inputs	4.7.1 For farms that use copper-treated nets, evidence that nets are not cleaned or treated in situ in the marine environment R: Yes		0	BAP 8.1	1.5
		4.7.2 For any farm that cleans nets at on-land sites, evidence that net-cleaning sites have effluent treatment R: Yes	AB 5.7.2	1.5	BAP 8.1	1
					BAP 8.10	1
		4.7.3 For farms that use copper nets or copper-treated nets, evidence of testing for copper level in the sediment outside of the AZE, following methodology in Appendix I-1 R: Yes		0	BAP 4.1	1
					BAP 4.6	1
		4.7.4 Evidence that copper levels are < 34 mg Cu/kg dry sediment weight OR in instances where the Cu in the sediment exceeds 34 mg Cu/kg dry sediment weight, demonstration that the Cu concentration falls within the range of background concentrations as measured at three reference sites in the water body R: Yes		0		0
		4.7.5 Evidence that the type of biocides used in net antifouling are approved according to legislation in the European Union, or the United States, or Australia R: Yes		0		0
The ASC Criteria		**ASC Indicators**	**Global GAP Standard**	**New rating**	**BAP Standards**	**New rating**
Principle 5: Manage disease and parasites in an environmentally responsible manner	Criterion 5.1 Survival and health of farmed fish	5.1.1 Evidence of a fish health management plan for the identification and monitoring of fish diseases and parasites R: Yes	AB 2.3.4	2	BAP 10.3	1.5
			AB 5.2.1	2		
			AB 5.2.2	2		
			AB 5.2.3	2		
			AB 5.2.4	2		
			AB 5.2.5	1.5		
			AB 5.2.13	2		
			AB 13.1.1	1		
			AB 13.1.2	2		

		5.1.2 Site visits by a designated veterinarian at least four times a year, and by a fish health manager at least once a month R: Yes	AB 5.2.3	2	BAP 10.1	1
		5.1.3 Percentage of dead fish removed and disposed of in a responsible manner R: "100%"	AB 5.6.1	1		0
			AB 5.6.3	1		
		5.1.4 Percentage of mortalities that are recorded, classified and receive a post-mortem analysis R: "100%"	AB 13.2.3	1		0
			AB 5.6.2	1		
		5.1.5 Maximum viral disease-related mortality on farm during the most recent production cycle R: ≤ 10%		0		0
		5.1.6 Maximum unexplained mortality rate from each of the previous two production cycles, for farms with total mortality > 6% R: ≤ 40% of total mortalities		0		0
		5.1.7 A farm-specific mortalities reduction program that includes defined annual targets for reductions in mortalities and reductions in unexplained mortalities R: Yes		0		0
	Criterion 5.2 Therapeutic treatments	5.2.1 On-farm documentation that includes, at a minimum, detailed information on all chemicals and therapeutants used during the most recent production cycle, the amounts used (including grams per ton of fish produced), the dates used, which group of fish were treated and against which diseases, proof of proper dosing, and all disease and pathogens detected on the site R: Yes	AB 3.1.1	1.5	BAP 8.4	0.5
			AB 10.1.4	1.5	BAP 10.10	1
			AB 5.4.1	2	BAP Traceability	1
			AB 5.4.2	1.5		
			AB 5.4.3	1.5		
			AB 5.3.2	2		
			AB 5.3.4	1.5		
		5.2.2 Allowance for use of therapeutic treatments that include antibiotics or chemicals that are banned in any of the primary salmon producing or importing countries R: None	AB 5.3.1	1.5	BAP 11.1	1.5
		5.2.3 Percentage of medication events that are prescribed by a veterinarian R: "100%"	AB 5.3.3	1.5	BAP 10.4	1.5
			AB 5.2.3	1.5		
		5.2.4 Compliance with all withholding periods after treatments R: Yes	AB 5.4.1	1.5	BAP 10.4	1.5
			AB 5.4.2	1.5		
		5.2.5 Maximum farm level cumulative parasiticide treatment index (PTI) score as calculated according to the formula in Appendix VII R: PTI score ≤ 13		0		0
		5.2.6 For farms with a cumulative PTI ≥ 6 in the most recent production cycle, demonstration that parasiticide load is at least 15% less that of the average of the two previous production cycles R: Yes, within five years of the publication of the ASC Salmon Standard		0		0
		5.2.7 Allowance for prophylactic use of antimicrobial treatments R: None	AB 5.3.6	1.5		0
		5.2.8 Allowance for use of antibiotics listed as critically important for human medicine by the World Health Organization (WHO) R: None	AB 5.3.3	0		0

		5.2.9 Number of treatments of antibiotics over the most recent production cycle R: ≤ 3		0		0
		5.2.10 If more than one antibiotic treatment is used in the most recent production cycle, demonstration that the antibiotic load is at least 15% less that of the average of the two previous production cycles R: Yes, within five years of the publication of the ASC Salmon Standard		0		0
		5.2.11 Presence of documents demonstrating that the farm has provided buyers of its salmon a list of all therapeutants used in production R: Yes	AB 5.3.5	2	BAP Traceability	1.5
	Criterion 5.3 Resistance of parasites, viruses and bacteria to medicinal treatments	5.3.1 Bio-assay analysis to determine resistance when two applications of a treatment have not produced the expected effect R: Yes	AB 5.2.3	0.5		0
		5.3.2 When bio-assay tests determine resistance is forming, use of an alternative, permitted treatment, or an immediate harvest of all fish on the site R: Yes		0		0
	Criterion 5.4 Biosecurity management	5.4.1 Evidence that all salmon on the site are a single year class R: "100%"		0		0
		5.4.2 Evidence that if the farm suspects an unidentifiable transmissible agent, or if the farm experiences unexplained increased mortality, the farm has: 1. Reported the issue to the ABM and to the appropriate regulatory authority 2. Increased monitoring and surveillance on the farm and within the ABM. Promptly made findings publicly available R: Yes	AB 13.2.1	0.5	BAP 10.5 BAP 10.8	1 1
		5.4.3 Evidence of compliance with the OIE Aquatic Animal Health Code R: Yes	AB 5.2.5	1.5		0
		5.4.4 If an OIE-notifiable disease is confirmed on the farm, evidence that: 1. the farm has, at a minimum, immediately culled the pen(s) in which the disease was detected 2. the farm immediately notified the other farms in the ABM 3. the farm and the ABM enhanced monitoring and conducted rigorous testing for the disease 4. the farm promptly made findings publicly available R: Yes	AB 5.2.5	1		0
The ASC Criteria		**ASC Indicators**	**Global GAP Standard**	**New rating**	**BAP Standards**	**New rating**
Principle 6: Develop and operate farms in a socially responsible manner	Criterion 6.1 Freedom of association and collective bargaining	6.1.1 Evidence that workers have access to trade unions (if they exist) and union representative(s) chosen by themselves without managerial interference R: Yes		0	BAP 3.4	1.5
		6.1.2 Evidence that workers are free to form organizations, including unions, to advocate for and protect their rights R: Yes		0	BAP 3.4	1.5
		6.1.3 Evidence that workers are free and able to bargain collectively for their rights R: Yes		0		0
	Criterion 6.2 Child labor	6.2.1 Number of incidences of child labor R: None		0	BAP 3.3	1
		6.2.2 Percentage of young workers that are protected R: "100%"		0		0
	Criterion 6.3 Forced, bonded or compulsory labor	6.3.1 Number of incidences of forced, bonded or compulsory labor R: None		0	BAP 3.3	1.5
	Criterion 6.4 Discrimination	6.4.1 Evidence of comprehensive and proactive anti-discrimination policies, procedures and practices R: Yes		0		0
		6.4.2 Number of incidences of discrimination R: None		0		0
		6.5.1 Percentage of workers trained in health and safety practices, procedures and policies on a yearly basis R: "100%"	AB 4.1.1	0.5	BAP 3.8	1.5

			AB 4.1.2	0.5	BAP 3.9	1.5
		6.5.2 Evidence that workers use Personal Protective Equipment (PPE) effectively R: Yes		0	BAP 3.8	1.5
	Criterion 6.5 Work environment health and safety	6.5.3 Presence of a health and safety risk assessment and evidence of preventive actions taken R: Yes	AB 4.2.3	0.5	BAP 3.26	1
			AB 4.1.2	1.5		
		6.5.4 Evidence that all health- and safety-related accidents and violations are recorded and corrective actions are taken when necessary R: Yes		0		0
		6.5.5 Evidence of employer responsibility and/or proof of insurance (accident or injury) for "100%" of worker costs in a job-related accident or injury when not covered under national law R: Yes		0	BAP 3.5	0.5
		6.5.6 Evidence that all diving operations are conducted by divers who are certified R: Yes	AB 4.2.3	2	BAP 3.14	1.5
	Criterion 6.6 Wages	6.6.1 The percentage of workers whose basic wage (before overtime and bonuses) is below the minimum wage R: 0 (None)		0	BAP 3.1	1
		6.6.2 Evidence that the employer is working toward the payment of basic needs wage R: Yes		0		0
		6.6.3 Evidence of transparency in wage-setting and rendering R: Yes		0		0
	Criterion 6.7 Contracts (labor) including subcontracting	6.7.1 Percentage of workers who have contracts R: "100%"		0		0
		6.7.2 Evidence of a policy to ensure social compliance of its suppliers and contractors R: Yes		0	BAP 3.26	2
	Criterion 6.8 Conflict resolution	6.8.1 Evidence of worker access to effective, fair and confidential grievance procedures R: Yes		0	BAP 3.4	1.5
		6.8.2 Percentage of grievances handled that are addressed within a 90-day timeframe R: "100%"		0		0
	Criterion 6.9 Disciplinary practices	6.9.1 Incidences of excessive or abusive disciplinary actions R: None		0		0
		6.9.2 Evidence of a functioning disciplinary action policy whose aim is to improve the worker R: Yes		0		0
	Criterion 6.10 Working hours and overtime	6.10.1 Incidences, violations or abuse of working hours and overtime laws R: None		0		0
		6.10.2 Overtime is limited, voluntary, paid at a premium rate and restricted to exceptional circumstances R: Yes		0		0
	Criterion 6.11 Education and training	6.11.1 Evidence that the company encourages and sometimes supports education initiatives for all workers (e.g., courses, certificates and degrees) R: Yes		0		0
	Criterion 6.12 Corporate policies for social responsibility	6.12.1 Demonstration of company-level policies in line with the requirements under 6.1 to 6.11 above R: Yes		0		1.5
The ASC Criteria		**ASC Indicators**	**Global GAP Standard**	**New rating**	**BAP Standards**	**New rating**
Principle 7: Be a good neighbor and conscientious citizen	Criterion 7.1 Community engagement	7.1.1 Evidence of regular and meaningful consultation and engagement with community representatives and organizations Yes R: Yes		0	BAP 2.3	2
		7.1.2 Presence and evidence of an effective policy and mechanism for the presentation, treatment and resolution of complaints by community stakeholders and organizations Yes R: Yes		0	BAP 2.4	1.5

		7.1.3 Evidence that the farm has posted visible notice at the farm during times of therapeutic treatments and has, as part of consultation with communities under 7.1.1, communicated about potential health risks from treatments R: Yes		0	BAP 2.1	1.5
					BAP 2.2	1.5
	Criterion 7.2 Respect for indigenous and aboriginal cultures and traditional territories	7.2.1 Evidence that indigenous groups were consulted as required by relevant local and/or national laws and regulations Yes R: Yes		0	BAP 2.5	1.5
		7.2.2 Evidence that the farm has undertaken proactive consultation with indigenous communities Yes R: Yes		0		0
		7.2.3 Evidence of a protocol agreement, or an active process to establish a protocol agreement, with indigenous communities R: Yes		0		0
	Criterion 7.3 Access to resources	7.3.1 Changes undertaken restricting access to vital community resources without community approval None R: None		0	BAP 2.1	1.5
		7.3.2 Evidence of assessments of company's impact on access to resources R: Yes		0	BAP 7.3	0.5

APPENDIX D – COVER RATE GAP

BAP				
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
1	1-1.1	1.29	1.50	85.7 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
2	2-2.1	0.00	1.50	0.0 %
	2-2.2	0.30	1.50	20.0 %
	2-2.3	0.00	1.50	0.0 %
	2-2.4	1.20	1.50	80.0 %
	2-2.5	0.78	1.50	51.9 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
3	3-3.1	0.73	1.50	48.5 %
	3-3.2	0.50	1.50	33.3 %
	3-3.3	0.50	1.50	33.3 %
	3-3.4	0.50	1.50	33.3 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
4	4-4.1	1.50	1.50	100.0 %
	4-4.2	1.00	1.50	66.7 %
	4-4.3	0.00	1.50	0.0 %
	4-4.4	0.17	1.50	11.1 %
	4-4.5	0.75	1.50	50.0 %
	4-4.6	0.00	1.50	0.0 %
	4-4.7	0.79	1.50	52.4 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
5	5-5.1	0.36	1.50	23.8 %
	5-5.2	0.65	1.50	43.6 %
	5-5.3	0.00	1.50	0.0 %
	5-5.4	0.40	1.50	26.7 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
6	6-6.1	1.00	1.50	66.7 %
	6-6.2	0.50	1.50	33.3 %
	6-6.3	1.50	1.50	100.0 %
	6-6.4	0.00	1.50	0.0 %
	6-6.5	1.07	1.50	71.4 %
	6-6.6	0.33	1.50	22.2 %
	6-6.7	1.00	1.50	66.7 %
	6-6.8	0.75	1.50	50.0 %
	6-6.9	0.00	1.50	0.0 %
	6-6.10	0.00	1.50	0.0 %
	6-6.11	0.00	1.50	0.0 %
	6-6.12	1.50	1.50	100.0 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
7	7-7.1	1.63	1.50	108.3 %
	7-7.2	0.50	1.50	33.3 %
	7-7.3	1.00	1.50	66.7 %

GLOBALG.A.P.				
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
1	1-1.1	1.44	1.50	96.3 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
2	2-2.1	0.25	1.50	16.7 %
	2-2.2	0.75	1.50	50.0 %
	2-2.3	0.00	1.50	0.0 %
	2-2.4	1.50	1.50	100.0 %
	2-2.5	0.56	1.50	37.5 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
3	3-3.1	0.00	1.50	0.0 %
	3-3.2	0.00	1.50	0.0 %
	3-3.3	1.50	1.50	100.0 %
	3-3.4	1.08	1.50	72.2 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
4	4-4.1	0.00	1.50	0.0 %
	4-4.2	0.00	1.50	0.0 %
	4-4.3	0.38	1.50	25.0 %
	4-4.4	0.83	1.50	55.6 %
	4-4.5	1.07	1.50	71.4 %
	4-4.6	0.63	1.50	41.7 %
	4-4.7	0.30	1.50	20.0 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
5	5-5.1	1.32	1.50	88.2 %
	5-5.2	1.18	1.50	78.9 %
	5-5.3	0.25	1.50	16.7 %
	5-5.4	0.75	1.50	50.0 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
6	6-6.1	0.00	1.50	0.0 %
	6-6.2	0.00	1.50	0.0 %
	6-6.3	0.00	1.50	0.0 %
	6-6.4	0.00	1.50	0.0 %
	6-6.5	0.63	1.50	41.7 %
	6-6.6	0.00	1.50	0.0 %
	6-6.7	0.00	1.50	0.0 %
	6-6.8	0.00	1.50	0.0 %
	6-6.9	0.00	1.50	0.0 %
	6-6.10	0.00	1.50	0.0 %
	6-6.11	0.00	1.50	0.0 %
	6-6.12	0.00	1.50	0.0 %
Principle	**Criterion**	**Cover rate**	**Applicable Score**	**Relative Score**
7	7-7.1	0.00	1.50	0.0 %
	7-7.2	0.00	1.50	0.0 %
	7-7.3	0.00	1.50	0.0 %

APPENDIX E – EXAMPLE PRIVATE STANDARDS SALMON FARMING[3]

Market	Type	Institution	Standard title	Description	F-Q/S	A-W/H	R/E	S/E	T
Global	S, SC, L	Aquaculture Stewardship Council (ASC)	ASC Salmon Standard	The goal of the ASC Salmon Standard is to credibly offer measurable, performance-based requirements that minimize or eliminate the key negative environmental and social impacts of salmon farming, while permitting the industry to remain economically viable.	Yes	Yes	Yes	Yes	
Global	S, SC, L	Bio Gro, New Zealand	Module 6 - Aquaculture Production Standard	Contain requirements and audit criteria for the certification of and licensing by BioGro of aquaculturists to use the BioGro trademarks and logos. This module covers aquatic plants and fish grown in any form of enclosures such as ponds, tanks and cages, or in open sea or fresh water aquaculture farms using ropes, frames, and other defined areas.	Yes	Yes	Yes Organic		
Europe	S, CS, L	Bioland, Germany	Bioland Standards	The standards explain in detail the application of the organic biological methods of farming, the conversion to this method of operation and enable inspection of the cultivation defined according to the standards to be executed.	Yes	Yes	Yes Organic		
Global	S, SC, L	Carrefour	Filière Qualité Carrefour - FQC	It has to be: (1) safe and healthy; (2) authentic-tasting; (3) economic progress; (4) environmentally correct; and (5) socially correct.	Yes		Yes	Yes	
Global	S, C, G	Codex Alimentarius	CAC/RCP 54-2004	Code of Practice for good animal feeding	Yes	Yes			
Norway, Europe	S, CS, L	Debio	Organic Aquaculture Standards	The organic production is based on a general view including the organic, economic and social sides of the production, both in a local and a global view. Organic aquaculture must be operated in such a way that the marine environment will be a positive part of the nature.	Yes	Yes	Yes Organic	Yes	Yes
Europe	C	Federation of European Aquaculture Producers (FEAP)	FEAP code of conduct	A Code of Conduct for European Aquaculture. Promotes the responsible development and management of a viable European aquaculture sector in order to assure a high standard of quality food production while respecting environmental considerations and consumers' demands.	Yes	Yes	Yes	Yes	
Global	S, CS, L	Global Aquaculture Alliance (GAA) - Best Aquaculture Practice (BAP)	BAP Salmon Farm Standards	Farms shall comply with local and national laws and environmental regulations, and provide current documentation that demonstrates legal rights for land use, water use, construction, operation and waste disposal.	Yes	Yes	Yes	Yes	
Global	G	Global Food Safety Initiative Foundation (GFSI)	The GFSI Guidance Document	The GFSI Guidance Document specifies the process by which food safety schemes may gain recognition through specifying the benchmarking process and requirements for the Management of Schemes and scheme scope and key elements.	Yes				
Global	S, SC, L	Global Trust	Certified Quality Salmon (CQS): Eco-Standard	Standards aiming to assist members to demonstrate and prove their commitment to environmental sustainable development and conservation when producing and processing farmed salmon.			Yes		
Global	S, CS	GLOBALG.A.P	Aquaculture Base Module	The GLOBALG.A.P. Aquaculture Standard sets criteria for legal compliance, for food safety, worker occupational health and safety, animal welfare, and environmental and ecological care.	Yes	Yes	Yes	Yes	
Global	S, SC	International Featured Standards (IFS)	IFS Food Standard version 6	Standard for auditing food safety and quality of processes and products of food manufacturers. It concerns food processing companies or companies that pack loose food products.	Yes				
United Kingdom, Europe	S, L	International Federation of Organic Agriculture Movements (IFOAM)	IFOAM Basic Standards for Organic Production and Processing	Covers the areas of general organic management, crop production (including plant breeding), animal production (including beekeeping), aquaculture, wild collection, processing and handling, labeling, and social justice.	Yes	Yes	Yes Organic	Yes	
Global	S, SC	International Fishmeal and Fish Oil Organization (IFFO)	Global Standard for Responsible Supply of Fishmeal and Fish Oil (IFFO RS)	To demonstrate to all stakeholders the commitment to responsible practice in areas of feed safety, raw material procurement and delivery.	Yes	Yes			
Global	C	International Social and Environmental Accreditation and Labelling Alliance (ISEAL)	The Standard-Setting Code	Primarily function is to make application to standards fulfil social, environmental and economic policy objectives.			Yes	Yes	
Global	S	International Standardization Organization (ISO)	ISO 12878:2012	Environmental monitoring of the impacts from marine finfish farms on soft bottom			Yes		Yes
Sweden, Europe	S, SC, L	KRAV	KRAV Standards: Aquaculture	KRAV-certified aquaculture encompasses cultivation of species of animals and plants in freshwater, brackish water and salt water as well as transportation and slaughter of these species.	Yes	Yes	Yes Organic		
France, European Union	S, SC, L	Label Rouge	Label Rouge	The rural code (Art. L 641-1) specifies that: "the red label certifies that these commodities and products have specific characteristics establishing a level of superior quality, including those that result from their particular conditions of production or manufacturing and conform to a specification, that distinguish them from the foods and similar products usually marketed ".	Yes				

[3] Category: F-Q/S = Food Safety/Quality A-W/H = Animal Welfare/Health R/E = Risk/Environment S/E = Social/Ethical T = Technical
Type: S = Standard C = Code G = Guideline CS = Certification Scheme L = Label

Global	S, SC	Marine Aquarium Council (MAC)	Mariculture and Aquaculture Management (MAM) International Performance Standard	To ensure that the mariculture and aquaculture management systems used by culturing organizations are based upon best practices that ensure that organisms are maintained in optimal health throughout the complete culturing process and that potential environmental and social impacts are mitigated.		Yes	Yes	Yes	
Australia, Global	S, C, L	National Association for Sustainable Agriculture, Australia (NASAA)	NASAA Organic Standard	Organic agriculture is a holistic system built upon natural ecological processes. It values the welfare of both the producer and the consumer of organic food and fibre products, and is committed to conserving natural resources for the benefit of all future generations.	Yes	Yes	Yes Organic		
Germany, Europe	S, CS, L	Naturland	Naturland Standards for Organic Aquaculture	Based on fundamental principles of organic agriculture, to provide a framework, as organic agriculture cannot function based on mere regulations. Dictated by the core fundamental principles of certified organic agriculture: the obligation to treat the elementary basics of our lives with prudence and responsibility.	Yes		Yes Organic	Yes	
Global	S, L CS	Safe Quality Food (SQF)	SQF 1000 Code	Provides for the Primary Producer a food safety and quality management certification program, tailoring their needs. It enables them to meet product trace, regulatory, food safety and commercial quality criteria in a structured and cost effective manner.	Yes				
Scotland, Global	C, L	Scottish Salmon Producers' Organization (SSPO), Code of Good Practice (CoFGP)	The Code of Good Practice for Scottish Finfish Aquaculture (CoGP)	To focus Government and public services on creating a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth.	Yes	Yes	Yes		
United Kingdom, Global	S, L	Soil Association	Soil Association organic standards: aquaculture	Standards for organic production and processing. More specified this document cover the organic production of farmed fish, including both finfish and shellfish.	Yes	Yes	Yes Organic	Yes	
Norway	S	Standard Norge	NS 9410:2007	Environmental monitoring of benthic impact from marine fish farms.	Yes		Yes		Yes
Global	S	Swiss Bio-Foundation	AquaGAP Standard For Good Aquaculture Practices	The aim of this standard is to improve aquaculture practices and bring more sustainable seafood products to the market.	Yes	Yes	Yes	Yes	
Europe	S, L	The Norwegian Industry Standards for Fish	Quality grading of farmed salmon	Describes quality grading of farmed salmon, salmo salar, in the categories Superior, Ordinary and Production.	Yes				
Global	S	The Occupational Health and Safety Advisory Services (OHSAS) Project Group	SN-BS OHSAS 18001:2007	Occupational Health and Safety Zone. To help organizations to control occupational health and safety risks.				Yes	
United Kingdom, Global	S	The Royal Society for the Prevention of Cruelty to Animals (RSPCA)	RSPCA Welfare Standards for Farmed Atlantic Salmon	Developed to represent 'best practice' in the care and welfare of commercially farmed Atlantic salmon at all stages of their lives.		Yes	Yes		
United States, Europe	S, SC, L	Whole Foods Market (WFM)	Quality Standards for Farmed Seafood: Salmon, Other Finfish, and Shrimp	Specify minimum requirements and expectations for all producers supplying or seeking to supply farmed seafood to Whole Foods Market.	Yes		Yes		
Global	S	World Organization for Animal Health (OIE)	The OIE Aquatic Animal Health Code	Sets out standards for the improvement of aquatic animal health and welfare of farmed fish worldwide, including through standards for safe international trade in aquatic animals and their products.	Yes	Yes	Yes		