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Public vs. Private Governance in the Norwegian Aquaculture: Can the ASC Supplement or Supplant the Public Regulations?

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Master's Thesis in International Fisheries Management | FSK-3910 | November 2020

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List of abbreviations

ASC	Aquaculture Stewardship Council
DoF	The Fisheries Directorate
EEA	European Economic Area
EFTA	European Free Trade Association
FAO	Food And Agriculture Organization Of The United Nations
FFSU	Fish Farmers Sales Union
GDP	Gross Domestic Product
IDH	Sustainable Trade Initiative
ISA	Infectious Salmon Anemia
IUCN	International Union for Conservation of Nature
IMR	Norwegian Institute of Marine Research
ISEAL	International Social and Environmental Accreditation and Labeling
ISO/ IEC	International Organization for Standardization
LADIM	Salmon Lice Particle Transport Model
MAB	Maximum Allowable Biomass
MTIF	Ministry of Trade, Industry and Fisheries
MFC	The Ministry of Fisheries and Coastal Affairs
NGO	Non-Governmental Organization
NFFA	Norwegian Fish Farmers Association

NSMD	Non-State Market-Driven
OECD	Economic Co-operation and Development
PD	Pancreas Disease
ROMS	Regional Ocean Model System
SINTEF	Stiftelsen for Industriell og TEknisk Forskning
TLS	The Traffic Light System
USAID	United States Agency for International Development ()
UN	The United Nations
WECD	World Commission on Environment and Development
WACOSS	Western Australia Council of Social Services ()
WTO	World Trade Organization
WP	White Paper
WWF	World Wide Fund for Nature

1 Introduction

It is predicted that by the year 2050, the world population will reach 9.8 billion (UN, 2017). The need for fish as a good source of nutrition is also increasing. Total global aquaculture production is now exceeding the global capture fisheries production by over 18.32 million tons (FAO,2019). This increasing demand for aquatic animals as human food, limited marine captured fisheries, and the continuous development of biological knowledge altogether bring the opportunity to farm domesticate finfish species (Harache,2002). The range of species that the global aquaculture industry produces is diverse, and It ranges from unicellular Chlorella algae produced with the help of indoor bioreactors to the production of carnivorous Atlantic salmon in outdoor floating net cages (FAO 2019). As aquaculture is growing, various environmental, economic, and social concerns have been arising. These concerns include pollution, feeding practices, disease management and antibiotic use, habitat use, non-native species, food safety, fraud, animal welfare, impacts on traditional wild fisheries, access to water and space, market competition, and genetics (Anderson et al., 2019). Addressing these concerns requires proper management systems in place.

The early development of the Norwegian aquaculture industry started in the 1970s and continued to grow so swiftly that aquatic animals' export value exceeded 65 billion NOK by 2016 (Norwegian Seafood Council, 2017). The industry now has been operating with the vision of representing a five-fold increment of the total production volume (5 million tons) by the year 2050 (Furuset, 2017, Olafsen et al., 2012, NSC, 2017). The Norwegian aquaculture industry is providing significant social and economic benefits to the nation. However, unlike the global aquaculture scenario, there are concerns about its wide-ranging impacts on the environment and ecology. Genetic disturbance and diseases that can be transferred to the wild stocks by the escaped farmed fish or the ingestion of contaminated wastage are some examples that can have negative impacts on the ecosystem (Fernandes and Read, 2001). Although the industry is compatible with handling most of the fish diseases and emissions, controlling some other factors like salmon lice and its impact on wild stocks, escapes, or fish mortality are still challenging. (Nofima, SINTEF Ocean and BarentsWatch, 2020).

Although environmental issues are dominant, there are social and economic concerns increasing too. Conflict among different users for the same space, risk related to the workplace are some of the social challenges that the industry has been facing. However, the

social benefits being driven by the industry by creating job opportunities or paying taxes are, to an extent, offsetting negative social and economic impacts (Nofima, SINTEF Ocean and BarentsWatch, 2020).

To pave a sustainable way to reach the 2050 goal, a practical and suitable governance system must be exercised. Now, governance is not as simple as it sounds as it does not deal only with those things that governors do; rather, it represents the interactions between the governing bodies and those to be governed and thus, governance can be defined as an interaction itself (Kooiman, 2003). Governance can either be public or be private (Kooiman, 2003). Due to the increasing criticisms raised by science and NGOs against public governance for putting less effort than required, private governance (like the ASC or the MSC) is becoming increasingly influential in setting up and governing sustainable practices (Foley 2012). However, international certification schemes are not free from criticisms for being too generic and considering necessary local conditions as required.

The Norwegian aquaculture industry has been governed by a combination of various acts and management systems. Among others, the Traffic Light System (TLS) is the newly introduced technology that came into effect on the 30th of October 2017 and is dedicated to aquaculture and regulates the production capacity of the Atlantic Salmon (Michaelsen, 2019). The system's three core aspects are the production zoning, environmental indicator (salmon lice), and the adjustment of production zones' production capacity based on action rule with threshold values (Michaelsen, 2019). On the other hand, the Aquaculture Stewardship Council (ASC), established in 2010 as a third-party independent certification scheme, is also working as a private governing body in the industry (The ASC, 2019). With eight principles and more than 150 indicators, this hybrid governance is, in some cases, challenging the public governmental policies (Vince, 2017). Although the Norwegian public governance and ASC have similarities and dissimilarities and are working in the same industry together, the necessity to compare, coordinate, and improve the interplay between them is not sufficiently explored.

This paper examines the roles of the public and private governance systems in the Norwegian aquaculture industry to understand if the ASC as a market-driven governance system can

supplement or supplant the public governance systems. To answer the main research question, below sub-questions will be addressed:

- Examining the Norwegian public legislation to regulate the aquaculture industry sustainably.
- Examining the development of ASC as a private governance system in the industry.
- Compare and contrast between the ASC and the Norwegian public regulations to identify the similarities and dissimilarities between them.
- And finally, based on the answers to the questions mentioned above, the paper will discuss if the ASC can fill up the gaps/supplement/ supplant the public governance system in Norwegian aquaculture industry.

2 Background:

Chinese aquaculturist S. Y. Lin noted that the aquaculture started some time during the period of 2000–1000 B.C. This claims the history of aquaculture to be as old as 4000 years (FAO, 1988). The period of 1960s can be considered as the period when aquaculture embraced the near future, more and more species were introduced, and the industry started to expand both in area and quantity (FAO, 1988). This chapter of the paper discusses the development of aquaculture from a global and a Norwegian perspective. The latter part explains the challenges associated with this industry that have impacts on the pillars of sustainability.

2.1 Aquaculture development in an international setting:

The development scenario was a bit different between the western part of the world, and Asia or Africa. Countries in Asia and Africa had many aquatic plants and animals produced and sold in local marketplaces. Thousands of skilled and expert laborers were engaged and

dependent on aquaculture for their living, but the farming technique were quite simple and traditional (FAO,1988).

By that time, the western world had fewer aquatic species, the rainbow trout, for example, was being farmed initially in Denmark and then started spreading over Europe (Nash, 2010). In the late 60s, Atlantic Salmon farming became possible in Europe in floating cages, which was an innovative fish farming idea imported from Japan. There was an insignificant number of people with expertise in fish farming, but political interests led to massive investments in aquaculture research and development. The result was several new production technologies and technical improvements. The only problem was the lack of sufficient producers to get the best advantage of these products. However, the demand was evolving overseas, and there was a need to bridge the gap between the developed and developing world (Nash, 2010).

The period of Bridging the Gap took place in the 1960s and 1970s. The U.S. Peace Corps and the British Voluntary Service started sending field technical ambassadors to Overseas countries (Nash, 2010). Furthermore, research, education, and trainings on aquaculture were being supported by western bilateral assistance organizations. The Rockefeller Foundation and the Oceanic institution realized the need for development and production of aquaculture in Oceania, and formed The International Centre for Living Aquatic Resource Management. The United Nations Food and Agriculture Organization started organizing meetings throughout the period. Awareness and knowledge started to increase among universities, institutions, and investors as new journals and books on aquaculture were more available. Another revolution in this period was the development of aquaculture insurance by Paddy Secretan (Nash, 2010).

As the wild salmon stock went down due to overfishing, Atlantic salmon became rare and expensive. Then in the 1960s, Japanese floating cage concept formed an ideal environment to develop fish farms in Norwegian fjords. Within ten years, the industry became efficient enough to produce its first significant volume of hundred tones of salmon. The production reached four thousand tons in 1980 and to 140 thousand tons in 1990 (Nash, 2010).

By the end of 1960, the lead in the Asian market was taken by Japan. They started rearing captured wild fry of yellowtail tuna until they became grown enough to sell. These wild fries usually were kept in floating enclosures, and trash fish was used as feed. The production

increased so rapidly that by the year 1985, their production reached to 150 thousand tons (Nash, 2010). However, the first species that was artificially reproduced from captive broodstock was the Japanese bream.

After 15 years of research, hatchery technology grew so far that seabass, seabream, and turbot juvenile became readily available, and started to spread throughout the Mediterranean basin. By the year 2000, the production reached ten thousand tons (Nash,2010).

Since the beginning of its industrialization in 1970, aquaculture is dominating the global aquatic food product market, especially in Asia. Over 95 percent of global aquaculture production being realized in developing countries. This region holds an average annual production rate growing by 5.89 percent since 2010, whereas the growth rate in America is 5.45 percent, in Europe 2.27 percent, and in the African continent is two percent per annum. China is leading the aquaculture by producing 64.36 million tons, equivalent to 57.5 percent of total global production.

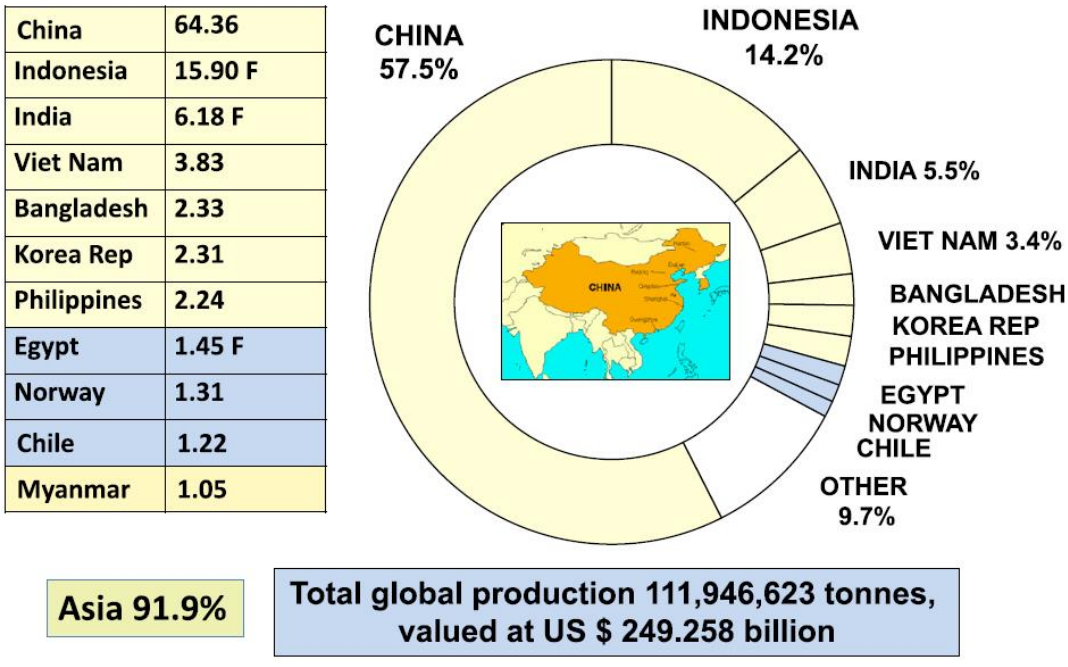


Figure: Country-wise aquaculture production in 2017: value in a million metric tons (FAO 2019)

Fish was the primary aquatic products in the world with a production of 53.4 million tons in 2017, valued at $139.7 billion. The annual growth rate of fish from 2000 to 2017 was 5.7 percent per year. Total production consists of 208 different species, including freshwater carps and cyprinids (53.1percent), miscellaneous freshwater fish (19.5percent), tilapia and other cichlids (11.0percent), salmonids (6.5percent), and other coastal fishes (2.8percent) (FAO, 2019).

Reported crustacean's production in the year 2017 was 8.4 million tons. The growing rate of this aquatic product since 2010 is 9.92percent. There were around 30 different kinds of crustaceans reported to be produced with a value of $61.06 billion. As reported, the top crustacean species by value was the white leg shrimp (US$26.7 billion).

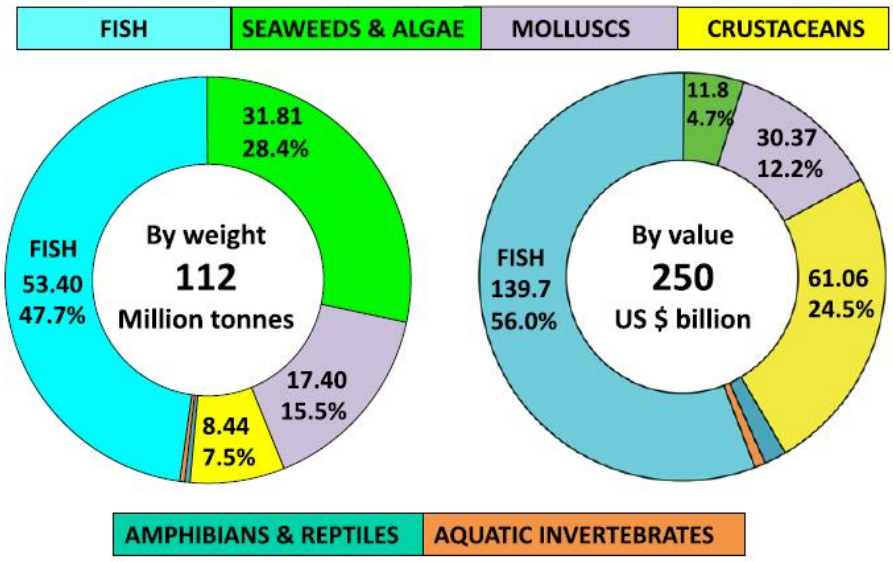


Figure: Global production based on significant species groups in 2017: Value in a million metric tons and $ billion (FAO 2019)

Developing countries are the fastest-growing aquatic food production sector. However, these countries' aquaculture sectors largely depend on imported raw materials to produce food for their fish and crustaceans. The management and the government effort should be more focused on locally available food supply to ensure this sector's long-term economic sustainability (FAO, 2020).

2.2 Developments in Norwegian aquaculture since the 1970s

Norwegian fisheries and their contribution to the economy are quite old. The northern part of Norway was engaged with exporting dried cod and herring to England since the 12th century (Sahrhage, 1992). During the 14th to 16th century, Bergen and Trondheim started trading salted and dried fish and became essential business centers for northern Norway and other European countries. In the 18th century, Finnmark and Lofoten became crucial for the sector for their cod fisheries (Haaland & Svihus, 2011). Atlantic Salmon aquaculture industry, being around 40-50 years old, can be considered as comparatively new. Since the beginning of its aquaculture industry in the 1960s, Norway has been playing the role of a pioneer (Nash, 2010).

The period between 1970 – 1989 is the early development period of the industry. In this period, the industry started mass production using a vast area than before. The sea pen became cheaper to produce and was easier to maintain. During this period, few other significant events were happening. One was the establishment of the Norwegian Fish Farmers Association (NFFA) to cooperate and guide the fish farmers and act to as a liaison between the industry and the authority. Another one was the appointment of the Lysø Committee by government in 1972 (Michaelsen, 2019). Within a year, the committee felt the need to establish a licensing system that resulted in the provisional act on "Construction, equipment, establishment, and expansion of facilities for hatching eggs and fish farming" (Hovland et al., 2014). Another important event in this period was the establishment of the Fish Farmers Sales Union (FFSU) in 1978. The first permanent Aquaculture act was passed in 1981 (Michaelsen, 2019). However, this act went through several modifications until 1985 due to its changes and the massive resistance against this (Michaelsen, 2019).

The Period between 1990 – 2010 can be considered as the period of industrialization and sustainability (Hovland, et al., 2014). A change in the Act of 1985 took during this period. The restriction for a person/ company to have majority ownership in multiple licenses was removed in 1991 . Another important event was the establishment of the state-owned Norwegian Seafood Council. Norway became a member of the European Economic Area (EEA) and European Free Trade Association (EFTA), which brought the opportunity of free access to the European Market. This period is vital for Norwegian Aquaculture as this was

when the government decided to shift its management focus towards a more technical, sustainable, and scientific knowledge-based system (Hovland, et al., 2014).

The industry was introduced with the Food Act in 2003 and with the Food Security Authorities in 2004 (Hovland, et al., 2014). This year is important as several standards to operate the aquaculture industry effectively were introduced during this period. Another important year of this period is 2005 as the 1996 feeding quota was replaced with two types of MAB (Maximum Allowable Biomass) as the new management tool in this year (Hovland, et al., 2014). In 2006, the 1985 farming act was replaced with the Aquaculture Act. More focus was also given to fish health and disease prevention. During this period, the lack of suitable space for fish farming started to increase. The possibility of conflict between the fish farmers and the recreational fishermen increased as the two groups were using the same area and were competing for the same resource (Hovland, et al., 2014).

In 2010, the government felt the necessity to develop a new management system that can be more predictable and can address the scarcity of suitable areas for big fish farms. The Gullestad committee was appointed by the government at that time with the mandate to come up with suggestions on the efficient utilization of the coastal zone for the aquaculture industry and also to suggest a new management system that could make the aquaculture industry more sustainable. After a year of work, the committee presented its report in 2011 with three major and a few other suggestions. The three significant suggestions were: dividing the coastal zone into several self-containing production areas, developing indicators to address the industry's issues, and the last one was not to allocate new licenses to fish farms until the new management system was established (Hovland, et al., 2014).

Starting from the presentation of the report till October 2017, some crucial events took place. One was the establishment of indicators and rules based on environmental factors that lead to technical regulations by The Ministry of Trade, Industry and Fisheries (MTIF) in 2012. In 2013, MTIF allocated 45 licenses among three groups through a round called ¨Green concession round¨. Another concession round was announced in 2015 which was, a signal from the government on the new management system. (DoF, 2017). The White Paper (WP) number 16 named "Predictable and environmentally sustainable growth in Norwegian salmon and trout farming" was delivered by the ministry during 2014-2015 (Michaelsen, 2019).

After the delivery of the report, the management put their full effort into designing and introducing the new management system. The new management system name as ¨The Traffic Light System¨ was approved and came into effect on the 30th of October 2017(Michaelsen, 2019).

2.3 Challenges in Aquaculture

Aquaculture is an integral part of the solution to provide food to the growing number of populations worldwide. However, it is not free from the challenges to operate the industry sustainably. From a holistic point of view, the aquaculture industry has been facing several sustainability challenges. Some of the challenges for example are, planning as an integrated part of other fields like agriculture, choosing the species to farm and balancing their impact on the environment, and maximizing the economic benefits for people keeping the environmental impacts in mind (Kooiman et al., 2005).

2.3.1. Environmental challenge:

Along with the production growing high, Norwegian aquaculture has also been facing substantial environmental issues. There are four potential direct threats that the industry causes to the ecosystem: 1) diseases and parasites, 2) environmental pollution, 3) genetic and other threats to wild and farmed salmon stocks, and 4) impacts on other species through releasing nutrients and protein to the fjords (Bailey, 2014).

Escapement of farmed fish from net pens is one of the direct environmental impacts brought by aquaculture. Escaped fish from the farms can have many ecological impacts on wild stock through competition, predation, hybridization, or spreading diseases. (Olaussen, 2018). Study estimates that in the Norwegian rivers, around 14-36 percent of the Atlantic salmon population comprises farmed salmon, and the figure can be up to 80 percent for some rivers (Bailey, 2014). The farmed salmon can cultivate diseases like infectious salmon anemia (ISA) or pancreas disease (PD), and when escaped, can spread them to the wild stock (Bailey, 2014). Escaped Genetically modified salmon, on the other hand, are risky too: 1) they can compete with wild fish for resources, 2) they can introduce parasites or diseases to the wild population, and 3) they can cause genetic interactions with the wild stock (Ahlbeck-Bergendahl, 2019).

Another major environmental issue that has been faced by the industry is the sea lice. Recent study indicates that the exchange of sea lice among farmed and wild stock is extensive in the regions where farms are densely located (Fjørtoft et al., 2017). Farms tend to use chemicals and medicinal treatments to cope up with sea lice problems. Treatments can be a solution to one issue but can be reasons to several other environmental impacts. These drugs mix with the seawater and negatively impact the crustaceans and other fish populations. The treatment is expensive and increases production costs for the farm. The excessive use of antibiotics to prevent and cure diseases by the farm can severely impact the fish's defense system against disease. However, the medicinal treatments in Norwegian aquaculture farms are under control. Apart from the medicinal release for the sea lice treatment, farms also release nutrition and protein (leftovers of fish feed and fish feces) to the fjords that cause eutrophication stimulating organic production. The result is excessive algae bloom, and, in some cases, reduced or depleted oxygen level in local water is equivalent to the release of sewage from about 10 million people (Olaussen, 2018).

The indirect impact of the industry on the environment is another crucial part of the story; the resources used (as fish feed and others), transportation, and consumption associated with production can also have negative environmental footprints (Winther et al, 2009).

2.3.2. Social challenges:

The industry, without any doubt, is responsible for creating job opportunities for society. According to the Norwegian Seafood Federation & Norwegian Seafood Council, the industry itself was responsible for providing around 22 thousand job opportunities countrywide. The concern is if the quantity and the quality of the work are sufficient, and how these jobs would impact the greater community. In 2012, the industry's number of direct jobs was as much as 4,605 throughout the nation, pretty much the same as it was in 1994 (Bailey, 2012).

The benefits of the job being offered by the industry are not even equally distributed. Most jobs related to production, transportation, feed, and equipment are centrally located and not accessible for smaller communities. Additional jobs like research and development funded by the industry and the state also not provide much benefits to the smaller and marginal communities. The number of companies used to produce 80 percent of salmon was 70 in 1997 and dropped 22 in 2012. The reason for this significant decline was mostly because of

consolidation. The same trend is being followed by slaughtering and processing facilities due to the automated and robotized technologies taking over (Bailey, 2014).

The process and plan related to aquaculture pens' placement cause conflicts among different interest parties, including recreational fishers, the tourism industry, and local groups. The industry also invites cultural issues. Handsome monthly wages ensure a better lifestyle, change the living pattern, and cause shifts in traditional lifestyles. This can also attract labor from other occupations causing the sector skilled labor shortage. Younger generations become comfortable to leave their traditional occupation behind and seek jobs in the industry, In some cases, immigrants can arrive to take up jobs and act as elements that transform local communities (Bailey, 2014).

2.3.3. Economic challenges:

Total quantity produced and farmed salmon value have a steady increment over recent decades. Current trends and future plans also show that the industry does not have any challenge to attract more investment. Instead, it is a more lucrative investment platform than other alternatives (Marine Harvest 2012: 15). However, the question about the industry being enough economically sustainable still exists. The industry is doing well at the national level in Norway. The total production value was leaped to 5 billion dollars in 2011 from about 757 million in 1990 (FAO 2014). Despite of a little dip in 2012, its average results show a steady increment since 2008. According to FAO statistics, the same development was prominent in the Chilean industry until 2007, when it was devastated due to the ISA (Infectious Salmon Anemia) virus outbreak. This incident is a clear suggestion that not all kinds of farms can be competitive or sustainable in the long run.

2.4. Governing the Challenges:

Salmon aquaculture is a mixed picture of positive and negative consequences. Further exploration of the picture provides the idea of trade-offs and the industry's choices to continue farming more sustainably. The trade-offs can be environmental-economic, or socio-economic, or environmental-social. The political system's fundamental role is to provide mechanisms to the municipalities to make rational choices of available alternatives (Matzdorf & Müller, 2010).

There must be some decision-making structures that can guide the industry in a sustainable direction, and these structures should be figured out and nurtured. Firstly, democracy is vital

at the national level as it allows local people to voice their concerns about the environment and their livelihood. On the other hand, the regulations guiding the industry should be followed by stakeholders at all levels. Second, civil society has more power to influence the negotiations among key stakeholders of the industry now. The most prominent example is the series of eight roundtables held by WWF initiated in 2004 that brought NGOs, scientists, and other key stakeholders together and developed production standards for aquaculture standards (Bailey, 2014). Third, WWF and NGOs have a strong influence on the key retail companies and consumer choices. This indirectly influences producers as well as the market to have direct influences on producers. Poor production practices can lead to economic loss or damage to the firms' reputation due to the market or health authorities' exclusion. Fourth, there are international organizations and agreements (FAO's code of conduct for aquaculture, for instance) who develop and promote principles and are the result of complex negotiation among states. These agreements open the avenue for the regulation authorities, scientists, and stakeholders to provide inputs to operate the industry sustainably. All these mechanisms bring together all the stakeholders related to the industry who exchange information and knowledge required to achieve sustainability (Bailey, 2014).

3 Theoretical Framework

The following section will outline the theoretical framework used in this thesis. First part discusses the theory of Sustainability and sustainable development, pillars of sustainability and how they interrelated with aquaculture. The later part talks about governance, whereas the last part is dedicated to provides a better understanding about indicators as tool of governance.

3.1 Sustainability and Sustainable development

The history of sustainability is as old as human civilization. Human being has been dependent and dominating the nature for their needs since the earliest civilization till today. Using the natural resources changes their composition and sometimes causes decline. Thus, sustainability can be defined as

> *the process of people maintaining change in a homeostasis balanced environment, in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations* (Bossel, 2008).

The term sustainability is broad and challenging to define precisely in modern days (Lackey, 1995). The word sustainability meant using natural and renewable resources that people can continue to rely on for their yields in the long term (World Ocean Review, 2019). .The principle of Natural Resource Management focuses on the equilibrium of nature and argues that species and resources, within their system, should be kept in balance to achieve sustainability. However, Modern use of the word sustainability is quite complicated, originally came from forestry, and means using renewable natural resources only that can be relied on for their long-term yields (Environment and Society Portal, 2019).

Sustainability is a widely used word in many fields and principles. According to the Systems Thinking principle, sustainability can be defined through three interconnected pillars: environmental, economic, and social (Seibert, 2018). From the sociological point of view, sustainability entails the way humans should use dynamic natural resources, and decides if the species dependent on nature shall be well managed. Or else, their capacity to provide us services shall be destroyed, which in the long run, can unleash dangerous dynamics of nature (Seibert, 2018)

The modern conception of sustainability is integrated with development: 'sustainable development is development that meets the present's needs without compromising future generations' ability to meet their own needs' (Keeble & Brian, 1988). This definition by the commission was a shift of sustainability from the limited socio-economic constructions towards the interaction with the dynamics of nature (Murphy, 2012).

Being modified by IUCN by the year 1991, this became the most used definition of sustainability:' to improve the quality of life while living within the carrying capacity of ecosystem' (Agyeman, 2003). However, these definitions by WECD and IUCN did not discuss two fundamentally important issues: justice and equity.

Two different trends have been stemmed from the debate of sustainability. One is hard/strong sustainability and weak/ soft sustainability (Seidler, 2009). Hard or strong sustainability strongly prohibits the drawing down of the renewable resources faster than they can be restocked again. On the other hand, soft or weak sustainability allows the depletion of specific resources if there exists the chance of their substitution by something else over time. This implies that natural resources can convert to manufactured resources of the same value (Seidler, 2009).

Sustainability is thus, more of a political than a technical construct as it represents a belief in the needs of societies, and there are many interpretations of what sustainability might be and how societies might make progress toward it (Agyeman & Evans, 2004).

While sustainability refers to maintaining human-ecosystem equilibrium, the term Sustainable Development holds a broader approach. The idea of sustainable development started getting more attention during the twentieth-century environmental movements, but the modern concept is derived mostly from the Brundtland Report in 1987. As stated earlier, sustainable development was defined by WECD in 1987 as: 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' This concept aims to provide social and economic benefits to the present and future generations and protect the environment and natural resources. Thus, this development concept represents itself as a set of principles to guide the present generation to fulfill their needs in an environmentally sustainable way without hampering the future generation's ability to meet their own needs (WECD, 1987).

However, this concept was criticized for its contradictory nature and lacking a clear solution. The reason is the approach does not show any limit to growth; neither does it offer any suggestion on balancing the continued economic growth against the necessity of the conservation of natural resources in practice (Purvis and Grainger, 2004). Beder (1994), Hunter (1997), and Bugge (2002) also state that the term sustainable development is economic growth-oriented, and humans need centered and mostly aims to address human need rather than be concerned about nature first.

3.2 The Pillars of Sustainability

The concept of sustainability is integrated with three fundamental components: environment, society, and economy. This concept reflects that development should consider human, natural, and economic components simultaneously. However, balancing all three sustainability pillars can be challenging as each of them involves different types of values that are not directly relative to each other (Hansmann, Mieg, & Frischknecht, 2012).

The 'pillars' can be presented through a display below. This is a way to visualize sustainability with Planet, People & Society, and Profit & Economy, all supporting sustainability.

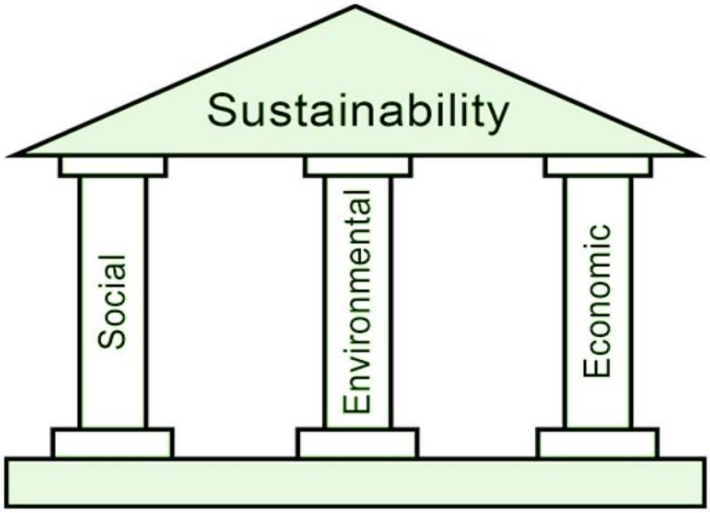


Figure: Pillars or Sustainability (Sustainability Definition, 2020)

The pillar of sustainability that most often gets more attention is the environmental pillar. Without the presence of healthy ecosystems, the environmental pillar of sustainability cannot be maintained. A healthy ecosystem is also crucial as humans and all other living organisms are dependent on them for their survival. This dependence on nature for survival or living is not free of charge and negatively impacts the ecosystem. According to Daly (1990), there are two significant ways to reduce the negative impacts on nature caused by humans' natural resource utilization; first, environmental management and second, human demand management. The environmental management approach largely depends on the information accrued from earth science, environmental science, and conservation biology. However, this management alone cannot be enough, as this can be affected by indirect factors caused by

human consumption. So, the second approach, management of resource consumption by humans, is more important. Management of human demand for resources largely depends on the information gained from economics. According to Daly, ecological sustainability has three broad criteria: renewable resource needs to provide a sustainable yield, there should be equivalent development of renewable substitute in case of non-renewable resources, and lastly, waste generation should not exceed the assimilative capacity of the environment (Daly,1990).

The next pillar is economic sustainability, which is concerned with the present generation undertaking principles to avoid hampering the future generation to enjoy the consumption of wealth, utility, or welfare. Economic sustainability is gained through the interaction between the social and ecological consequences of economic activities (Daly & Cobb, 1989, 1994). Economic sustainability is ¨a broad interpretation of ecological economics where environmental and ecological variables and issues are necessary but part of a multidimensional perspective. Social, cultural, health-related, and monetary/financial have to be integrated into the analysis¨ (Söderbaum, 2008). In today's corporate world, we must practice fair trade, debt eradication, or ensuring equity to ensure economic development and sustainability at the same time (Liu, 2003).

The third pillar of sustainability is social sustainability, which deals with the human-environment interaction and requires social development without harming the environment. The Western Australia Council of Social Services (WACOSS) states that: "Social sustainability occurs when the formal and informal processes; systems; structures; and relationships actively support the capacity of current and future generations to create healthy and liveable communities (Partridge, 2014). Socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life." McKenzie defines the social pillar of sustainability as "a positive condition within communities, and a process within communities that can achieve that condition." (Hajirasouli & Kumarasuriyar, 2016). His definition of the social pillar of sustainability provides a list of principles that include but are not limited to equity to access critical services, equity between generation political participation of citizens, or community ownership. On the other hand, Nobel Laureate Amartya Sen provides six dimensions of the social pillar of sustainability: equity, diversity, social cohesions, quality of life, democracy and governance, and maturity (Sen,2013).

3.3 Sustainability in aquaculture:

As discussed in previous chapters, aquaculture is the fastest-growing food-producing sector in the world and plays a vital role in several ways. Firstly, the sector has been providing nutritional dietary benefits and increasing food security for the rising population. Also, it is helping to maintain a safe and natural level of wild fish stocks. Fish farming is a way to feed their population and a source of export income for many developing countries. It creates job opportunities and increases the standard of living. According to FAO, sustainability in aquaculture consists of four significant aspects: economic viability, environmental integrity, social license, and technical feasibility (Hishamunda, Ridler & Martone, 2014). To respond positively to the ecosystem, it is operating in, aquaculture should use natural resources in a manner that does not lead to ecosystem degradation. The ways to address social impacts on society caused by the industry are to create job opportunities for the local community, increase the quality of life, and to respect local culture. The industry shall also be technically feasible with its inputs adapted to local conditions, which means expanding the aquaculture industry should adopt technological advancement to limit its impact on the environment (Hishamunda, Ridler & Martone, 2014).

Despite all social and economic benefits that aquaculture is bringing in, there are concerns about its environmental impacts. Those impacts on the environment hampers sustainability and are wide-ranging. The effluents, such as medications and pesticides generated by the production process, can have unwanted wild population effects. Genetic disturbance and diseases can be transferred to the wild stocks by the escaped farmed fishes, or the ingestion of contaminated wastage can negatively impact the ecosystem (Fernandes et al., 2001). The increasing demand for the farmed fish feed also has pressure on wild fish stock.

Norwegian research institutes Nofima AS and SINTEF Ocean AS, together with BarentsWatch, have been working on a research project on sustainability in the Norwegian aquaculture. The project's view is to make the environmental, economic, and social sustainability facts more accessible to the Norwegian aquaculture users. As stated on their website, the Norwegian aquaculture industry has reasonable control over emissions and diseases caused by bacterial infection. However, diseases caused by viruses and amoebic gill

diseases are still challenging. Escapement of farmed fish from the cages, sea lice and its impact on wild stocks, and rate of fish mortality also few other matters of concern.

What Nofima AS and SINTEF states about economic sustainability is that the industry includes but is not limited to costs associated with production and fish feed, profitability, and contribution to GDP. The costs associated with the production were on the rise between 2012-2017, but since 2018, the costs started to drop slightly. The industry's profit and its regular contribution to GDP play an important role in Norwegian economic growth.

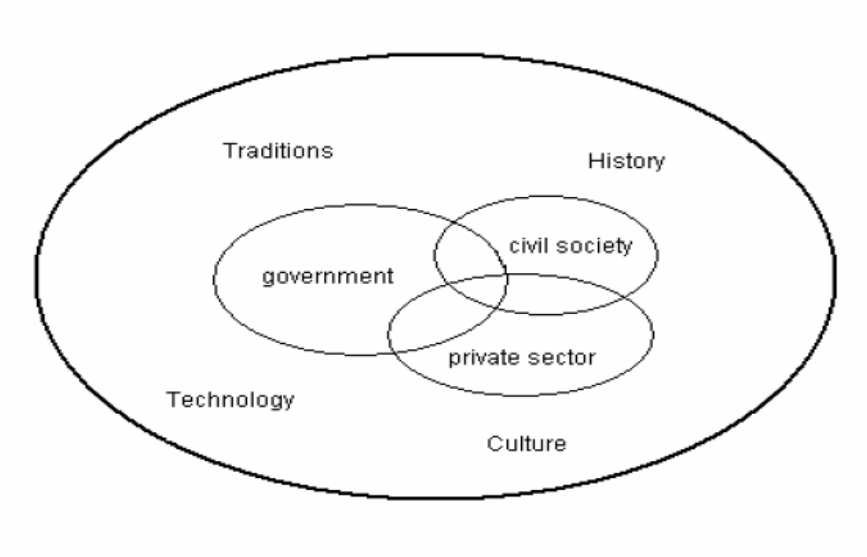
In Norway, community development and social conditions are also being impacted by the industry – both positively and negatively. Farms need ample space to construct marine plants, and the allocation of the space can be conflicting due to the existence of more than one user with different interests. Also, the farming facilities are still among the riskiest workplaces in Norway where the risk can be of minor injury, serious injury, or even death. However, the positive impacts of the industry in Norwegian social conditions are also plenty. The industry has been creating job opportunities, paying taxes that all together improving the citizens' living standards (Nofima, SINTEF, and BarentsWatch).

3.4 Governance: Public and Private

Governance is the society's function to set and manage the rules to guide the making and implementation of policy. Governance is a vast concept and exists everywhere, such as households, villages, municipalities, nations, regions, or the globe (Mimicopoulos et al, 2007). Depending on the disciplinary perspective, the term governance can take different definitions. Whatever the point of view is, governability is not only those that governors do; instead, it comprises all the interactions between the governing bodies and those governed. Governance is thus an interaction itself (Kooiman, 2007). The United Nations considers good governance an essential element of Millennium Development Goals as good governance can develop a framework that fights poverty and inequality.

Now, based on inherent diversity in national traditions and public cultures, governance can take different forms. It is possible to isolate governance into three different categories. Firstly,

governance can be Political or public, authority belongs to the state governance, or public sector. The Public sector can be defined as "activities that are undertaken with public funds, whether within or outside of core government, and whether those funds represent a direct transfer or are provided in the form of an implicit guarantee" (Dooren, 2006). The second form, the Economic Governance, is the one that belongs to the private sector. This type of governance is engaged with an organizational mechanism necessary to produce and distribute goods and services. The final governance system is social governance, whose authority belongs to the civil society that includes citizens of a country and NGOs. This governance has a direct relationship with the systems, values, and beliefs that form social behavior. These three aspects of governance can be illustrated as follows:



Types of governance: Source: Mimicopoulos et al., 2007, p3

Social governance provides a moral foundation, while economic governance provides a material foundation, and political governance guarantees the order and the cohesion of a society (Mimicopoulos, 2003). Thus, it is easily understandable that these three kinds of governance are inter-dependent in a society. So governance shall not be limited to public governance only. Considering these three actors are equally important, governance can be defined as the process whereby a society makes essential decisions, determines whom they involve, and how they render account (Graham, Amos, Plumptre 2003).

3.5 Public Governance:

Rhodes defines governance from a public policy perspective and articulates that governance is a self-organizing, inter-organizational network characterized by interdependence, resource exchange, and regulated by rules of the game (Rhodes, 1997). Jan Kooiman, on the other hand, defines governance as the whole of the public and private interactions that are initiated to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them (Kooiman, 2003). Some of the words in Kooiman's definition imply certain things that require further explanation. Interaction in this definition refers to a specific form of action undertaken to remove barriers to create a new way. Problems or Opportunities can sometimes take different forms along with the contexts and topics they are being discussed. Societal is common or social for everyone. Institutions refer to the structures or orders for the actors involved that make them understand how to interact, how they are expected to behave, and how they can expect others to behave. Principles are fundamental assumptions, views, or ethical values that governors use to solve any problem.

The common goal of governance in aquaculture is sustainability, and the means to achieve the goal depends on values and traditions. Thus, the type of governance may vary as the traditions and values may vary across jurisdictions. Governance can be hierarchical with an elite and top-down decision-making government, or the governance can be market-driven where one of the priorities of governments is to earn foreign exchange. It can also be a participatory governance, more common in countries with democratic values (Policy and governance in aquaculture, n.d.).

Based on the paper's nature, two types of governance will be discussed: Public and Private. In brief, public governance has been characterized as carried out by a sovereign ruler or executive that controls the governance process through organized bureaucracies with authority to develop and implement policies (Pedersen et al., 2011). On the other hand, Smith defines private governance as the outcomes when private actors take governmental intervention fields into their own hands and apply to the instruments that are customarily part of the private sphere (Smith and Fischlein, 2010, pages 511-522). As Garcia-Johnson says, the network forms at the product, firm, industry, or process level to create formal rules,

norms, standards, and procedures, voluntarily adopted or contracted by firms and the organizations that draft, monitor, and enforce compliance with them (Garcia-Johnson, 2001).

3.5.1.1 Public Governance and Aquaculture:

From a general perspective, public governance is a hierarchically structured governance system where state-owned governments are responsible for developing policy independently and leaving the producers to manage their farms. However, this kind of governance in aquaculture has a chance to disappear, as in Thailand, where command and control measures failed to produce sustainable shrimp aquaculture; laws became outdated, enforcement was inadequate, and producers non-compliant (FAO, 2014).

State-owned or public governance should regulate so the industry can have a proper political and economic environment to run the business smoothly. Although private regulations is becoming more dominant in modern aquaculture, public governance also plays a vital role by controlling the private sector to trade off environment and social sustainability for short term profits. Market failures such as externalities, scale economies, asymmetry in information, and non-excludability in research require intervention through regulations, economic incentives, or a combination of these (Hishamunda et al., 2010)

The extent and timing of public governance in aquaculture may vary.. Public governance, particularly in developing countries like Thailand, the Philippines, or Vietnam, successfully provides necessary inputs and services to the industry to develop aquaculture. However, arguments and debates favor reducing the role of public governance in reducing corruption in the sector. As World Bank says, "The more the state is involved in supplying inputs such as fertilizer and credit..., the greater is the potential for corruption" (World Bank, 2008).

Policymaking for aquaculture is best served by the state, especially when there are different tiers of government. Public governance in aquaculture is also essential to coordinate, plan and establish regulation and integrate aquaculture policy horizontally and vertically (Hishamunda et al., 2010).

3.6 Private Governance:

State-based or public regulatory bodies have the power to dominate different sectors, say, the fisheries industry or the forestry, but sometimes, this governance system experiences

difficulties or is questioned due to certain regulatory failures. Consumers and the broader community were becoming more concerned about and focused on sustainable resource exploitation and can use their power of shared interest to question any industry's social license to operate (Cullen-Knox et al., 2017). This acts as a pressure on industry actors to recognize and to perform their social responsibilities to achieve full trust and acceptance by society. Achieving full trust and acceptance provides stronger and higher social license levels, whereas legitimacy seems to have the minimum requirement (Parsons and Moffat, 2014; Thomson and Boutilier, 2011).

Non-state actors play an essential role in governing sustainable resource exploitation and largely depend on third-party assessment and certification bodies which act as a gatekeeper for checking the quality and provides consumers the confidence that the products they are buying, and consuming are produced in an environmentally sustainable way (Gale and Haward, 2011). From forestry (Forest Stewardship Council)to fisheries (the Marine Stewardship Council or The Aquaculture Stewardship Council), from coffee (Fairtrade) to food production (Food Alliance) and even tourism, Non- Governmental Agencies have developed structures and rules concerning the production and sale of products and services (Cashore, 2002). However, the rules developed by certification schemes are stricter than that of public government authorities; thus, they raise business costs for the farms certified against their standards (Vormedal & Gulbrandsen, 2020).

3.6.1.1 Private Governance and Aquaculture:

in 2007, the major outbreak of Infectious Salmon Anemia (ISA) caused by sea lice in booming salmon farming in Chile, leading to substantial downsizing and financial write-downs in the years to come. Uncontrolled contamination of shared water by viruses, sea lice, and bacteria, and the lack of proper governance by the public authority and insufficient industry preparedness allowed the situation to happen. This crisis, therefore, set an example of inadequacy of efficient public governance and acted as the catalyst to push the leading farms towards adopting ASC (Aquaculture Stewardship Council), which is a non-state market-driven regulatory body that sets standards and rules for the industry to manage aquaculture in a sustainable way (Vormedal & Gulbrandsen, 2020).

Like the Chilean case, the lack of proper and adequate public regulations to maintain sustainability in aquaculture made global civil society frustrated enough to lean increasingly

on private governance and persuade and coerce global businesses to adopt private regulation (Bendell 2004; Vogel 2005, 2010). The civil regulations' defining characteristic states that none of their legitimacy, governance, or implementation is rooted in public authority. Instead, they carry on their operations beside or around the state rather than through it (Vogel 2005, 2010). Civil regulations are based on soft law; participants who disobey the regulations face social or market penalties than legal (Abbott & Snidal, 2000; Kirton & Trebilock, 2004; Moth, 2004). Thus, these regulations provide the power to the private governance systems to regulate global farms and markets to address labor practices, environmental performance, and human rights policies (Vogel 2010). Like other fields, In aquaculture, private governance has become a prominent mode to address globalized economy challenges (Auld & Gulbrandsen 2013). However, in the long run, private regulatory bodies can compensate for some of the shortcomings of public governance but can not substitute for the state authorities' more effective exercise either at national or international levels (Vogel, 2010).

In 2002, Benjamin Cashore, in his book ¨ Legitimacy and the Privatization of Environmental Governance: How Non-State Market-Driven (NSMD) Governance Systems Gain Rule-Making Authority' made a comparison between public governance and non-state market-driven governance:

Features	Private governance	Public governance
Location of authority	Market transaction	Government
Source of authority	Evaluation by external audiences, including those it seeks to regulate	Governments monopoly of legitimate use of force, social contract
Role of government	Acts as one interest group, landowner (potential indirect facilitator)	Has policymaking authority

3.7 Indicators in Governance

Indicators are being treated as prominent tools to governors these days. Public-private, even global governance, are increasingly getting dependent on indicators to compare states for

purposes. This part of the paper defines indicators and discusses the distinctive features of indicators and why they are essential to the governance systems.

3.8 Defining Indicators:

The wordy definition of indicator is ¨a pointer or index that indicates something¨. Fundamentally, indicators are tools to measure something that we care about; they provide a sign or signal that something exists or is true. They are very common in our day-to-day life, and we use them everywhere to understand the world around us, make decisions, or plan what we do. We label them with many other names like instruments, measurements, signs, grades, or signals, but our purpose of using them is the same, to measure something we value (Meadows, 1998). Indicators are critical as their presence, absence, or prominence affect behavior but can also be dangerous simultaneously as they are the center of the decision-making process (Meadows, 1998).

Indicators may vary based on the way different organizations define them. The Organisation for Economic Co-operation and Development (OECD) defines an indicator as a quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, reflect changes connected to an intervention, or help assess the performance of a development actor (Church and Rogers, 2006). According to The United States Agency for International Development (USAID), an indicator is a variable whose purpose is to measure change in a phenomenon or process (Church and Rogers, 2006). European Commission defines indicators as a description of the project's objectives regarding quantity, quality, target group(s), time, and place. Indicators can be quantitative or qualitative. They are quantitative when they measure quantities or amounts (Church and Rogers, 2006). They are qualitative when they take the form of peoples judgments or perceptions about a subject (Church and Rogers, 2006)

To be feasible and to pass the test of reliability, indicators need to contain some necessary information. The important components that a reliable indicator must hold are: What is to be measured, units of measurement to be used to describe the change, Pre-program status, the magnitude of the intended change, the standard of the change to be achieved, target population, and timeframe (Church and Rogers, 2006)

Selecting appropriate and useful indicator is very important and takes careful thought, iterative refining, collaboration, and consensus-building. There are several frameworks useful to identify quality indicators, SMART (Specific, Measurable, Attainable, Relevant and Time-bound), SPICED (Subjective, participatory, Interpreted and communicable, Cross-checked and compared, Empowering, Diverse and disaggregated), and CREAM (Clear, Relevant, Economic, Adequate, Monitorable) are to name a few (Church and Rogers, 2006).

3.9 Why Indicators:

Abraham Lincoln, in his speech to the Illinois Republican State Convention in June,1958 said, ¨If we could first know where we are, and whither we are tending, we could better judge what to do and how to do it¨ (Lincoln,1995). This statement simply explains why and how indicators are important for us to accomplish our objectives. Using indicators is useful when we measure our progress or performance from time to time against our objectives, policy actions, or plans. Indicators also help us provide meaningful information to the stakeholders regarding the status, trend, or performance of a given project or system. They help compare and identify the areas where an organization or a specific project needs to pay increased attention.

Indicators can be used as instruments to set standards, both in public and private, even in global governance. Indicators are useful in decision making as the decisions made based on indicators are more objective. Governance that relies on indicators is more efficient to use time and other resources to make decisions. Indicators help to convert ordinal data to numerical form, and thus the decisions can be expressed in mathematical form, which makes the decision-making process consistent. Using indicators make the governance process transparent, scientific, and impartial. Finally, consistent use of indicators educates users about the costs and benefits of systematic effort that they need to put to perform their responsibilities.

4 Methodological Framework:

This section presents the specific techniques or procedures used to identify, select, process, and analyze information or data to answer the research questions. The idea is to enable the reader to evaluate this study's validity and reliability from a critical perspective. It is important to keep in mind the main purpose of this paper: to conduct comprehensive research to explain the basics and status of both the Norwegian public governance and the ASC and elaborate on how they contribute to the Norwegian aquaculture industry. It is also important to assess how and why ASC has to coexists with the state-owned governance system to ensure its growth sustainably as a private governance system. This paper relies on a qualitative research method consisting of document analysis and literature review.

4.1 Qualitative Method

"Not everything that can be counted counts, and not everything that counts can be counted "(Albert Einstein)

Strauss and Corbin define qualitative research as "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" (Golafshani, 2003) It is; for instance, research that produces findings arrived from real-world settings where the "phenomenon of interest unfold naturally" (Patton, 2001). The qualitative approach helps gather information and produce results that are not easily measured or presented through numbers but is still useful to create a point for future reference.
The qualitative research method is a type of a scientific investigation that seeks answers to a question, uses a predefined set of procedures to answer the question systematically, collects and produces evidence that were not there in advance, and produces findings which are useful even beyond the immediate limit of the study (Mack et al., 2005). The reason why this method has been chosen for this research is its versatile, flexible nature. The qualitative research method can provide a detailed textual description of the people experiencing a specific research issue. Qualitative research provides information about the human side of any issues like human behavior, beliefs, opinions, emotions, and individual relationships. This

method can also identify intangible factors like social norms or socioeconomic status (Mack et al., 2005). The qualitative method of research is advantageous for exploratory research. Besides, this method is advantageous due to its meaningfulness to the participant, unanticipated by the researcher, the nature of being rich and explanatory (Mack et al., 2005). Due to the study's dynamic nature and to gain an in-depth understanding, the qualitative method was chosen for this thesis.

4.2 Literature Review

A literature review is conducting a critical examination of research relevant to the given phenomena of interest or theoretical ideas (Bryman, 2012). Generally, a literature review can be described as a systematic way of collecting and synthesizing previous research (Baumeister & Leary, 1997; Tranfield, Denyer, & Smart, 2003). Webster and Watson explain that a useful and well-conducted review as a research method creates a firm foundation for advancing knowledge and facilitating theory development (Webster & Watson, 2002). The literature review addresses research questions by integrating empirical findings and perspectives from many different studies that a single literature might not have.

For this thesis, the basis of the literature review was extensive desk-based study. The process of conducting a literature review started with searching for relevant literature. Considering this paper's research questions, literature searches were done on ScienceDirect, JSTOR, and Google Scholar. Single or combinations of keywords has been used to find out the relevant literature. *aquaculture, Norwegian aquaculture, area regulation in Norwegian aquaculture, The Traffic Light System, Norwegian salmon farming, governance (private and public), Indicators (private and public), standards (private and public), certification scheme, sustainability, sustainable development, Aquaculture Stewardship Council, ASC Salmon Standards, Indicators, Norwegian aquaculture history, pillars of sustainability,* are to name a few of them. Boolean operators have been used to narrow down the search. For example, NOT was used to exclude specific terms from search results, AND was used to search for sources that contained more than one keywords, OR was used to include synonymous words in the search, and so on.

Due to the time constraint, it was not possible to read everything that the searches were generating. Most relevant sources have been evaluated carefully and picked up to scheme the search results. Screening of the literature has been performed based on a few key points. For example, the literature's focus, theories, models, methods, or approaches have been

considered. The credibility of the sources was strictly monitored. Zotero and Mendeley were used as citation generators, whereas the APA format of citation has been used in this study for reference.

Throughout the searching and reading process, notes about significant or strong relationships with the research questions were being taken. For example, questions and concepts recurring across more than a few literature (like governance, sustainability, standards, indicators) were noted down to discuss in the theory chapter.

4.3 Document Analysis:

To get a vivid picture of the Norwegian aquaculture and its governance, document analysis of the ASC standards and The public regulations were carried out. Document analysis is a systematic procedure for reviewing or evaluating documents – both printed and electronic material (Bowen, 2009). Document analysis is advantageous as documents are stable, and investigators' presence does not change the study's subject (Merriam, 1988). Another nature of documents is that they are 'unobtrusive' and 'non-reactive, which enables them to avoid being affected by the research process. Document analysis is less costly than other research methods; one reason is that in many cases, documents are easy to avail of as they are in the public domain. Also, the range that documents cover is huge; they cover an extended period, many events, and many settings (Yin, 1994).

However, document analysis is not free from limitations. Firstly, the documents are usually prepared for some other purposes and may have insufficient details compared to the research requirements. In this study, this issue was dealt with by expanding the range of documents analyzed. The documents' availability can also be difficult due to the documents being blocked, or the retrieval is challenging. Collecting enough documents regarding ASC and their salmon standards, information from the FAO was comparatively convenient as their websites are open to all. The Norwegian regulations relating to the industry were easily accessible through respective websites. Many of the documents and law data on Norwegian government websites are in Norsk and thus were challenging to analyze. The only way to deal with this was to translate them to English using Google translate again, a little time-consuming. Another challenge was to gather enough documents on the TLS as the concept is new, and not much research has been conducted on this yet.

According to Bowen, another challenge is the document's selectivity, which means there may not be enough time for the researcher to analyze all the documents retrieved during thorough research. Selectivity was a significant challenge for this master thesis as the time frame for the study was limited. So ultimately, the major challenge faced during document analysis was limited time. Here as well, scheming all the documents and picking up the relevant ones (just as I have done during the literature review) helped to use time efficiently. Another way to overcome the problem was to stick with the ASC salmon standards only, although there are numerous other market standards developed by several certification schemes.

4.4 The Fundamental Concepts:

Norway has its legislation to regulate the salmon aquaculture industry. Still, private certification schemes in the market offer governance to regulate the industry more sustainably. Now, the question is, is there any positive impacts that the private governance can add on top of the Norwegian public regulations?

This section has been arranged to describe the fundamental concepts of the model used to compare and answer the research questions.

4.4.1.1 Potential Additionality:

The term ¨potential Aditionality¨ refers to the added outcomes on the national regulations by the ASC standards' to manage the industry sustainably. The representation of the additionality in a quantifiable manner demands a logical comparison between these two governance systems. The model used in this study for the comparison has been inspired by the formula developed by Rachael Garrett et al. (2016). Garrett describes additionality as the additional requirements to ensure the sustainability and wellbeing of the environment and the workers (Garrett et al.,2016).

According to Garrette et al., diverse economic, cultural, environmental, and political factors influence voluntary environmental programs' potential additionality concerning native conversion (Garrett et al.,2016). This additionality can be computed by globally available two indicators identified by Garrette's previous research. They are Standard Stringrncy, and Business as Usual

4.4.1.2 Standard Stringency *(S):*

The first indicator, Standard Stringency as defined by Garrett is:

> ¨behaviors required by the standard compared to behaviors required by existing policies and their enforcement. Behaviors required by a voluntary standard should be complementary, rather than redundant or antagonistic, with other regional laws and statutes¨

The concept of Stringency has always been a challenge due to the environmental degradation debate speeded up in the 1970's (Abate, Nielsen, & Tveterås, 2016). For this paper, several aspects of national regulations has been reviewed to examine legislative stringency.

4.4.1.3 Business As Usual *(BAU)*:

The second indicator is Business As Usual. According to Garrett. Business As Usual:

> ¨include the rate at which natural ecosystems are converted to the crop in question, either directly or through displacement. Certification will have a higher likelihood of additionality in regions with high forest-to-crop conversion rates¨.

These two indicators are substitutes as well as complement each other in terms of potential additionality. Where the standard stringency adopted is higher than the *Business As Usual* forest-to-crop conversion rates, the additionality is low. However, the opposite happens when the *Business As Usual* forest-to-crop conversion rates are higher than the *Standard Stringency*.

4.5 Operationalization of the Theories for the Study:

As Garrett determined in his model, the measure of the potential additionality has been represented by *A*. The difference between the *Stringency* (S) and the *Business As Usual (BAU)* represents the potential additionality. This study uses a simple approach to quantify the difference between the public regulations and the ASC based on environmental, social and economic impact categories (variables). For this thesis, ASC standards, represented as *S*, has a constant value of 1. The public regulations has been represented as the *Business As Usual*

(BAU). When the public legislations match the ASC standards, the potential additionality *(A)* results to zero.

The potential additionality is thus the difference between *BAU* and *S*. So finally,

$$A = S - BAU$$

The design of the study requires a comparison of the national regulations and the ASC standards. The methodological approach, i e, document analysis, literature review, and content analysis in some cases helped to structure an objective comparison between these two governance systems and to examine how they deal with the impact categories. Impact categories are the key focus areas from a sustainability point of view. Each focus area consists of several questions developed based on the literature review and ASC salmon standards.

Impact categories and their sustainability impact for this study have been developed being inspired by Ola Nilsson's study ¨*Adding sustainability to salmon farming regulations: A comparative case study of salmon farming regulations and the ASC salmon standard*¨ Although the main focus of that study was only on social sustainability, this paper examines potential additionality based on all three pillars of sustainability.

5 Result

Norwegian regulations governing the aquaculture industry The Norwegian fisheries governance – its institutions, procedures, and participants-is a public and private partnership where the policies result from formal and informal consultations and negotiations between the industry representatives and government officials (Jentoft and Mikalsen, 2014). This section highlights the Norwegian regulations in use to govern the industry sustainably. As the Traffic Light System is solely dedicated to the governance of the aquaculture industry, this paper emphasizes and discusses more on this regulation

5.1 The Traffic Light System: Empirical Setting:

The production area regulation, commonly known as the Traffic Light System, is the latest Norwegian state-owned management system to regulate the salmon aquaculture industry sustainably. The law came into action on October the 30th 2017, and thus is comparatively new. However, TLS, as a management system, has a lengthy historical background. This

section briefly describes the historical development of the TLS. The latter part represents the core aspects of the system. The public work in 2007, which began with publishing the "strategy for a competitive Norwegian aquaculture industry," can be identified as the starting point of the TLS (Michaelsen, 2019). This document was an examination by the Government to determine its competitive condition (MFC, 2007).

One of the measurements represented by this document was to ensure that the industry keeps operating sustainably. (MFC, 2007). In 2009, another strategic document named "Strategy for an environmentally sustainable aquaculture industry" was published by the same Government (MFC, 2009). This document mentioned that to be sustainable; the industry needs to be environmentally sound. This document identified salmon lice as the primary challenge for the industry, which has a tremendous impact on the wild salmon stock. Several important strategic ideas were presented through the document: first was to use the salmon lice level on wild salmon stock to regulate the industry's production capacity. Another idea was to use production zoning as a regulatory tool to control sea lice level on farmed salmon. However, the purpose of production zoning was also to regulate the production capacity of the industry. One particularly important measure in the strategy was to appoint a committee with a twofold mandate. The first was to suggest the Government on securing sufficient space in the industry's coastal zone. The second mandate was to develop an idea about a new management system to ensure more space, an efficient and more sustainable industry (Hovland et al., 2014). The committee, known as the Gullestad Committee, was appointed In 2010 and after a year, in 2011, delivered their final report. The report made several recommendations, but three of them are most relevant to mention. The first one was to divide the coastal zone into several self-containing production areas to reduce the infection pressure. The second one introduced indicators and action rules (e.g., sea lice, MAB) to deal with the industry's challenges. And lastly, the report suggested to hold the allocation of license for salmon farming till the new system comes into force (Gullestad et al., 2011)

As the industry struggled with several environmental challenges like fish escape, sea lice impacting wild stock, or the higher rate of fish mortality, the sector and its management focused more on biological sustainability since 2010. As a result, the set of indicators and rules suggested by the committee were based on environmental factors.

In 2012, a detailed and technical regulatory plan was prepared by the Ministry of Trade, Industry, and Fisheries (MTIF). As a regulatory measure, this plan included counting salmon lice and the limit of sexually mature female lice on salmon (MTIF, 2012). In 2013, ¨ The Green Concession Round¨ was announced by the MTIF to better control sea lice pressure and the number of escapees. The round announced to distribute 45 licenses among three groups. These licenses were different than other regular licenses as the rules regarding the maximum allowed mature lice on salmon were more strict. The medicinal treatments used to reduce the salmon lice level were much more controlled (DoF, 2017).

The next concession round announced by MTIF was in 2015, focusing on solving the industry's challenges by inducing substantial innovation with sizable investments. However, the round's discretionary nature was that it was not easy to define significant design with sizable investment. One interesting point about the round was the Government's signal about the new management system (DoF, 2017). This year, White Paper number 16 named "Predictable and environmentally sustainable growth in Norwegian salmon and trout farming" was delivered to the ministry (MTIF, 2015). Since the report was delivered, the ministry worked intensely to design and introduce the new management system considering WP 16 and the Gullestad Committee report's suggestions. Finally, on October the 30th 2017, the new management system named ¨The Traffic Light System¨ was approved and implemented.

5.2 Central Aspects of the TLS

The three central characteristics of TLS, namely production zones, environmental indicators, and the action rules, are controlled under the production area regulation (MTIF, 2017). This part of the paper discusses these core characteristics of TLS based on the law.

Production Zone: Section 8 states that the production capacity regulation in a production zone must be based on its environmental status, whereas a set of updated environmental indicators should be used (MTIF, 2017). Section 3 of the regulation divides the Norwegian coast into 13 geographically delimited production zone (MTIF, 2017). Lastly, sections 8- 13 says that based on the decision of the MTIF, the production capacity in a production zone should be adjusted every other year and that the environmental status of the production zone would be taken into consideration to do so (MTIF, 2017)

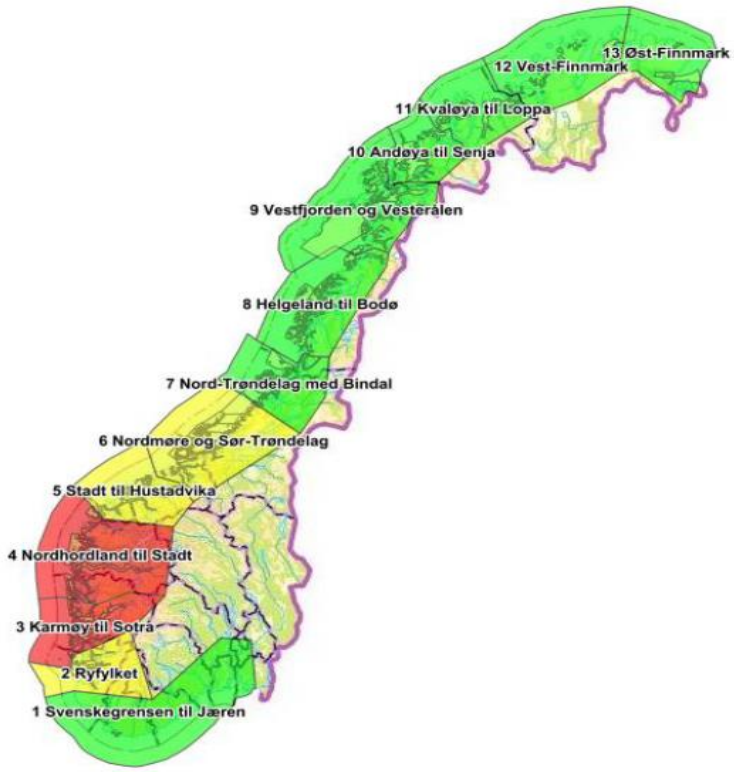


Figure: Zones with their assigned colors (source: Directorate of Fisheries, October the 30th,2017)

Environmental Indicator: The only environmental indicator that the system possesses now is the salmon lice (Lepeophtherius salmonis) and its impact on the wild salmon stock. Now, the reason why salmon lice had been chosen as an environmental indicator was explained in Aquaculture Paper (2014 – 2015): *There is a good correlation between the amount of farmed fish in the sea, the level of salmon lice on the farmed fish, and how much impact salmon lice have on wild salmonids stocks, especially sea trout. Therefore, the salmon lice's impact on wild populations is well suited as an indicator* (MTIF, 2015).

Salmon lice, as an environmental indicator, has also been used to design the production zones to minimize the lice infection among them alongside the coast. The production zones were divided based on the report by IMR named "Proposal for production areas in Norwegian salmon and trout farming" (IMR, 2015). In this report, considering the salmon lice as an indicator, IMR suggested to divide the coastal area into 11 production zones (IMR, 2015). However, coming up with the suggestion needed to go through several modeling and

analytical techniques. There were three main scattering models used to calculate the rate of spreading of the lice and proliferation area along the coastal zone. For this, the Regional Ocean Model System (ROMS) was used as the hydrodynamic current model. The ROMS was then combined with the NorKyst-800m model to get salinity, temperature, or current status along the coastal zones. Finally, combining these two models with the IMRs salmon lice particle transport model (LADIM) displayed the salmon lice's spread rate along the coastal areas (IMR, 2015). The next step was to use this data to identify the potentiality of infections between farms across the coast. Each of the farms were counted both as 'target' and 'source' for the salmon lice infections. To represent the data in a quantifiable manner, an influence matrix was used. The data from the influence matrix was then analyzed to draw the borders of production zones. Based on the results derived and the recommendation from IMR, MTIF decided to divide the coast into 13 production zones as listed below:

1. The Swedish border to Jæren

2. Ryfylke

3. Karmøy to Sotra

4. Nordhordaland to Stadt

5. Stadt to Hustadvika

6. Nordmøre to South-Trøndelag

7. North-Trøndelag to Bindal

8. Helgeland to Bodø

9. Vestfjord to Vesterålen

10. Andøya to Senja

11. Kvaløya to Loppa

12. West-Finmark

13. East-Finmark

5.3 Action Rules: How the Production Capacity in Production Zones is Adjusted:

The production capacity adjustment in a production zone relies on its environmental status and is decided every other year. Currently, the only environmental indicator for the action rule is the salmon lice and its impact on the wild salmon stock. The risk posed by the farmed fish to increase salmon lice induced mortality rate on the wild stock indicates how the production status should be adjusted:

Table: Critical limits and effects of the Traffic Light System (Pettersen & Hamarsland, 2018)

	Low risk/influence	Moderate risk/influence	High risk/influence
Criteria	It is probable that <10 % of the population dies due to lice infection	It is probable that 10-30 % of the population dies due to lice infection	It is probable that > 30 % of the population dies due to lice infection
Effect of the regulation	2 % growth on existing MAB 4 % growth offered through auction	No change in MAB	6 % reduction in MAB

As seen in the table, a farm is considered green if the risk of the farmed salmon's lice-induced mortality rate is less than 10 percent. A green is allowed to increase its production by 6 percent. When the risk is within the range of 10 – 30 percent, the farm is considered yellow and is not allowed to increase production. However, the farm can maintain its current production level. If the risk level is more than 30 percent, the farm is considered red and is bound to decrease its production. The percentage of reduction, however, is decided by the ministry during each round.

5.4 Paragraphs §12: The Exemption rule:

Section 12 in production area regulation states that a farm can still increase its production by 6 percent despite being red or yellow. However, there are two conditions, and the farm needs to fulfill at least one of them. The first exception is the production method that the farm has must not release lice larvae to the sea over the last production cycle and at least for 12 months. This method also needs to be documented by a third-party professional body. The second condition is the comply with an open production method. Firstly, the number of sexually mature female lice with all lice counting (once a week) shall not cross 0.1 per salmon (MTIF, 2012). The period to be considered is from April the 1st to September the 30th. However, there is an alternative to this; the number of eggs and the lice (in its free-floating life period) discarded by the farm should be the same as the corresponding number of fish with 0.1 sexually mature female lice on average. There is still a chance to increase the production capacity even though the lice count exceeds 0.1 per fish on average. Here are the two requirements the farm needs to follow to avail the chance; the first one is, the counting of sexually mature female lice in one counting within April the 1st to September the 30th shall not exceed 0.17 per fish. The other one is, the lice level shall not be higher than 0.1 in more than three consecutive counting within the above stated period. The second exception rule is that the farm cannot use medicinal treatment against salmon lice more than once per production cycle.

The detail about the exemption rule is available in appendix 1 and appendix 2 for more explicit representation of this very topic.

5.5 Other General Laws Applicable to the Norwegian Aquaculture Industry:

The Traffic Light System, developed based on the Gullestad committee's report, aims mainly on sustainability's environmental pillar. Indeed environment is essential, but the economic value creation and supporting the social system shall also be parts of the goal or aim (Lyotard, 1986). Some other general laws that play essential roles to offset the TLS's lack of support for sustainability's social and economic pillars have been discussed in this section.

Being a part of the EEA-Agreement with the EU, Norway implements most of the EU regulations and directives into Norwegian law, including regulations and mandates regarding Labour Law. Parties engaged in the labor market are the employers, employees, employers' associations, and trade unions.

5.5.1.1 Working Environment Act 2005:

The working environment act is one of the most important acts that regulate job security, working hours, employment termination, and the employees' health and safety. This act also includes but is not limited to ensuring the priority of the re-employment of former employees, treating agency workers and permanent employees equally, basic pay and working conditions, i.e., working time, rest periods, night work, holiday, and salary. The Working Environment Act prohibits direct or indirect discrimination based on political view, membership of a trade union, age, part-time or temporary employment.

5.5.1.2 The Equality and Anti-Discrimination Act

Another act that works to ensure equality at the workplace is *the Equality and Anti-Discrimination Act.* This act came into effect on January the 1st 2018, as a combination of the Gender Equality Act, the Ethnicity Anti-Discrimination Act, the Anti-Discrimination and Accessibility Act, and the Sexual Orientation Anti-Discrimination Act. The aim was to strengthen the protection of discrimination by making legislation more accessible to those who enjoy protection under the law. Another goal was to ensure equality and prevent discrimination related to gender, pregnancy, leave connected with childbirth or adoption, care responsibilities, ethnicity, religion, belief, disability, sexual orientation, gender identity, gender expression, age, or other significant characteristics of a person. The act is applicable to all areas of society and includes family life and other purely personal relationships (Ministry of Culture, 2018)

5.5.1.3 The Labour Disputes Act 2012

has been designed to regulate disputes between the parties of the labor market. This act deals with two kinds of conflicts: legal disputes concerning the interpretation of collective agreements and on-jural disputes concerning the creation and renewal of collective agreements. Under this law, the Labour Court of Norway has been designated to resolve disputes concerning the interpretation, validity, and existence of collaborative agreements, cases of breach of collective agreements and the peace obligation, and claims for damages

arising from such violations illegitimate industrial action. Special provisions relating to the employment relationship, the announcement of a position, appointment, reassignment and promotion, training and skills development, pay, working conditions, and cessation have been stated under Chapter 5 of the Act. (Ministry of Labour and Social Affairs, 2006)

5.5.1.4 Annual Holiday Act

Another mentionable act is the *Annual Holiday Act*, which ensures the employees have 25 days of paid holiday each year, amounting to four full weeks and one day. Under this act, the employee becomes entitled to holiday pay, which is 10.2 percent of the previous year's annual wages. Longer holidays may be granted to employees based on individual or collective agreement. The basic collective agreements in Norway allows the employee a contractual right to five weeks of holiday. The holiday payment is upgraded proportionally to 12 percent.

5.6 The ASC as a private governance: What, Why, and How

The Aquaculture Stewardship Council is an entirely independent third-party certification and labeling organization working around the globe. The ASC can be defined as ¨a global organization working internationally with aquaculture producers, seafood processors, feed producers, retail and foodservice companies, scientists, conservation groups, social NGO's, and the public to promote the best environmental and social choice practices in aquaculture¨ (The ASC, 2019).

The definition clarifies that ASC as a certification body deals with the whole value chain, including aquaculture producers, seafood processors, food service companies, scientists, conservation groups, and consumers. All these parties' involvement in the certification process is essential as the mission is not to change only but to transform seafood markets towards sustainability. To use the logo on their products, farms need to ensure that the production process has not harmed the environment, society, and the community.

To answer the second research question, this section of the study discusses the ASC and its development as a private governance system, its vision-mission-strategic plans, and its standards and indicators used to govern the industry sustainably.

5.6.1.1 Empirical Setting:

in 2004, the World Wildlife Fund (WWF) initiated and coordinated the official dialogues to develop principles and standards to ensure sustainable aquaculture. Those standards aimed to eliminate or reduce the significant social and environmental impacts by creating performance levels that are verifiable, measurable, economically sustainable, and acceptable to the stakeholders.

The dialogue process took place over around a decade in many cities worldwide, engaging more than 2000 scientists, farmers, retailers, and many other stakeholders to ensure that the process was transparent, universal, multi-cultural, and involved multi-stakeholders. In 2010, the Sustainable Trade Initiative (IDH) and WWF Netherlands became a part of the force and created The Aquaculture Stewardship Council as a ¨not for-profit and fully independent¨ organization.

In 2013, ASC joined the ISEAL (International Social and Environmental Accreditation and Labeling) as an associate member. Now, ISEAL is the global membership association for credible sustainability standards that helps its members to work collectively to address the most pressing social and environmental issues the world is facing. To be an ISEAL Alliance member, an organization needs to be a multi-stakeholder sustainability and accreditation body compatible with the ISEAL codes of good practices and requirements. Another essential condition is to be committed to learn, improve and to support a unified movement of standards in a sustainable way

Being an independent organization, ASC sets up its system and holds the responsibility to develop, manage, or revise its standards depending on aquaculture dialogues. To maintain credibility and transparency, ASC follows the ISEAL Alliance Code of Good Practices. These good practices are aligned with ISO/ IEC Guide 59: Code of good practice for standardization and WTO Technical Barriers to Trade: Code of good practice for the preparation, adoption, and application of standards.

In 2015, ASC became a full member of ISEAL; it is the only aquaculture scheme of such a kind.

5.6.1.2 The ASC Vision, Mission, Strategies, and Objectives:

As an independent certification body, ASC's vision is to transform aquaculture ¨towards a world where aquaculture plays a major role in supplying food and social benefits for mankind whilst minimizing negative impacts on the environment¨ (ASC, 2020).

The ASC's general statement of how they will achieve their vision, or their Mission Statement is to "transform aquaculture towards environmental sustainability and social responsibility using efficient market mechanisms that create value across the chain¨ (ASC, 2020).

The first ASC Strategic Plan, named "Strategic Guidelines for 2012-2015," was its transition period. The strategies were focused on bringing principles and standards extracted from dialogues to operation. During this period, other vital strategies were developing tools to implement the standards and principles, design and register the ASC logo, and get CAB (Conformity Assessment Body) on board to assess and certify farms against established ASC standards (The ASC strategic overview, 2012).

The second ASC Strategic plan is supposed to be happening over five years, starting from 2017 to 2021 with five key objectives (The ASC 2017-2021 strategic overview,2017).

- The ASC's global standards and certification program strengthened and developed to maintain its reputation as the world's leading certification and labeling program for responsibly produced seafood. Additional steps have been planned to maintain future credibility as well.

- To keep on expanding the range of certified and labeled farms worldwide, ASC continues extensive direct support, partnerships, and training. What is new onboard is the Aquaculture Improvement Program.'

- Developing effective communication with the key stakeholders to protect the organization's reputation, inform them about the social and environmental benefits of ASC, and show the program's difference from other alternative assurance schemes.

- Collaborating with other relevant certification bodies working with the same vision to eliminate or mitigate market confusion.

- Strengthening organizational structures by setting up objectives and adopting actions to focus on top quality staff, high-quality communication, implementing high-quality information technology, and assuring financial stability to support its mission.

5.7 Challenges Faced By the ASC

The ASC strategic plan 2017-2021 came with three core challenges to address to get going successfully. First, salmon and pangasius has been the most successful certifications and holding the lion's share (10 percent & 23 percent respectively) of the ASC program worldwide until now. In contrast, shrimp and tilapia represents less than 5percent of global production. The next big challenge is increasing the number of certified tilapia and shrimp producers and suppliers. Second, ASC is a voluntary and market-driven program, and thus its continuity is not guaranteed. The interests, choices, or needs of buyers, ultimate consumers, and farmers can shift at any time, leading the ASC to lose its market share. To ensure the continuity of the program in the market, ASC must focus on strengthening its value proposition, resulting in the supply of responsibly produced seafood in plenty. Finally, with the expansion of the market, the risk of losing integrity can also arise. The risk can be caused by ASC and proxies' actions or by changing others' perceptions towards those actions. Increasing the integrity through ASC teams and procedures will have to be emphasized.

However, to address those challenges, the ASC has prioritized several strategic plans. Few important strategic plans are - developing and increasing its global standards and certification programs, focusing on its key countries (Asia, America, or Europe) to increase the number of certified and labeled products, raising awareness of the program among consumers and stakeholders, collaborating operations with other relevant certification and rating organizations, strengthening development inside the organization (The ASC Strategic Plans, 2017).

5.8 The ASC Salmon Standard, Its Principles, and Indicators

After eight years of development, salmon farming standards were finalized by the Salmon Aquaculture Dialogue and handed over to the ASC in 2012 (SeafoodSource, 2012). The standards were developed to address all critical environmental and social impacts caused by salmon farming and maintain the industry's economic viability at the same time. This

standards development process involved farmers, conservationists, scientists, seafood buyers, government officials, aboriginal people, and other salmon-farming stakeholders. Petter Arnesen of Marine Harvest, one of the members of the dialogue's steering committee, welcomed the standards and said,

¨the final standards represent an extraordinary accomplishment and sets a new and unprecedented standard for responsible farmed salmon production. I look forward to seeing the results of their implementation and hope that retailers and customers will value the efforts of farms that choose to work towards certification. As an industry, we are often challenged on lack of transparency. Implementing the standards will therefore provide useful documentation on current environmental and social status of salmon farms and the efficiency of the standards." (SeafoodSource, 2012)

Table 1: Overview of ASC Salmon Standard (Bonaksen, 2014)

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**

The ASC Salmon Standard defines a standard as, ¨A document that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory (The ASC, 2019).

ASC Salmon standards have seven principles, several criteria, and more than 150 indicators. ASC defines its Principles as 'a thematically related Criteria which contribute to the broader outcome.' Each of the ASC Principles has multiple Criteria, and the ASC defines Criteria as 'an outcome that contributes to achieving the outcome of the Principle.' Finally, each of the

Criteria contains one or more Indicators. ASC defines the indicator as 'an auditable state that contributes to achieving the Criterion outcome.'

5.9 The ASC Standards vs. The Public Regulations: A Comparative analysis

Norway has been the second-largest exporter of aquaculture production and is whereas Norway's salmon aquaculture sector is the largest producer of salmon in the world. In 2018, Norway exported seven percent of the global fish and fish products in terms of value (FAO,2020). One percent of Norway's workforce is engaged in the seafood industry. The industry contributes one percent of the total GDP, making it the second-largest export industry after gas and oil. Norway generally exports its seafood to Sweden and Finland; however, its exporting territory has been expanding to Asian markets and the US (Statistics Norway,2017).

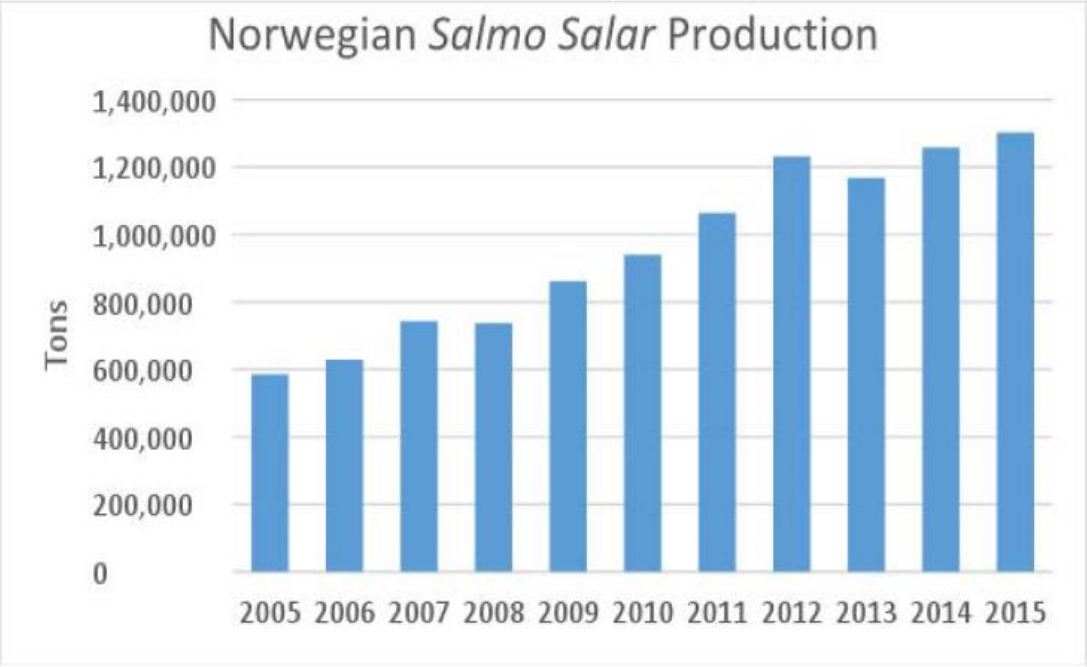


Figure 1: Trends in Norwegian salmon production from 2005 to 2015 (SSB, 2017)

From the global perspective, the demand for eco-labeled salmon has dramatically increased Over the last few years (Vince & Haward, 2019). Not only that, the reputation of ASC as one of the most globally prominent and stringent certification systems is also increasing. Given that the ASC shall complement national/regional/local standards/regulations, which raises the question: how does the ASC differs from the regional or national standards to regulate the salmon farming industry in Norway? What do the ASC standards have to add on top of the Norwegian regulations already in existence?

This section has been organized to compare the ASC standards and Norwegian regulations to govern the aquaculture industry. The comparisons require quantification of both the events and their consequences. However, The events are categorized based on the three pillars of sustainability, whereas each of the pillars consists of several major impact categories.

5.10 Comparison Based on The Environmental Pillar of Sustainability

The rapid change and development in the aquaculture industry in Norway has not happened without impacting the environment. Thus it is crucial to assess the environmental risks associated with the industry and address them with acceptable management practices. The Norwegian Government is very much concerned about the environmental risks associated with salmon aquaculture. In 2009, the Norwegian Government established a set of environmental goals for sustainability in the "Strategy for an Environmentally Sustainable Norwegian Aquaculture Industry" (Anon, 2009). Basing on that, the Institute of Marine Research, Norway, initiated a risk assessment of Norwegian salmon farming in 2010 (Taranger et al., 2011). The risk assessment was based on the proxies or hazards related to the environmental impacts of salmon farming. Selecting the environmental impact categories are inspired by this set of goals developed by the Norwegian Government in 2009.

Table: five primary goals established by the Norwegian Government to develop the industry sustainably (Geir et al., 2015)

Goals	
Goal 1: Disease	Disease in fish farming will not have a regulating effect on stocks of wild fish, and as many farmed fish as possible will grow to slaughter age with minimal use of medicines.
Goal 2: Genetic interaction	Aquaculture will not contribute to permanent changes in the genetic characteristics of wild fish populations.
Goal 3: Pollution and discharges	All fish farming locations in use will maintain an acceptable environmental state and will not have higher emissions of nutrient salts and organic materials than the receiving waters can tolerate.
Goal 4: Zoning	The aquaculture industry will have a location structure and zoning which reduces impact on the environment and the risk of infection.
Goal 5: Feed and feed resources	The aquaculture industry's needs for raw materials for feed will be met without overexploitation of wild marine resources.

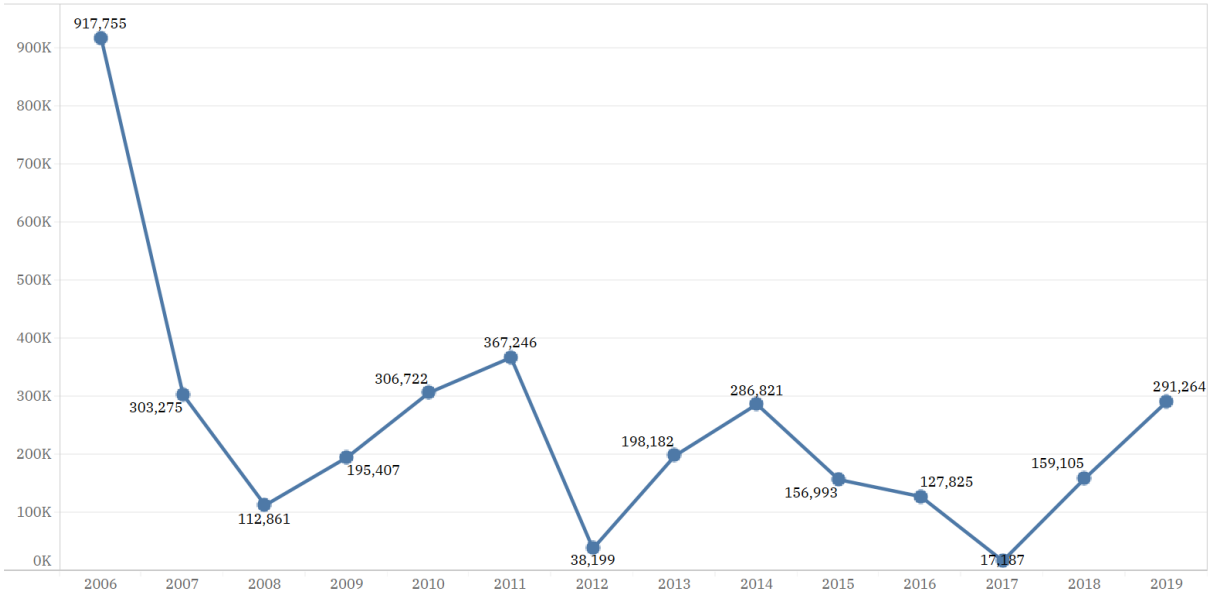
The impact categories are developed based on these goals and fine-tuned to fit the research requirement and are as follows:

1) interactions with wildlife, 2) feed, 3) fish health 4) waste management, and 5) Zoning

Escapes:

The first element of the impact category is farmed salmon's escape, which is the biggest problem than others under this category. Each year hundreds of thousands of farmed fish escape into the natural environment (table X). Norwegian national regulations focus on controlling escapes of farmed salmon strictly. The reason is not only to have control over the negative impact on wild stock but also to minimize the escapement's economic losses.

Table: Year by year comparison of escaped fish (Directorate of Fisheries, 2020)



According to the national regulation, each farm must have trained personnel and a retention plan. The estimated number of the escaped fish is reported to the Norwegian Directorate of Fisheries by fish farmers. One of the downsides of this reporting is that the numbers of escapees reported to the Norwegian Directorate of Fisheries underestimate the real number of escapees. However, documentation supports the fact that legal authorities in Norway have utilized DNA tracing methods to identify the farm of origin for escapees where they have not been reported (Glover et al., 2008; Glover, 2010; Zhang et al., 2013). Regarding the number of escapees, national legislation does not have any maximum limit. On the other hand, the ASC has set its escape limit to 300 salmon per production cycle (ASC, 2012). Nevertheless, Norwegian legislation matches with that of ASC standards in terms of predator interaction.

Interaction With Wildlife:

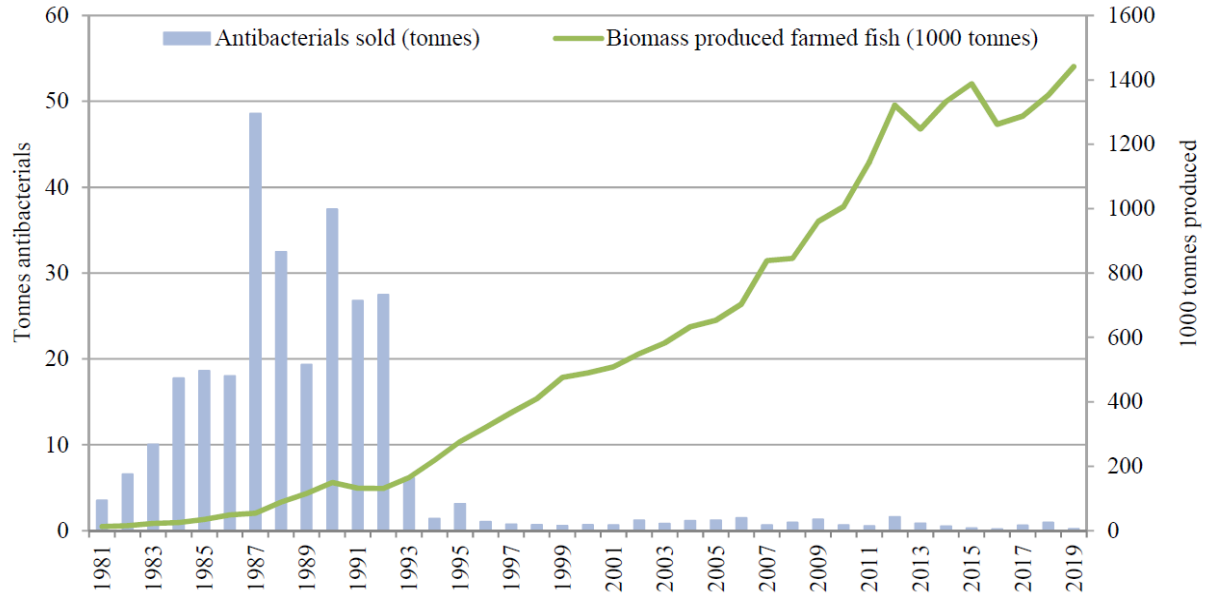
The Norwegian regulation significantly differs from the ASC standards on the ground of using Acoustic Deterrent Systems. Under the Norwegian legislation, using the system is allowed, whereas the ASC does not allow farmers to use it. However, regulation relating to the lethal action against the predators is similar in both the national legislation and the ASC.

The farmers are only allowed to take such measures only if appropriate authorities authorize that, but never on endangered species.

Fish Health:

Norwegian salmon industry has proper management of antibiotic use gained by successful vaccination programs (WHO, 2015). If prescribed by a veterinarian, antibiotics (such as Amphenicols, Quinolones, and Tetracyclines) are not restricted by the Norwegian legislation (WHO, 2015). However, the antibiotics used to treat the farmed salmon's illness has dropped year on year (NSC,2020). Furthermore, data derived from the annual report on antibiotics use in Norwegian aquaculture shows that in 2019, only 16 prescriptions were issued for Norwegian salmon farming. This is the lowest antibiotic use ever recorded and implies that 99 percent of Norwegian salmon were produced without any antibiotic treatments. However, almost zero amount of antibiotics usage does not mean that antibiotic use is prohibited. Instead, this results from increased governmental focus on fish welfare and food safety (NSC, 2020).

Figure: Sales, in tonnes of active substance, of antibacterial veterinary medicinal products for therapeutic use in farmed fish (including cleaner fish) in Norway in 1981-2019 versus produced biomass (slaughtered) farmed fish. For 1981-2014 the data represent sales data provided by the Norwegian Institute of Public Health; for 2013-2019 data represent prescription data obtained from the Veterinary Prescription Register. Data on slaughtered biomass farmed fish were obtained from Statistics Norway (Source: NORM-VET report 2019, p22)



In therapeutic treatments, the farm requires to consult a licensed veterinarian, and the treatment must be prescribed by him/her. Sea lice monitoring by the farms under Norwegian legislation depends on the water temperature. The monitoring should be weekly if the water temperatures are more than four °C or bi-weekly if the temperature is less than four °C. The sea lice counting threshold is 0.2 lice during the period when wild salmon migrate; otherwise, the limit is 0.5 lice per salmon. The regulation relating to the yearly number of veterinary checkups depends on the farm's size, which can vary from four to six times a year.

On the other hand, the use of any antibiotics critical for human health is prohibited by the ASC. Therapeutic treatments can only be used if a licensed veterinarian prescribes it. Unlike the Norwegian national regulation, the ASC standards requires the farms to monitor the sea lice level weekly or monthly, depending on the wild stock population in proximity. The ASC limits the maximum number of sea lice to not more than 0.1 lice per salmon. The farms are bound to arrange veterinary checkups for four times a year. This standard also limits antibiotics use to three times or less during the last production cycle. The farms that have gone for the ASC certification is bound to arrange vaccinations. The ASC standards also use the Parasiticide treatment index (PTI) to regulate the parasiticide usage. The PTI level shall not cross 13, and this also requires a decrease of treatments by 15percent compared to the last two production cycles.

Feed:

The goals set by the Norwegian Government in 2009 include the sustainability of feed and feed resources. However, this goal is very generic and does not specify sustainability indicators and related thresholds for societal/political acceptance of fish farming's environmental impact in Norway (Taranger et al., 2015). Thus the Norwegian regulation does not score anything relating to the variable selected under the feed impact category.

Farms under the ASC certification are bound to collect seafood ingredients from the MSC or another ISEAL member only. The ASC is also concerned about the sustainable use of terrestrial components and requires its members to collect soy ingredients from the suppliers certified by the Roundtable for Responsible Soy (RTRS) or equivalent.

Waste Management:

The waste management under Norwegian legislation is rigorous enough. It demands farmers to monitor and test the aquatic environment as vigorously and frequently. The testing requirement for benthic flora/fauna can vary depending on the site. Farms need to perform Sediment measuring tests to have proper control over the pollution being caused by fish feed residue or medicinal treatments. How frequently the tests shall be performed depends on the results from previous tests, but sometimes the frequency can be as often as once every three months. Farms having copper treated net are allowed to clean in situ. However, if the sediment tests show high levels of Cu, consequences can vary.

Regarding the benthic flora/fauna, ASC restricts the limit to 100 organisms per square meter. To measure the impact on the Sediment caused by the medicinal treatment or feed residue, ASC follows test standards like ISO 8265, 7828 & 9391: Redox, S2, Cu, P, Zn, CN-, F-. How many times the farm should go through the test depends on the test's type and the last test result. ASC member farms are not allowed to clean copper treated net in situ in the marine environment.

Table 1. Comparison between the impact categories in the ASC standard and the national/regional requirements.

Impact category 1: Escapees		
	ASC	Norwegian legislation
Maximum allowable escapes	≤300 per production cycle	No maximum
Impact Category 2: Interaction with wildlife		
	ASC	**Norwegian legislation**
Use of Acoustic Deterrent Systems	Not allowed	Allowed
Lethal action against predator	Only after authorization from appropriate authorities, and never on endangered species	Only after authorization from appropriate authorities, and never on endangered species
Impact Category 3: Fish health		
	ASC	**Norwegian legislation**
Regulatory prohibitions against using any critically important antibiotic for human health	Yes	No
Therapeutic treatment use	After consultation and prescription by a licensed veterinarian	After consultation and prescription by a licensed veterinarian
Sea lice monitoring	Weekly or monthly, depending on wild stock populations in the proximity	Weekly if water temperatures are >4 °C, bi-weekly if < 4 °C
Sea lice count threshold	0.1 mature lice per salmon	0.2 lice during wild salmon migration period, otherwise 0,5
Veterinary checkups	Four times a year	4-6 times annually, depending on the size of the farm
Number of antibiotic treatments during the last production cycle	≤Three times	No maximum
Vaccination	Yes	Yes
Parasiticide use	Parasiticide treatment index (PTI)≤13. Furthermore, a decrease of treatments by 15percent in comparison to the last two production cycles	No maximum
Impact Category 4: Feed		
	ASC	Norwegian legislation

Certified sustainable seafood Ingredients	Yes, from MSC or another ISEAL member	Not a requirement
Certified sustainable terrestrial ingredients	Yes, for soy ingredients. They need to be certified by the Roundtable for Responsible Soy (RTRS) or equivalent	Not a requirement

Impact Category 5: Waste Management		
	ASC	**Norwegian legislation**
Benthic flora/fauna requirements	100 organisms/m2	Site specific requirements
Sediment measuring tests	ISO 8265, 7828 & 9391: Redox, S2, Cu, P, Zn, CN-, F-, medicinal- and feed Residue	NS-9410 & NS-9423: pH, eH, Redox, Fish feed residue, medicinal compounds
Frequency of tests	Depending on the test and how well the last test went	Depending on the previous test results, but as often as every three months in some cases
Copper treated net cleaning	Cannot be cleaned in situ in the marine environment	In situ, cleaning is allowed and practiced. However, there will be consequences if sediment tests show high levels of Cu.

Based on the comparison, the below table to calculate potential additionality has been developed. The concept of potential additionality was explained in the method chapter; however, below is a quick recap for better understanding:

- *S* represents the relative stringency, the ASC in this case
- *BAU* (Business As Usual) is the function of governmental policies.
- *A* is the potential additionality, the difference between the relative stringency *(S)* and the Business as usual *(BAU)*, the formula is as follows:

$$A = S - BAU$$

The detailed calculation of potential additionalities that the ASC standards can bring is as follows.

Establishing potential additionality for escape:

As we can see in the comparison table, the ASC has a more stringent rule for 1 out of 1 variables. Thus the *BAU*= 0 *p* out of *1* = 0

Potential additionality by the ASC standards:

A (escape) = $S - BAU$ = (*1.0 - 0*) = ***1***

- ***Establishing potential additionality for interaction with wildlife standards:***

As we can see in the comparison table, the ASC has more stringent rule for 1 out of 2 variables. Thus the *BAU*= 1 *p* out of *2* = 0.5

Potential additionality by the ASC standards:

A (interaction with wildlife) = $S - BAU$ = (*1.0 - 0.5*) = ***0.5***

- ***Establishing the potential additionality for fish health standards:***

For the fish health, we can see in the comparison table that the ASC has more stringent rules about four categories; thus, the *BAU* = 4 *p* out of 8 = 0.5

Potential additionality by the ASC standards:

A (fish health) = $S - BAU$ = *(1.0 – 0.5)* = ***0.5***

- ***Establishing potential additionality for feed standards:***

For feed standards, ASC has stricter rule than the national legislations; thus the *BAU*= 0 *p* out of 2 = 0

Potential additionality by the ASC standards:

A (feed) = *S* − *BAU* = (1.0 – 0) = ***1***

- ***Establishing potential additionality for waste management standards:***

Two of the five variables under the waste management, Norwegian legislation, and the ASC, have proper regulation. Thus the *BAU*= 2 *p* out of 4 = *0.5*

A (waste management) = *(S − BAU) = (1.0 - 0.5)* = ***0.5***

Now, putting all those potential additionalities in the following table to get the final result:

1	***Escape***	***1***
2	***Interaction with wildlife (A):***	***0.5***
	1.1. Use of Acoustic Deterrent Systems (p)	1
	1.2. Predator and endangered species protection (p)	0
3	***Fish health (A):***	***0.5***
	2.1. Regulations against using critically essential antibiotics (p	1
	2.2. Veterinary prescriptions (p)	0
	2.3. Frequency of veterinary visits (p)	0
	2.4. Use of vaccines to combat known diseases (p)	0
	2.5. Number of antibiotic treatments per production cycle (p)	1
	2.6. Sea lice thresholds (p)	1
	2.7.Sea lice monitoring (p)	0
	2.8.Parasiticide treatments (p)	1
4	***Feed requirements (A)***	***1***
	3.1.Requirements on sustainably certified fish products (p)	1
	3.2.Requirements on sustainably certified soy products (p)	1
5	***Waste management (A)***	***0.5***
	4.1. Benthic flora/fauna count requirements (p)	0
	4.2. Sediment measuring tests (p)	1
	4.3. Frequency of measuring tests (p)	1
	4.4. Copper treated net cleaning in situ in marine environments (p)	0
Total Average (A) = (1+0.5+0.5+1+0.5)/5		***0.7***

5.11 Comparison based on the Social pillar of sustainability:

The global sustainability discussions, including fisheries management, are more focused on environmental and economic sustainability, but social sustainability is also getting more attention recently. Focusing on social sustainability is important not only because this plays an important role to enable other sustainability initiatives, but also because social injustice of a supply chain can lead the farms to face significant losses throughout the chain (Nøstvold et al., 2019).

The Norwegian seafood industry is the second-largest seafood exporters globally and is serving approximately 145 markets around the globe. The TLS, which is dedicated governance system for the Norwegian aquaculture, equipped with only one environmental indicator. However, other general legislations in the Norwegian labour market considers workers' rights and safety as vital and covers fundamental human rights like slavery, trafficking, child labor, decent working conditions, social security, equality, and safety (Nøstvold et al., 2019). As a private regulatory body, the ASC also has standards to develop and operate farms in a socially responsible manner and deals with the safety and rights of the workers at work (The ASC Salmon Standard, 2019). To balance between the public governance and the ASC standards, this study relies on the basic impact categories that both the governance are consists of.

Permit for area use: As already discussed in the previous chapter, the Norwegian governance has proper regulation regarding area use. § 8-13 of the Traffic Light System states the detail about the area regulation. According to this rule, MTIF decides if the production capacity in a production zone should be adjusted depending on the environmental capacity. The production capacity adjustment by the MTIF happens once every two years (MTIF, 2015).

On the other hand, the ASC does not have any specific regulations related to the area usage. However, principle 1 of The ASC Salmon Standards states that any farm certified against the standard shall comply with all applicable national laws and local regulations (ASC, 2019)

¨Principle one is intended to ensure that all farms aiming to be certified against the ASC Salmon Standard standards meet their legal obligations as a baseline requirement. Adhering to the law will ensure that producers meet the basic environmental and social requirements

and the minimal structures, such as legitimate land tenure rights, on which the effectiveness of the requirements will stand.¨ (The ASC Salmon Standard, 2019)

Impact Category 2: Job condition: The second impact category consists of several vital variables related to the labor market. As discussed before, Norwegian fisheries are socially sustainable, and this industry is free from any severe kind of violation of human rights, slavery, and child labor. Addressing all those issues through excellent and sound governance is the key to keep the industry socially sustainable (Nøstvold et al., 2019). However, some areas, foreign labor as an example, are still facing some challenges. Authorities and trade unions are concerned about these issues and continuously improve the scenario (Nøstvold et al., 2019). Being a part of the so-called EEA-Agreement with the EU, Norway implements most EU regulations and directives into Norwegian law, including regulations and directives regarding Labour Law. There are several public policies in place to protect and benefit the individual employees at the workplace. The most important among these are the *Working Environment Act*, which came into effect in 2005. This law regulates job-related issues like job security, working hours, termination of employment relationships, and health and safety. *The Labour Disputes Act 2012* regulates disputes between the labor market parties, which can either be legal disputes concerning interpretation of collective agreements; or on-jural disputes concerning the creation and renewal of collective agreements. The *Annual Holiday Act* is also important as it regulates annual holidays and holiday payments for employees. Although the Working Environment Act imposes a general prohibition on discrimination, the Equality *and Anti-Discrimination Act* came into effect to strengthen the protection of discrimination by making legislation more accessible to those who enjoy protection under the law.

Norwegian regulation is strict and has made it mandatory to have a formal and written agreement between parties relating to the employment conditions. On the other hand, criterion 6.7 under principle 6 of the ASC Standards is dedicated to describe that the farm shall have contracts with 100percent of its employees.

Under Norwegian governance, working hours and overtime of employees are subject to strict and detailed rules. Ordinary general working hours are not to be more than ten hours a day

and 40 hours per week, including breaks. However, most of Norway's collective agreements state that the ordinary working hours should not exceed 7,5 hours per 24 hours and 37,5 hours per seven days. The Working Environment Act also states that the overtime work shall be performed only in exceptional cases and shall be subject to supplementary payment. Regarding the working hours, The ASC Salmon standard relies on local legislations and states that, ¨ In cases where local legislation on working hours and overtime exceed internationally accepted recommendations (48 regular hours, 12 hours overtime), the international standards will apply¨. ASC also does not encourage unlimited overtime and requires overtime work voluntarily, with the payment at a premium rate.

The Norwegian legislation considers training at the workplace necessary. The employer is responsible for ensuring that the employees receive the necessary training, practice, and instruction to maintain safety. This act also requires the employer to appoint safety representatives to ensure that employees receive the necessary training to properly perform their duties. The ASC Standards require the farm to perform training that is beneficial to companies and enable workers to improve their incomes regularly, and the record should be documented.

Section 11-1 explains regulation regarding prohibition against child labor in Norway. School-going children under 15 years of old are not allowed to work unless the work is cultural or light, or the work is a part of their schooling and is approved by the school. People below the age of 18 are not allowed to perform any work that is detrimental to their safety, health, development, or schooling. On the other hand, the ASC standards define a child as a person under 15 and does not allow child labor at work. However, the minimum age of a child can be 14 only if the country allows it. It also requires 100percent of the young workers protected. Those between the ages of 15 and 18 are not allowed to be exposed to hazardous health and safety conditions. This age group's work time shall not exceed 10 hours and shall not interfere with their education.

The Norwegian public governance ensures employees right to access the unions. All the employees also are entitled to bargain, and their accessibility to the association requires to be evident. The farms certified against ASC standards are also bound to allow their employees to access trade unions (if exist) and to bargain collectively to establish their rights.

The Norwegian Labour Law has been grounded upon the legal dispute resolution mechanisms implemented through legislation, making the Norwegian labor market a relatively low conflict area. The State Mediator is responsible for resolving conflicts between the unions on one side and the employers and their organizations on the other. The dispute needs to be solved through the State Mediator's involvement, but a compulsory Pay Board may be imposed if it fails. The ASC standards demand the farms to handle the grievance within a timeframe of 90 days. According to Criterion 6.8, all the workers shall have access to effective, fair, and confidential grievance procedures, and the process needs to be documented.

Several acts under Norwegian public regulations state prohibition of discrimination concerning employment, work-life, and the workplace. These acts all together promote equality at the workplace and prevent discrimination on the ground of gender, pregnancy, leave in connection with childbirth or adoption, care responsibilities, ethnicity, religion, belief, disability, sexual orientation, gender identity, gender expression, age, or other significant characteristics of a person. Criterion 6.4 of the ASC Salmon Standards also prohibits discrimination at the workplace and states that discriminating workplace incidents shall be zero. It also requires evidence of comprehensive and proactive anti-discrimination policies, procedures, and practices in practice.

Impact Category 3: Occupational safety: The Working Environment Act under The Norwegian legislation requires the employer to ensure that employees are well informed about the risks of accidents associated with their work. The employer is also responsible for providing necessary training, practice, and instructions to the employees. The employer must also provide expert assistance when needed. The ASC Salmon Standards also requires all the workers to be trained on HS practices, risk assessment documentation, and prevention measures. The farm also must record all the HS related incidents and shall take corrective actions.

Impact Category 4: Indigenous rights: The Norwegian regulations do not talk that much about indigenous rights. However, The ASC Standards require that the farms certified against the standards must have Protocol agreement and consultation with indigenous groups, and those must be evident.

Impact Category 5: Community engagement: Like the previous impact category, Norwegian legislation does not have any clear and strict regulations relating to the industry's community engagement. The ASC Standards, on the other hand, requires the farms to post policies, engagements, and notifications to the community and make them evident.

The impact categories explained above are put into the below table to make the comparison easier:

Impact Category 1: Permit for area use:		
	ASC	**Norwegian legislation**
Permit for area use	No, but they follow local legislative guidelines	Yes, the TLS
Impact Category 2: Job condition		
	ASC	**Norwegian legislation**
Employment contract	Mandatory	Mandatory
Minimum wage	No specified minimum wage	No statutory provision but can have collective agreement.
Working hours and overtime	Policies in place. OT must be voluntary, and supplement shall be paid on top of regular payment	Policies in place. OT must be voluntary, and supplement shall be paid on top of regular payment
Training	Must be regular and evident	The employer is obligated to undergo training in health, environment, and safety
Child/ young/ bonded labour	Zero tolerance	Prohibited by law with some exceptions
Association and bargaining	Workers must have the right to bargain, and their accessibility to unions must be evident	Workers have the right to engaged with unions.
Dispute resolution	Workers must have access to the proper grievance procedure; the grievance handling timeframe is 90 days.	Dispute resolution has been protected by working environment law, chapter 17

Discrimination	Zero tolerance, anti-discrimination policies, procedures, and practices must be evident.	Discrimination, either directly or indirectly, is prohibited by law
Impact Category 3: Occupational safety		
	ASC	**Norwegian legislation**
Occupational safety	Requires all the workers are trained on HS practices, documentation of risk assessment and prevention measures are necessary, HS related incidents must be recorded, and corrective actions should be taken	The employer is obligated to undergo training in health, environment, and safety
Impact Category 4: Indigenous rights		
	ASC	**Norwegian legislation**
Indigenous rights	Protocol agreement and consultation with indigenous groups must be evident	No
Impact Category 5: Community engagement		
	ASC	**Norwegian legislation**
Community engagement	Policies, engagements, and notifications posted to the community must be evident	No

Below is the calculation of the potential additionality based on the comparison table above:

- ***Establishing potential additionality for standards on area usage:***

BAU= 1 p out of 1 = 1

A (area use) = S − BAU = (1.0 – 1.0) = 0

- ***Establishing the potential additionality for job condition:***

BAU = 8 p out of 8 = 1

A (job condition) = S − BAU = (1.0 – 1.0) = 0

- ***Establishing potential additionality for Occupational health and safety:***

BAU= 1 p out of 1 = 1

A (feed) = S − BAU = (1.0 – 0.1) = 0

- ***Establishing potential additionality for Indigenous rights:***

BAU= 0 p out of 1 = 0

A (indigenous rights) = (S − BAU) = (1.0 - 0) = 1

- ***Establishing potential additionality for community engagement:***

BAU= 0 p out of 1 = 0

A (community engagement) = (S − BAU) = (1.0 - 0) = 1

Finally, below table summarises the results of potential additionality derived from above calculations:

1	***Permit for area use: (A):***	***0***
2	***Job condition: (A):***	***0***
	2.1. Employment contract (p)	0
	2.2. Minimum wage (p)	0
	2.3. Working hours and overtime (p)	0
	2.4. Training (p)	0
	2.5. Child/ young/ bonded labour (p	0
	2.6. Association and bargaining (p)	0
	2.7. Dispute resolution (p)	0
	2.8. Discrimination	0
3	***Occupational safety (A)***	***0***
4	***Indigenous rights (A)***	***1***
5	***Community engagement (A)***	***1***
Total average (A)= (0+0+0+1+1)/5		***0.4***

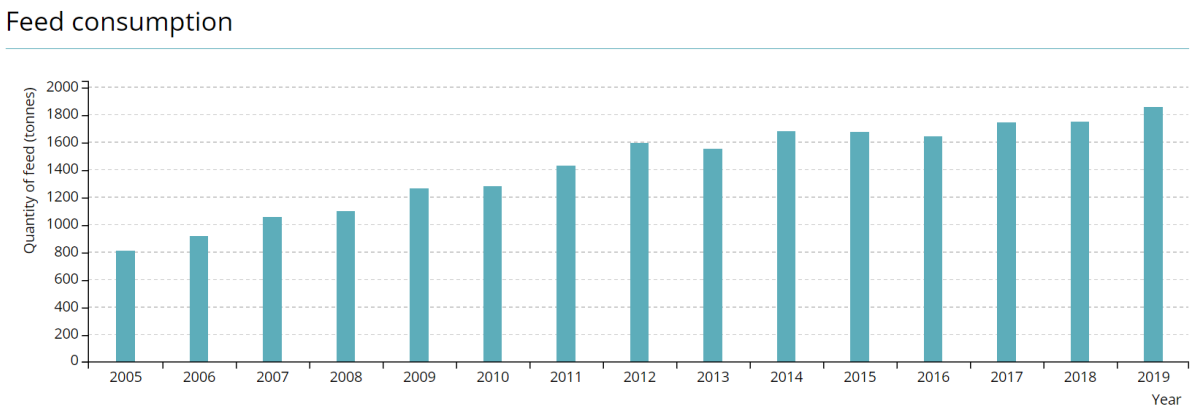
5.12 Comparison based on the Economic pillar of sustainability:

Economic sustainability can be referred to either as the continued success of an economy over time or how it operates sustainably, protecting social and environmental elements. According to the University of Mary Washington, ¨Economic sustainability refers to practices that support long-term economic growth without negatively impacting social, environmental, and cultural aspects of the community". This definition holds a greener view as it brings environmental and social factors into the mix for sustained economic growth (Courtnell, 2019).

Norwegian aquaculture entered an industrial era in 1970, and state governance to regulate the industry has developed over time. The focus has been shifted to ensure local ownership and jobs to sustainability (Asche & Bjørndal, 2011). Although there is no directly related indicator to calculate the economic sustainability, other social and environmental indicators impact on the economy can be utilized to calculate the economic effects of the regulation.

Impact category 1: Feed ingredients converted into fish: Fodder is the largest expense item for the fish farmers, and so, efficiency in converting the feed ingredient to fish as the final product is crucial. The amount of feed consumption is increasing every year, along with the industry's expansion. Below figure shows year by year increment of the feed consumption by the industry:

Feed consumption by the industry:



Year by year food consumption (Nofima, SINTEF Ocean and BarentsWatch, 2020)

Section 44 of the Norwegian governance demands the farmers to report the feed consumption, wastage, slaughter, and biomass each month. The ASC standards identify the release of nutrients into the environment from salmon farms using SAD participants as a critical impact of production. Requirement 2.3.1 addresses the immediate release of uneaten feed in the form of fines into the environment. Setting a maximum percentage of fines in the feed also addresses the efficient and proper transport, storage, and physical delivery of feed pellets to the farm site—poor performance in any of the above phases of feed handling results in a higher percentage of fines.

Impact category 2: Technical requirement to prevent escape: Escapement of the farmed salmon is not only a threat to the environment; it also causes economic loss to the industry. Thus, when the governance systems work to regulate escapes, they also indirectly limit the financial loss.

Under section 38 of the Norwegian Aquaculture Regulation, all fish farmers are bound to report the number of escaped fish to the Directorate of Fisheries. The reporting must be done as soon as the escape has been discovered or suspected. Massive as well as small incidents, must be reported. According to the ASC Standards, farms shall report all escapes. Unlike the Norwegian regulation, the total aggregate number of escapees per production cycle must be less than 300 fish.

Based on the regulations that have impacts on the economic sustainability of the industry, the below tables helps comparing between the Norwegian regulation and the ASC Standards:

Impact category	**ASC**	**Norwegian legislation**
1. Feed ingredients converted into fish	- Mandatory reporting - Poor performance can lead to a percentage of fine.	Reporting of the feed consumption, wastage, slaughter, and biomass is mandatory every month.
2. Requirement to prevent escape	The maximum number of escaped fish per cycle is less than 300	Escaped fish must be recaptured immediately, and the incident must be reported

The detailed calculation of potential economic additionalities that the ASC standards can bring is as follows.

Establishing potential additionality for feed ingredients converted into fish:

As we can see in the comparison table, both the ASC and the Norwegian regulation has stringent rule captioned variables. Thus the *BAU*= 1 *p* out of *1* = 1

Potential additionality by the ASC standards:

A (*feed ingredients converted into fish*) = *S − BAU* = (*1.0 – 1.0*) = ***0***

Establishing potential additionality for escape:

As we can see in the comparison table, the ASC has a more stringent rule for 1 out of 1 variables. Thus the *BAU*= 0 *p* out of *1* = 0

Potential additionality by the ASC standards:

A (escape) = *S − BAU* = (*1.0 - 0*) = ***1***

Finally, the below table summarises the results of potential economic additionality derived from the above calculations:

1	***Feed ingredients converted into fish (A):***	***0***
2	***Escapes (A)***	***1***
Total average (A)= (0+1)/2		***0.5***

The below table summarises the potential additionality that the ASC can bring in all three pillar os sustainability:

Impact Category	Environmental	Social	Economic
Potential additionality	0.7	0.4	0.5

6 Discussion:

Natural conditions like longer coastlines, biological and technological advancements are considered the factors behind the Norwegian salmon farming industry's success. However, a sound governance system and the regulatory frameworks are also important (Osmundsen et al., 2017). Previous research argues a strong relationship between stable and quality governance with technological adoption (Kumar et al., 2018). Good governance is also connected with the possibilities of expansion (Young et al., 2019). The Norwegian aquaculture industry is a multi-million-dollar industry, and its goal is not only to multiply its production level by five times within 2050, but this industry also is committed to do that sustainably. This is why governing the industry gives birth to controversies and becomes more challenging. This part of the thesis is designed to discuss the results presented in the last chapter to illuminate the research question's content.

As discussed earlier, Norwegian aquaculture governance is a combination of different regulations, of which the TLS is the latest addition. When the white paper related to the TLS came into effect, most of the industry agreed with it and expressed the necessity to establish an improved environmental control. It was also agreed that the salmon lice could be used as a good indicator of salmon farming's environmental impact. However, there is resistance against this agreement too.

Over the last ten years, science has made more knowledge available about sea lice. The increased knowledge enabled the parasite to indicate the environmental impact on the wild salmon stock. Different statistical overviews have been developed; models and tools are available to help the decision-making process. All the industry stakeholders are not convinced of the scientific ground of the sea lice-based governance system. The salmon lice may be considered essential to assess the environmental impact but showcases only a part of the whole picture. Besides, the problem with having only one indicator is that the focus becomes very narrow. By placing such an emphasis on local externalities of aquaculture production, important broader scale impacts of the industry are, to a large degree, not addressed (Amundsen et al., 2019).

The lice are counted and reported to the authority by the farms representatives, and thus are not entirely reliable. Besides, the idea of using sea lice as the sole indicator is argued to be very narrow. Even many of the personnel in public agencies acknowledge the importance of having more knowledge about this topic. For example, the Norwegian Seafood Federation argues that using salmon lice as a proxy for environmental control is not enough. This argument's logic is that the assertation of correlation between the mortality of emigrating wild stock and the infestation level of lice in the farmed salmon is not based on firm scientific ground. (Osmundsen et al., 2020).

The amount of the infestation depends on the geographical variation. Nevertheless, the geographical variations are not considered when the coordinated delousing medication is enforced in areas among several fish farms (Osmundsen et al., 2020). This is not always acceptable to the farmers who have zero or less infestation as they still have to use the medicinal treatment, even without being sure why. The industry also argues about the significance of the lice issue and the way to deal with it.

The White Paper's suggestion to use the salmon lice as an indicator is claimed to be very weak and very strict at the same time. The disagreement highlights the concern about the number and level of lice that indicates appropriate measures to be taken by the farm. The permissible lice limit has been decreased which can lead to more delousing treatment, which may have various adverse reactions to the farm and the fish itself. Firstly, more frequent delousing operations can cause more stress, high mortality, and reduced growth and weaken salmon's immunity (Osmundsen et al., 2020). This may also increase the risk to the personnel employed to do the delousing treatment. Moreover, the chance of getting the net pen damaged increases, which may cause more escapes.

How the public authority represents the sea lice as an indicator has created several impressions. The first one is that lice counting is a routine task and is not susceptible to bias. Another impression is that even though the medicinal treatments against sea lice were limited, there were other measures (like cleaner fish). However, these alternative measures, cleaner fish, have negative consequences for fish welfare as they cause stress and mortality (Holen et al., 2018).

Although the white paper discusses the use of other indicators like fish escape, or discharge, they have not been considered as governable objects as much as salmon lice had. The reason can be their lack of preciseness or easy countability. Also, it is vital to gather enough knowledge before these indicators come into effect.

Although the TLS, deals with environmental indicator to regulate the industry, the result from the previous chapter shows that the ASC can have the most potential additionality on the environmental impact category, which is 0.7. Among all the variables under this category, the feed impact is where the ASC has the highest potential to additionality. There is still much room for the public governance to strengthen the regulation by improving the requirements to collect feed ingredients from sustainable sources. However, the ASC standards also has room to strengthen its stringency in this category as they do not adequately address the dependency on the fish oil or fish meal as raw material for fish feed.

The spread of the sea lice has been considered the main threat to the wild salmon stock, and thus, national legislation in Norway pay enough attention to this. Sea lice is the only environmental indicator that The TLS deals with and the prevalence of sea lice among the wild stocks determines the production growth in an area (Olaussen, 2018). The TLS demands the average of motile female sea lice to be less than 0.2 per salmon during wild salmon migration periods. The rate can be higher up to 0.5 during the rest of the year. However, the maximum number that the ASC allows is 0.1 mature female lice per salmon during the migration periods (ASC Standards, 2012).

The ASC also has stricter regulations relating to the number of parasiticide used in every production cycle. However, the amount of antibiotic use in Norwegian farms is generally less than other salmon farming countries, so the ASC's additionality can is low.

Interesting finding in this paper shows that the general public regulation being used to address social issues have proper control over the industry, and thus, the ASC has the lowest potential additionality in this area. Besides, production zone regulation is one of the three core concepts of the TLS, but the ASC standards does not have any dedicated standard for this. However, the ASC requires all its members to follow local and regional regulations, so the Norwegian farms certified against the ASC standards are still bound to follow along the TLS requirements.

The Norwegian national regulations relating to the job conditions are very sound and employee friendly. The ASC has almost the same standards as the national legislation and has no additionality to bring over the national regulations. However, the ASC requires its members to ensure indigenous rights and be more engaged with the community, which is weaker in the Norwegian national legislation.

Another interesting finding is that neither the Norwegian regulations, nor the ASC standards directly address the industry's impacts on the economic pillar. Few regulations to address the environmental issues can indirectly address the economic issues as well. This paper identified two environmental factors that indirectly address the economic issues. The efficient use of ingredients converted to fish feed can decrease feed production cost and increase profitability. The ASC standards and the Norwegian regulations made it mandatory for the farms to report the feed consumption and wastage periodically. Nevertheless, the ASC is more stringent than the national regulation as poor performance on this by the member can lead to a penalty.

Farmed fish escape impacts the environment, but handling this efficiently is also important to reduce the economic loss. Norwegian regulation demands the farms to report the escaped fish as soon as the incident happens. Farms are also bound to recapture escaped fish immediately. In this category also, the ASC standards is more strict as it has a maximum allowable limit of the escaped fish that the Norwegian national regulation lacks.

Although the ASC standards have potential additionality over the Norwegian regulations, there are still some environmental risks unattended. The certified salmon farms still operate their production in the open net-pen, which poses the risk of escapement, disease, and discharging. These issues can only be handled when the farms are transferred to land-based facilities. The ASC standards has a lower limit of fish escapes compared to the national legislation. However, this does not terminate the consequences of escaped farmed fish on the wild stock as they still allows few escapes under certain external rare incidents.

The salmon farming policies shall be improved to address the impacts on the industry's sustainability pillars. For instance, the national legislation may have stricter rules against the use of antibiotics listed by the WHO. Furthermore, considering the social impact category, farms' responsibility to the indigenous people or community engagement shall be more strictly regulated by the national legislations.

Although the ASC can bring some potential additionality, one primary purpose of the certification scheme shall be to complement and build international standards around local or regional judicial requirements (Bernstein & Cashore, 2007). There should not be any contradiction between certification schemes and actions from the local or regional agencies, instead the certification schemes should work to add to the existing regulation to help producers, consumers, and retailers in making environmentally conscious choices (Bernstein & Cashore, 2007). The great side of the ASC standard is that the farms certified against the standards abide by this requirement in its principle#1:

Principle 1 is intended to ensure that all farms aiming to be certified against the ASC Salmon Standard standards meet their legal obligations as a baseline requirement. Adhering to the law will ensure that producers meet the necessary environmental and social requirements and the minimal structures, such as legitimate land tenure rights, on which the effectiveness of the requirements will stand. (ASC Salmon Standard, version 1.3)

The Government and intergovernmental agencies need to come forward to create a two-way collaboration by composing requirements for private eco-labeling initiatives to abide by. Many states are now supporting certification schemes and are aiming to provide incentives for fisheries to become certified (Gulbrandsen, 2014). A similar trend has been observed in Norwegian aquaculture governance as well, where the state is collaborating with the companies to increase ASC certified farms (Vormedal, 2017).

7 Conclusion:

The Norwegian aquaculture industry has its own national regulatory framework to address the sustainability issues. Although TLS, the dedicated public governance system is dependent on only one environmental indicator, the general governance tools are backing up the industry's impact on social pillar well. However, lack of proper governmental regulations to support the economic sustainability demands sufficient attention. The ASC on the other hand, has stricter regulatory tools that offers more sustainable governance. But the ASC certification does not guarantee complete elimination of negative impacts on local ecosystems or wildlife. Despite

of having more potential additionality, the goal of the ASC standards shall never be to supplement or supplant the national regulations. Instead, as stated in the ASC's first principle, all its member farms shall be obligated to adhere to the local law.

7.1 Limitation and future scope of studies:

Apart from the TLS, other general regulations being used to regulate the industry is vast in nature. The variables of the impact categories to compare has been selected based on the variables that the ASC standards already have. Thus the selection process was not totally balanced. This limitation leaves the future researchers with the opportunity to study more to find out already available national regulations that can strengthen the TLS to address social and economic issues.

7.2 Methodological limitations:

Determining the effects of regulatory environmental stringency and the level of the industries sustainability is difficult and not free from obstacles. As identified by Brunel and Levison (2013), there are four conceptual problems with determining stringency: 1) its difficult to represent environmental regulations by only one measure of "stringency"; (2) countries who has strong economic condition or bad environmental pollution may impose the most stringent regulations; (3) countries may have higher average abatement costs and measured regulatory stringency due to mixed industries and average more pollution intensive; and (4) capital vintage – regulatory standards are typically tighter for new sources of pollution, with implication to the environment, the economy, and measures of regulatory stringency (Brunel & Levison, 2013)." Besides, the determination of stringency depends on the information provided by the government.

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9 Appendix: Section 12 (the exemption rule)

9.1 From the Production Area Regulation

§ 12.Tilbud om kapasitetsøkning uavhengig av miljøstatus i produksjonsområdet

Uavhengig av miljøstatus i produksjonsområdet, kan departementet gi tilbud til innehaver av tillatelse som har lokaliteter der

a) lakseluslarver ikke slippes ut i frie vannmasser, og dette er dokumentert for den sist gjennomførte produksjonssyklusen og samtidig for en periode på minimum 12 måneder av en uhildet faginstans, eller

b) det

1. var færre enn 0,1 voksne hunnlus per fisk ved alle tellinger i perioden 1. april til 30. september, eller at utslippet av egg og frittsvømmende stadier av lakselus til miljøet ikke er større enn det utslippet ville ha vært fra et tilsvarende antall fisk med et lusenivå på 0,1 voksne hunnlus i gjennomsnitt per fisk, og

2. behandlet medikamentelt mot lakselus ikke mer enn 1 gang under den siste produksjonssyklusen. Dersom produksjonssyklusen er kortere enn 12 måneder, forlenges perioden bakover i tid til 12 måneder men samtidig slik at hele produksjonssyklusen omfattes.

Selv om det observerte lusenivået på en lokalitet overskrider lusegrensen angitt i første ledd, kan departementet likevel gi tilbud til innehaver av tillatelse så fremt den observerte verdien

1. oversteg 0,17 kun ved en telling per periode nevnt i første ledd bokstav a, og

2. et lusenivå høyere enn 0,1 voksne hunnlus ikke ble påvist i mer enn tre påfølgende tellinger i løpet av perioden.

Tilbudet vil kunne omfatte de tillatelsene som er knyttet til lokaliteten som oppfyller vilkårene. Tilbudets størrelse avgrenses i utgangspunktet av hvor stor del av den samlede tilknyttede tillatelseskapasiteten som faktisk er benyttet på lokaliteten som oppfyller vilkårene. Departementet kan redusere tilbudets størrelse forholdsmessig basert på den faktiske vektøkningen hos fisken som holdes på lokaliteten. Hver tillatelse knyttet til lokaliteten som faller inn under unntaket kan ikke økes med mer enn 6 pst. i hver tildelingsrunde. Tilbudet beregnes på grunnlag av

1. samlet vektøkning på fisk i sjø på lokalitet som oppfyller vilkårene, eller

2. samlet vektøkning på settefisk over 250 gram eller matfisk produsert for samme formål (postsmolt), som er produsert på lokalitet i sjø som oppfyller vilkårene i første ledd.

3. Matfisk som er flyttet til eller fra lokaliteten som oppfyller vilkårene, med unntak for fisk til slakt, medregnes ikke.

4. perioden 1. februar i søknadsåret og to år tilbake i tid, og snittet av de to årene legges til grunn i beregningene.

5. Dersom selskapet eller konsernet ikke har tilsvarende produksjon i samme produksjonsområde, kan departementet i beregningen av (1) og (2) legge andre erfaringstall eller estimater til grunn.

Dokumentasjon av oppfylling av vilkårene etter denne bestemmelsens første og andre ledd sendes på fastsatt skjema til Mattilsynet innen 1. mars i oddetallsår, likevel slik at i 2019 skal dokumentasjonen sendes innen 5. april 2019.

Kapasitetsjustering av maksimalt tillatt biomasse (MTB) etter denne bestemmelsen forutsetter innbetaling av et vederlag til statskassen. Vederlagets størrelse og frist for innbetaling fastsettes særskilt av departementet for hver runde med tilbud. Vederlaget blir ikke tilbakebetalt ved en eventuell senere endring eller tilbakekall av tillatelsen på grunn av forhold nevnt i akvakulturloven § 9. Det samme gjelder dersom andre forhold gjør at tillatelsen helt eller delvis taper sin verdi.

Det skal betales gebyr for tilsyn utført etter denne bestemmelsen.

Endret ved forskrifter 7 juli 2017 nr. 1161, 20 feb 2019 nr. 216.

Source: (Lovdata, 2017,a).

9.2 From the Capacity Adjustment Regulation (2017-2018)

§ 12.Tilbud om kapasitetsøkning uavhengig av miljøstatus i produksjonsområdet

Innehaver av tillatelse som nevnt i § 2 kan sende søknad om å motta tilbud om kapasitetsøkning. For å motta tilbud må innehaverens tillatelse ha vært eller være tilknyttet en lokalitet der

a) lakseluslarver ikke slippes ut i frie vannmasser, og dette er dokumentert av en uhildet faginstans for den sist gjennomførte produksjonssyklusen og samtidig for en periode på minimum 12 måneder, eller

b) det

1. var færre enn 0,1 voksne hunnlus per fisk ved alle tellinger i perioden 1. april til 30. september i årene 2016 og 2017, eller at utslippet av egg og frittsvømmende stadier av lakselus til miljøet ikke er større enn det utslippet ville ha vært fra et tilsvarende antall fisk med et lusenivå på 0,1 voksne hunnlus i gjennomsnitt per fisk,

2. ikke er behandlet medikamentelt mot lakselus mer enn 1 gang under den siste produksjonssyklusen. Dersom produksjonssyklusen er kortere enn 12 måneder, forlenges perioden bakover i tid til 12 måneder, men samtidig slik at hele produksjonssyklusen omfattes,

3. ikke er truffet vedtak om reduksjon av maksimalt tillatt biomasse, og dette vedtaket har hatt effekt innenfor kalenderårene 2016 og 2017.

Selv om det observerte lusenivået på en lokalitet overskrider lusegrensen angitt i første ledd bokstav b) nr. 1 og 2, kan fylkeskommunen likevel gi tilbud til innehaver av tillatelse så fremt den observerte verdien

a) oversteg 0,17 kun ved en telling per periode per kalenderår nevnt i første ledd, og
b) et lusenivå høyere enn 0,1 voksne hunnlus ikke ble påvist i mer enn tre påfølgende tellinger i løpet av perioden per kalenderår.

Source: (Lovdata, 2017,b)