THE STANDARD DILEMMA: A COMPARATIVE ANALYSIS OF GLOBAL SALMON AQUACULTURE STANDARDS

By

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Abstract

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For the last three decade, aquaculture has been the fastest growing food production method – with particular growth within finfish species. In order to achieve its potential to feed a growing global population, however, salmon aquaculture must be able to overcome the negative impacts and encourage the positive outcomes. Certification schemes help lead the industry towards sustainable and responsible aquaculture; standards are established as an integral part of such schemes. The current salmon aquaculture standards provide a varying approach to the means of achieving these goals. Only when effective standards emerge and appropriate rigorous criteria developed, can aquaculture be truly sustainable. Standards must not only be accessible, but at the same time set high enough to move the industry in the direction of long term sustainability. This study examines the language and the development of standards as an important step in the movement towards better practices. As a large-scale predatory fish farming industry, salmon aquaculture will potentially have a significant impact on the environment that can be modulated by standards with criteria that incorporate all aspects related to the production of farmed salmon. The solution to the standard dilemma must encompass both increased participation amongst salmon producers as well as more stringent standards. Such a solution faces a number of challenges and will require the cooperation of multiple stakeholders and a desire on the part of everyone to work towards better environmental, social and animal welfare standards.

Keywords: Salmon aquaculture standards, environmental and social impacts, better management practices, sustainable aquaculture

List of Acronyms & Abbreviations

BAP: Best Aquaculture Practice

COADS: Canadian Organic Aquaculture Draft Standards

FAO: Food and Agricultural Organization

GAA: Global Aquaculture Alliance

GOC: Government of Canada

ISEAL: International

NOAS: Naturland Organic Aquaculture Standards

SAD: Salmon Aquaculture Dialogue

SADDS: Salmon Aquaculture Dialogue Draft Standards

WWF: World Wildlife Fund for Nature

CHAPTER 1: INTRODUCTION

Today, fish from traditional wild capture fisheries in the ocean are less able to feed the growing human population due in large part to overfishing (Myers and Worm, 2003). In response, and to maintain a constant supply of seafood to a demanding population, aquaculture production has increased exponentially in the last thirty years. With the growth of aquaculture, comes environmental and social impacts needing regulating and monitoring. In particular, salmon aquaculture growth has far exceeded other cultured species to become one of the higher grossing food production methods. However, the current salmon standards are potentially not keeping up pace with the growth and not providing adequate means to encourage sustainable salmon production in the entire industry.

As an integral part of certification schemes – along with accreditation and certification – standards are the backbone and the meat that the rest of the scheme is based on. Without solid standards the label and the promises are mute. The eco-certification of aquaculture products has been gathering speed and there is a growing body of certification schemes globally. However, as a young industry, the salmon farming standards that many of these schemes are based on have not been assessed or properly evaluated. Knowing where these standards are and where they are taking the industry and the state of sustainable production is important to the furthering of aquaculture regulation. Are the standards encouraging overall sustainable practices or simply advancing a small percentage of the industry in the right direction? Furthermore, are voluntary eco-certification schemes enough to change the entire salmon industry into better management practices and clearer improvements to the traditional negative environmental and social impacts it creates.

The following study aims to take apart a selection of global salmon aquaculture standards to assess them against an evaluative framework. The study will involve a background on aspects related to standards and aquaculture, an overview of the standards assessed, scoped down standard analysis as well as a discussion and the author's recommendations. In the end certain conclusions will be drawn based on the assessment and other findings. A number of questions will be answered but a number of questions will be posed for future research and assessments.

CHAPTER 2: BACKGROUND

2.1 Aquaculture

The FAO defines aquaculture as the "farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants" (FAO, 2011, p.1). In addition, farming requires intervention in processes associated with rearing, feeding, and husbandry (FAO, 2011). One of the significant differences in the water between fisheries and aquaculture management, is that aquaculture implies ownership and private proprietorship of the stocks as well as planning and development of all processes (FAO, 2011).

2.1.1 Growth of Aquaculture

Aquaculture has been the fastest growing food producing sector over the last several decades (Tacon *et al.,* 2010; FAO, 2006; Haland, 2002). The farming of fish and other organisms has had exponential growth at a rate of nearly nine percent worldwide (FAO, 2006). According to some estimates, production from aquaculture, largely from sources in developing countries, increased from an estimated 3.9 Million Metric Tons (MMT) in 1971 to 42 MMT in 2001 (Ahmed, 2004). Aquaculture output was worth US$86 billion in 2006 compared to US$27 billion in 1990 (Hishamunda et al, 2009). In 1970, Aquaculture produced around 5.3% of all seafood eaten; by 2002 the percentage was closer to 30% (FAO, 2003). Currently, it is estimated that aquaculture produces fully half of the fish and seafood eaten globally (FAO, 2006). And predictions estimate this growth will continue at least until 2020 (Hishamunda et al, 2009; Hall et al, 2011).

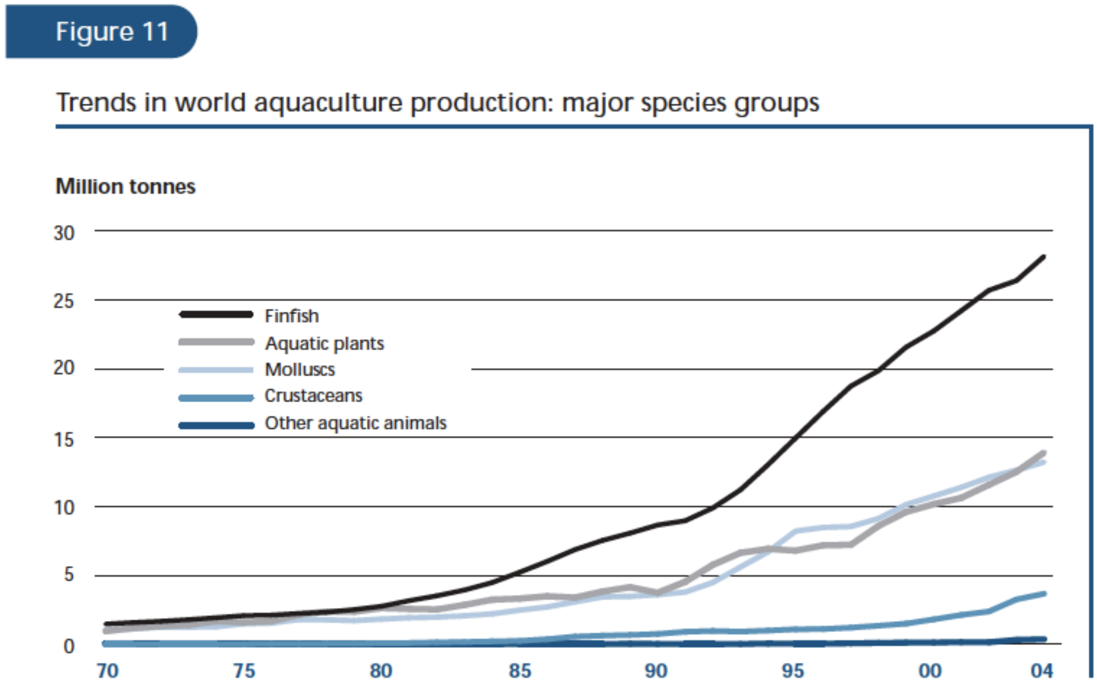

Figure 1: Trends in world aquaculture production (FAO, 2006)

In the early years, the largest sector of aquaculture was not based in the oceans, but remained relegated to fresh water and inland fisheries requiring few inputs, and that were furthermore, small-scale more traditional focused fish farms, carried out by local and artisanal farmers. In more recent years, however, aquaculture has transformed into a "large-scale science, with innovations in feed technology, cage design, and fish breeding" , whereby large farms have begun to raise high-value predatory fish (Halwell, 2008, p.5). Therefore, the growth of aquaculture has been marked not only by increases in production, but also by the shift of aquaculture from fresh water production to salt water. This trend has dominated the past two decades, giving hope to the potential for aquaculture to be able to feed more and more people, thus relieving the wild catches of the oceans of the burden to do so.

Aquaculture is one of the most environmentally efficient ways to produce animal sourced foods (Hall et al, 2011). However, increased production and increased scale of production are accompanied by increased environmental and social costs – both real and perceived – that could threaten the long-term success of the industry. Nowhere is this more apparent than in the farming of carnivorous finfish species such as salmon in open net pen aquaculture farms.

2.1.2 Salmon Aquaculture: Potential and Challenges

Salmon net pen farming originated in Norway in the early 1970s and expanded into Scotland, Japan, Chile, Canada and the United States in the 1980s (Naylor et al, 2007). The industry boomed in the 1980s, expanding by thirteen fold in its production and operations worldwide (Naylor et al, 2003). In 2002, the industry produced 1.2 million metric tons (MT) (Naylor and Burke, 2005). Today, the industry is dominated by a small number of multinationals, mostly from Europe and in particular Norway, who have created a vertically integrated supply of consistent and readily available fresh and frozen salmon products for global markets (Naylor et al, 2007). The four largest multinational companies involved in global salmon aquaculture production are Panfish, Fjord Seafood, Cermaq, and Marine Harvest (Naylor and Burke, 2005). While most other aquaculture, including much of the freshwater species developments, exists in the developing world in places such as China, finfish and in particular salmon are produced largely in the developed world (and in Chile). This production in the developed world has not only had an effect on production costs, but has also influenced how the industry is run.

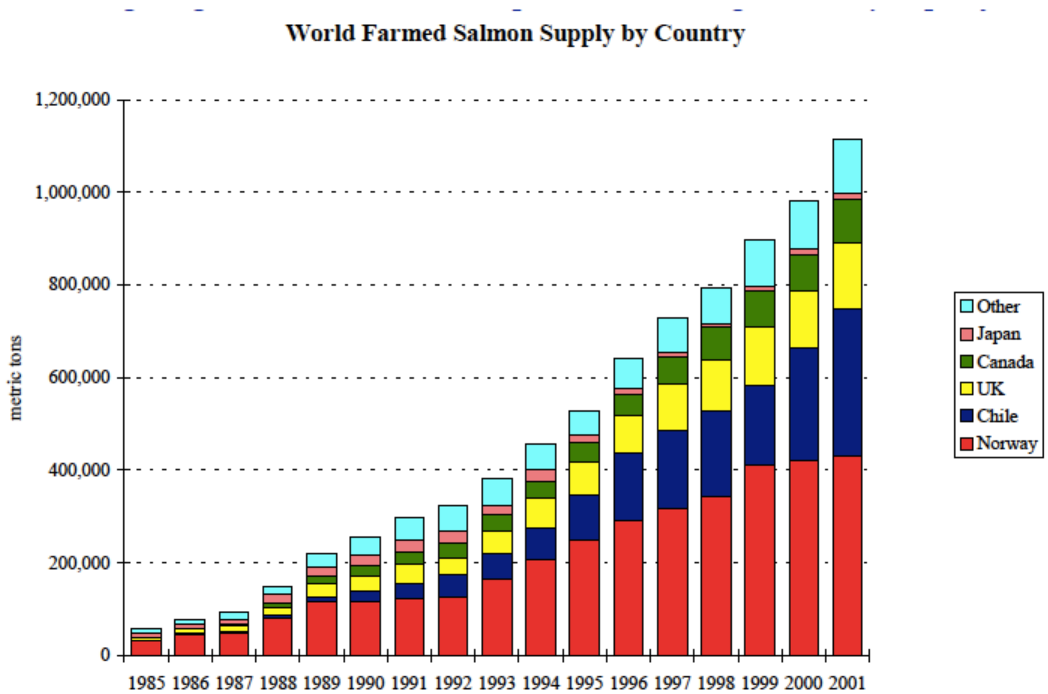

Figure 2: World farmed salmon supply by country (Knapp, 2002)

2.1.3 Environmental and Social Impacts: Negative

Some of the negative impacts are environmental (White *et al.* 2004; Duarte et al, 2009). According to some estimates, the amount of wild fish and shellfish used in products not destined directly for human consumption but used for fishmeal and fish oil to feed the aquaculture industry has increased almost tenfold, from 3 million to 28 million between 1950 and 2000 (Duarte et al, 2009). And while other industries also use fishmeal and fish oil, Tacon (2005) reported that farmed salmon consumed 10.3% of global fishmeal and 44.3% of global fish oil in 2003, proportions that can only be on the rise since then, given the industry growth. Since these fish are also food for larger predators as part of the ecosystem's food web and used for direct human consumption, one cannot help but question the long-term wisdom of this practice (Hannesson, 2002). The negative environmental impacts are pervasive: natural habitats are altered, either to make space for farms or through a build-up of nutrients and sediment; oxygen levels are reduced (as a result of eutrophication), which directly causes further negative impacts and pressure on coastal ecosystem and other wild species in the area; biodiversity is reduced; and multiple-use conflicts by and on aquaculture are increased (Frankic and Hershner, 2003). The negative impacts also extend to the widespread use of chemicals that are used on salmon farms (for example, antibiotics, parasiticides, and spawning hormones) and that may pose risks to marine organisms. The use of therapeutic compounds (both pharmaceuticals and pesticides) is thought to harm marine life around the pens, and heavy metals in sediments is postulated to damage marine life on the floor beneath the farms. The salmon farms also attract other wildlife, including birds, seals and cetaceans, potentially leading to more conflicts and incidents.

2.1.4 Environmental and Social Impacts: Positive

Conversely, there are some recognized social benefits to aquaculture. These positive aspects are often related to the economic benefits and the benefits to global food production. They can include an increase to household food supply and improved nutrition; increased household economy through diversification of income and food sources; strengthened marginal economies by increasing employment and reducing food prices through creating a downward pressure on prices (Frankic and Hershner, 2003; Lee, 2008).

Aquaculture can reduce the prices of fish available to the consumer, and increase the supply for the growing demand for fish products. The current reality is that as supply decreases, prices rise, and therefore, combined with the increased demand for fish, will cause its prices to rise as fewer wild fish are available (reduced supply) (Delgado et al, 2003). An increase in fish prices will affect all income levels, but will have the highest impact on the poor. Once the efficiencies and policies are worked out ("assuming much greater technological and policy success") aquaculture has the potential to reduce the market price of fish ("lead to a drop in the real price of low-value food fish") (Ahmed, 2004, p. 67). In addition, fish supplied by aquaculture and wild fisheries must be substitutes for each other - such as shrimp and salmon – to lead to a decrease in real price (Delgado et al, 2003). A problem with farmed salmon is that it tends to outcompete wild salmon in the marketplace (Eagle et al, 2004). Through increases and changes to the supply of fish, therefore, aquaculture can lead to a more stable market and a more affordable meal, a meal that capture fisheries cannot obtain with its current stocks.

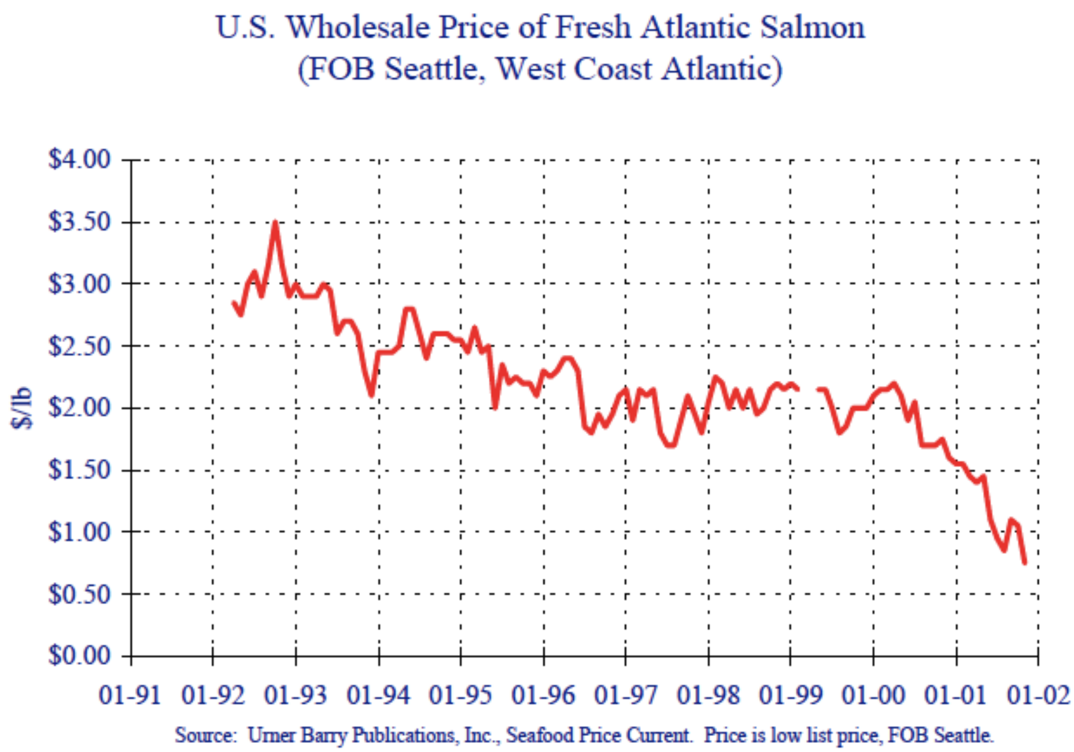

Figure 3: US wholesale price of fresh Atlantic salmon (Knapp, 2002)

Aquaculture has the potential to fully satisfy consumer demand for fish. It can supplement capture fisheries and “significantly contribute to feeding the world’s growing population" (White *et al.*, 2004, p. 4). Aquaculture could not only meet the ever increasing consumer demand for all food products, but also potentially, as mentioned above, reduce the pressure on wild capture fisheries and fish stocks.

There are a number of socio-economic advantages to aquaculture. Aquaculture can create new “economic niches” in locations where employment levels are challenges for communities. Aquaculture would provide an opportunity for creating jobs “in areas where there are few alternative job choices” (Costa-Pierce, 2002, p. 342). The future outlook of other jobs in communities now reliant on traditional commercial fisheries, when wild fish stocks are depleted, can be bleak. According to Naylor and Burke (2005), communities that have experienced significant loss of income-generating activities and employment, due to either collapsed or weak market conditions, can gain significant benefit from income generated through aquaculture activities.

Aquaculture can therefore provide a viable alternative, a resilient and robust means of ensuring survival for communities when capture fisheries are no longer a viable option. If fishery managers provide opportunities for diversifying income through aquaculture (Tacon *et al*., 2010), then those communities will be less vulnerable to the uncertainties associated with fishing. For example, in British Columbia, salmon farming created 1800 direct year-round full-time jobs and over 2000 indirect jobs for coastal communities who have been affected by changing economies and reduced natural resource jobs (FAO, 2006).

	Wild Salmon	Farmed Salmon
Production volume	Production volume is inconsistent from year to year and difficult to predict.	Farmers can accurately forecast production and guarantee supply commitments.
Production timing	Wild harvests must occur during a short summer run.	Farmed production can occur over many months or year-round.
Product consistency	There is wide variation in the size and quality of individual wild fish.	Farmed fish can be produced of consistent sizes and quality.

Figure 4: Wild salmon versus farmed salmon attributes (Knapp, 2002)

2.1.5 Socially Responsible and Sustainable Aquaculture

With the potential advantages and benefits of aquaculture, the question becomes: how do we retain and enhance these benefits while lessening the negative impacts. One potential solution is socially responsible aquaculture. Socially responsible aquaculture, as defined by FAO is “Aquaculture that is developed and operated in a responsible manner, i.e. that benefits the farm, the local communities and that country; that contributes effectively to rural development, and particularly poverty alleviation; has employees who are treated fairly; maximizes benefits and equity; minimizes conflicts with local communities; ensures worker welfare and fair working conditions; minimizes risks to smallholders; and provides training to workers in responsible aquaculture practices” (FAO, 2011, p. 1). This definition encapsulates all aspects of aquaculture and makes reference to social and environmental issues.

Another socially responsible definition comes from Lee (2008): sustainable aquaculture is “aquacultural systems that are environmentally sound, profitable and productive and maintain the social fabric of coastal communities” (Lee, 2008, p. 107). Achieving socially responsible aquaculture, in whatever forms that may take, will be a challenge globally as aquaculture expands. One possible solution that is already gaining momentum comes from the marketplace in the form of eco-labelling and the practice of encouraging certification schemes.

2.2 Certification Schemes

In response to the growing need to mitigate negative impacts of modern aquaculture development, an increasing number of market-oriented certification schemes for aquaculture products are being developed and implemented. The basic premise behind such product labelling schemes is to provide economic incentives to both producers and the industry overall for adopting more sustainable production practices while safeguarding or enhancing access to consumer markets. The dramatic rise in seafood consumption (where in the U.S. between 1987 and 2000, per capita consumption rose 285% (Bostick et al, 2005) has also fuelled the need to look more closely and to manage where the seafood is coming from. In the last five years, corporations have grown increasingly aware of their role in sustainable aquaculture and have had to become more reactive to NGO campaigns against the unsustainable procurement of seafood (Monterey Bay Aquarium, 2009; Raynolds et al., 2007).

2.2.1 What is an Eco-label?

While there are a number of different definitions for eco-labels and eco-labelling in the sustainable seafood world, Ward and Philips (2008) provide a practical and comprehensive interpretation. To begin with, "an eco-label is a mark, a logo, a label or a product endorsement affixed to a seafood product at the point of sale that implies to a purchaser that the product has been produced through ecologically sustainable procedures, and is from a source that is well managed" (Ward and Philips, 2008, p.3). The main purpose of the eco-labelling programmes, regardless of the sector in which they are applied, is to "create a market-based incentive to encourage products that can demonstrate they are produced in an ecologically sustainable manner" which have the potential to lead to price premiums and market advantages for producers and enhance perceptions of market advantages of those products by consumers (Ward and Phillips, 2008, p. 2). Certification provides avenues that can work in a number of different ways in favour of the producer or the consumer. The label can differentiate the products to create value for both producers and buyers (Reardon and Flores, 2006; Ponte 2002) and can also provide an avenue for consumer purchasing power to express concerns about environmental and ethical concerns (Raynolds, 2004; Tallontire, 2007).

The fastest growing eco-labelling sector is that of the third-party certification. These certifications "have non-corporate coordinating bodies, typically NGOs that set standards and monitor compliance" (Raynolds et al, 2007). Research finds that these systems have the most legitimacy – strong consumer appeal and good marketing campaigns (Raynolds et al, 2007). In third-party certification schemes, the farm applies to be certified on a voluntary basis, then independent certifiers certify against the standards and then fish from successfully certified farms can be marketed to consumers with an accompanying label.

Eco-labelling exists in the timber and coffee industries as well as for organically produce agricultural products and have proliferated as far back as 2005 (Gulbrandsen, 2006). However, there is still debate as to the effectiveness of the schemes (Knudson and Peterson, 2007; Ward, 2008a; Ermann, 2009). Even though a survey conducted by Wessells et al in 1999 found that 70 percent of US residents polled preferred to purchase seafood that was labelled to indicate sustainably sourced seafood, there is still a lack of confidence as to whether eco-labelling provides a price premium incentive for producers and a willingness to pay amongst consumers (Wessells et al, 1999). Furthermore, from the producer perspective, eco-labels may at some point soon become more commonplace and therefore not provide higher prices as originally promised. Nonetheless, at this stage in the seafood movement, labelling may be the quickest most efficient means of encouraging industry to accept voluntary and somewhat more rigorous controls than typical government regulations (Naylor et al, 2003). This may be due to the fact that even though voluntary standards are not required, the competition is becoming even fiercer for market access and the labelling can provide such an avenue.

However, and regardless of how effective labelling schemes are, they can tend to be confusing to consumers. As stated by Ward, “the confusion of concepts, language, expectations and standards has resulted in a situation where some products may be labelled as sustainable or acceptable by one programme, but black-listed by another” (Ward, 2008b, p. 215). Consumers may not know where to turn for the true answer to both questions of what does the label mean and what is behind these labels? In addition to consumer confusion, there is evidence of confusion among other stakeholders. FAO reports that "the proliferation of private standards causes confusion for many stakeholders: fisheries and fish farmers trying to decide which certification scheme will maximize market returns; buyers trying to decide which standards have most credence in the market and will offer returns to reputation and risk management; and governments trying to decide where private standards fit into their food safety and resource management strategies" (Washington et al, 2011, p. vi). How do we know what makes a good and credible eco-certification?

CHAPTER 3: AQUACULTURE STANDARDS

One way of measuring the credibility of the eco-label is to examine the guidelines for production or processes that it represents – in other words, the standards, which the label upholds. According to FAO, a standard is a "document approved by a recognized organization or entity, 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 under international trade rules." (FAO, 2011).

Private certification schemes, which are distinguished by the specific standards they establish and uphold, are especially influential for consumers, according to Ward, who claims that the "quality and coverage of the standard" is "probably the most important and influential feature of any market-based incentive programme" (Ward, 2008b, p. 216). However, defining quality becomes challenging when one is dealing with sustainability and responsibility of practices, especially for as vast, complex and unpredictable a subject as aquaculture. How does one measure sustainability? How does one evaluate responsibility?

3.1 Current reach and scale of aquaculture standards today

In 2007, more than 30 eco-labelling standards were applicable to the aquaculture industry (WWF, 2007); some of the better known labels include: Friends of the Sea, Best Aquaculture Practices, La Belle Rouge, Global Gap, Naturland, Global Trust, WholeFoods Market and Biosuisse. However, despite the numbers of eco-labels, since all these certification schemes are voluntary, only roughly 3% of aquaculture is currently certified. Equally perturbing is the fact that different standards cover different aspects of aquaculture.

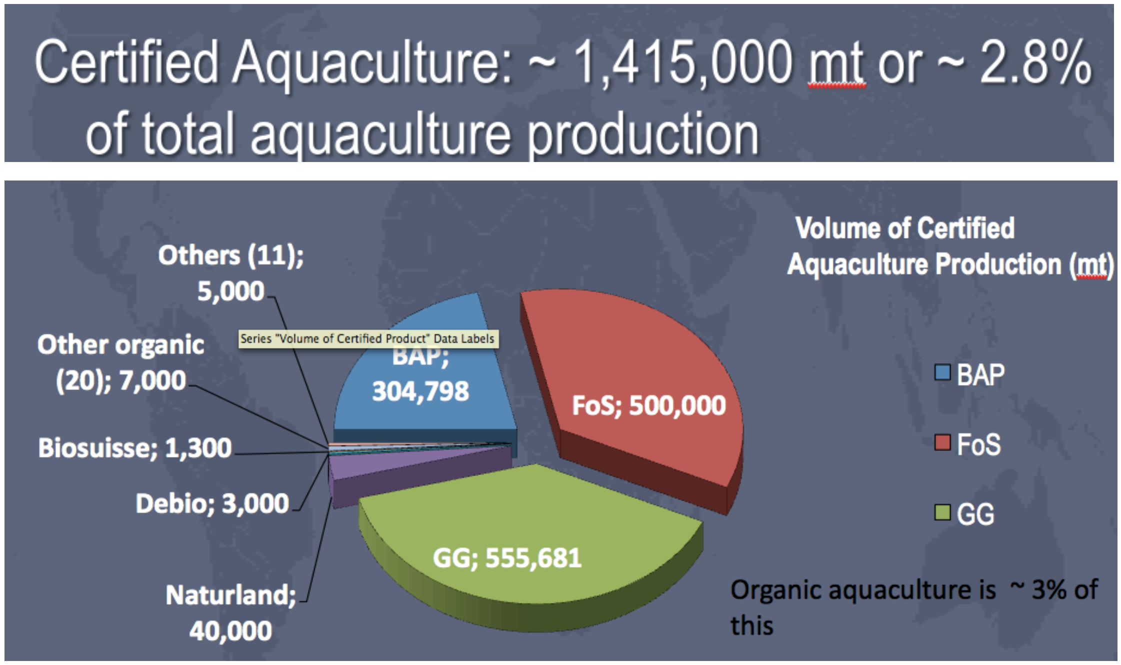

Figure 5: Certified Aquaculture (McNevin, 2011)

Standards available to the aquaculture industry focus on the following issues as laid out in FAO Aquaculture Guidelines 2011:

- Food Safety: Proper food health and safety measures
- Food Quality: Product quality characteristics
- Environment: Environmentally sound production processes
- Social Responsibility: Social accountability within the production process
- Animal Welfare: Issues related to animal welfare and health

One important difference between standards is which aspects are emphasized and which aspects neglected. Because existing standards are developed by different groups of stakeholders, e.g. NGOs, private organizations, and retailers (who produce buyer guides), not all standards cover all aspects, but instead reflect a specific group's interests – a fact that should be remembered by the producer when a standard is evaluated for use.

Another principal difference between the standards is whether they are descriptive, e.g. risks are pre-defined by standard owner, or whether they are a management system based approach, e.g. the producer has to define relevant risks and incorporate appropriate procedures and routines in the management system. This important distinction can affect their adoption, because the prescriptive nature of certain standards can come across as un-productive for management purposes. FAO aquaculture guidelines stipulate that “certification schemes should not be overly prescriptive, but set measurable benchmarks that encourage improvement and innovation in environmental performance of aquaculture” (FAO, 2011).

A third difference between standards is whether they are business-to-business, therefore less visible to the consumer, or business-to-consumer, with recognizable labels and marketing campaigns.

3.2 ISEAL and FAO Standard Development

Two important sources of guidance for standard development and guidelines are the International Social and Environmental Accreditation and Labelling (ISEAL) Alliance Code of Practice for Standard Development (2010) and Food and Agriculture Organization (FAO) Technical Guidelines on Aquaculture Certification (2011) as well as other FAO standard literature.

The ISEAL Alliance is an international non-profit organization that codifies best practice for the design and implementation of social and environmental standard systems (ISEAL, 2010,). “ISEAL works from the premise that voluntary standards systems that are effective and accessible can bring about significant positive social, environmental and economic impacts” (ISEAL, 2010, p. 1). ISEAL’s Code of Practice emphasizes multi-stakeholder – accompanied by consensus building – and transparent processes in the creation of social and environmental standards. ISEAL further emphasizes management over descriptive terms: “standards shall be expressed in terms of process, management and performance criteria, rather than design or descriptive characteristics.” (ISEAL, 6.3.2, 2010)

FAO Technical Guidelines on Aquaculture Certification 2011 encompass three main areas: Principles for certification schemes, Minimum Substantive Criteria for animal health and welfare, food safety, environmental integrity and socio-economic aspects, and Institutional and Procedural Requirements for governance, standard setting, accreditation and certification (FAO, 2011). The criteria emphasize transparency in all stages of a certification scheme but also highlight a need for the standards to have scientific evidence and promote responsible aquaculture as outlined in the FAO Code of Conduct for Responsible Fisheries (FAO, 2011). Finally, consistent with other FAO guidelines, the criteria encourage greater inclusion of farmers from developing countries in both development and implementation of certification schemes (FAO, 2011).

3.3 The Standard Dilemma: Raising Participation or Raising the Bar

The dilemma facing the adoption of standards is clear. If the goal is to attain increased overall "sustainability" and "responsible" aquaculture practices within the industry, why then seek to create standards only achievable for a minority? If on the other hand, the goal is to push the industry to better management practices through higher standards, why then create standards that everyone can achieve?

Ward provides an astute description of the standard dilemma:

> "For incentive systems focused on the ecological sustainability of fisheries and aquaculture ventures, setting a high standard of environmental performance potentially creates a greater incentive because of the higher levels of ecological benefits that will flow and a higher level of market differentiation for their product recommendation. However, the higher the ecological standard and the greater the distance between the present level of environmental performance and the performance encoded within the sustainability standard, the greater the barrier for a seafood venture in order to become compliant with the standard…Also it means that fewer ventures and products will become endorsed and be offered in the marketplace, thereby restricting the

> potential for consumer “pull” of environmental practices” (Ward, 2008b, p. 216).

There is a disconnect that will potentially arise from the proliferation of aquaculture standards, although this could apply across industry standards. If the standard bar is set too low, then there is potential for blue washing and the initial objectives of sustainability will become meaningless (Naylor et al, 2003). This scenario might lead to very successful pick up of certification across the industry, but because standards are so low, the industry would not actually be moving in an environmentally beneficial direction. Furthermore, it might create a downward pressure on overall standards as more standards are set at a lower bar.

If the bar is set lower, then there will be an increase in certification because more farms will be able to achieve certification. For example, Friends of the Sea (FoS) is well recognized for setting a lower and more inclusive standard (CAAR, 2011). As shown in Figure 5 above, FoS maintains a large percentage of those farms certified, but *without recognition for lessening environmental and social impacts.*

Therefore a possible solution would be to raise the standard bar higher so as to increase competition and push the industry into better management practices. However, this solution has its challenges as well.

If the bar of certification schemes standard is set too high, then, because of its voluntary nature, certification would not succeed in increasing the overall sustainability of aquaculture because of lack of participation. According to a recent article by Tlusty (2011) “Practical experience within the aquaculture realm suggests that those producers too far below the certification bar will be unlikely to be motivated to improve as the level of improvement needed to obtain certification is likely beyond their technical or financial means [J. Heerin and W. Moore, Global Aquaculture Alliance (GAA), personal communication]” (As quoted in Tlusty, 2011, p. 3). While it is true that a smaller fraction of the industry might seek certification in order to achieve a competitive advantage, many producers will not seek certification because of unreachable standards. Currently, as it stands the SADDS (discussed further in the following sections) seeks participation from 20% to 30% of currently operating salmon farms because only that small percentage can attain the high standards set forth in the draft standards (SAD, 2011).

Increasing competition might be beneficial to the marketing opportunities of big business. There are those who believe that eco-labelling schemes are simply that, marketing tactics (Kaiser and Edwards-Jones 2005; Jacquet and Pauly 2007). By reducing the accessibility of certification to only certain products, retailers can include a competitive advantage and a price premium for those products. Major involved retailers envision standards heading in this direction. Standards will therefore become more stringent, according to research conducted on retailers by Fulponi, 2006. “In general all retailers interviewed expected standards to become more stringent with more precisely identified processes and control mechanisms and to advance in the areas of social and labour conditions, environment and even health” (Fulponi, 2006, p.10).

However, standards set high and fewer farms certified because of those high standards, does not necessarily mean there is better environmental performance. Ward (2008) reported that there were no demonstrated achievements in marine conservation due to eco-labelling. Furthermore, the evidence base on the environmental and socio-economic impacts of sustainable certification is relatively thin, according to one study conducted by Blackman and Rivera (2010). The demonstrable evidence to show the effectiveness of certification programs at reducing negative impacts is still limited. Much attention is paid to these types of regulations for aquaculture production, but in actual fact, so far very little shows whether they make a difference, as shown by the estimated limited certification of only three percent of aquaculture production.

One possible solution put forward by Raynolds et al (2007), is to use progress standards, as with Fair Trade certified products. The development approach is one whereby "poor producers can enter Fair Trade, but then uses progress standards to foster improvements" (p. 154). Similarly, certification could be more of a ranking system instead of absolute sustainability. This would involve creating a system whereby certification may be achieved on a sliding scale. Farms would be able to achieve sustainability certification if they meet standards at 80% with a continuous improvement plan. This would allow for greater inclusion. Kaiser and Edwards-Jones (2006) suggest a softer approach to certification than that instituted by the Marine Stewardship Council MSC: "A tiered ranking (e.g., gold, silver, and bronze) [that] could be used to signify the level of achievement reached on the road to full sustainability" (p.397). A more complex ranking system, however, could lead to even greater confusion among consumers (Kaiser & Edwards-Jones, 2006).

3.4 What Makes a Good Standard?

While there is no formula for what makes a good standard, several authors have put forward certain definitions and components that for the purposes of this study, the author has compiled and analyzed in order to create a comprehensive practical definition of a good standard.

To begin with, individual elements of the standard should have accompanying quantitative indicators where possible. In the literature we find that quantitative measures and quantitative indicators have become more of a focus for decision makers, according to recent research conducted by Global Aquaculture Performance Indicator (GAPI) (Volpe et al, 2010). Second, good standards must raise the bar to improve existing practices. Duplicating government rules that uphold existing conditions are less useful in the effort to encourage industry to adopt more sustainable fisheries practices than standards that raise the bar (Raynolds et al, 2006). Third, a standard must take into consideration context and global reach and both North and South issues for production. This is especially important in the South because difficulties are amplified in developing economies (Fulponi, 2006). Fourth, standards must be clearly defined with objective benchmarks that that comprise explicit interpretation to avoid ambiguity and implicit interpretation (Ward, 2008b). Such benchmarks include strong and binding language to avoid misinterpretation. Fifth, standards must provide a balance between a plan or process and outcomes (Ward, 2008b). Farms must ensure that “there is a robust support system for the maintenance of sustainability through the provision of an appropriate set of management processes” (Ward, 2008b, p. 224).

The aquaculture dialogue process undertaken by the WWF provides welcome clarification of the components that further round out the definition of a good standard, and from which the author has chosen the following: compliance with best practices - in terms of process, focus, performance and verification; a multi-stakeholder involvement process that is both open and transparent; and the inclusion of metrics-based elements to ensure proper evaluation and identification of the desired performance levels that producers must achieve (WWF, n.d.).

Finally, a good standard must find a compromise between being both focused and comprehensive, which leads to questions as to the extent of the focus or the extent of the comprehension. What to include and what not to include? Should the standard be focused in a single area or should it encompass all certification components? Can it reconcile food safety and quality with environmental concerns?

Whether a certification programme encompasses environmental, social and animal welfare issues still depends mainly on the focus, interests and background of the stakeholders of the certification scheme. Yet, to be credible, it is increasingly expected that programmes should address all three issues, regardless of the limitations of the stakeholder group that created them (WWF, 2007). The fact that one individual stakeholder group chooses not to address a specific topic should not exempt it from being evaluated against a topic that is now considered important. A standard with a too limited a scope “such as covering only one part of the sustainability issues that surround a product” (Ward, 2008b, p. 220), has severe limitations, although there does seem to be a trend, as with SADDS, to move towards more focus on sustainability over other concerns, which is a positive direction in terms of assessing sustainability standards.

However, a trend towards greater focus on sustainability issues creates complications. A study conducted by Roheim and Donath (2003) found that consumers generally do not want to cross between species nor do they want to switch from non-labelled favourite fish to less popular or recognized labelled fish. A conclusion drawn by Peterson and Fronc (2007) was that consumers prioritize taste and that “taste buds matter more to consumers than eco-labelling, and it raises the critical question about how far eco-labelling can go to increase sustainable consumption” (p.432). A similar conclusion was drawn in more recent research on the decision-making process of Ontario households with regards to fish. Rudd et al (2011) confirmed in a consumer study what Fulponi (2006) had found with retailers, that food safety and quality were considered the most important criteria for consumer fish choices. Sustainability does not rank a high priority.

It is not surprising that sustainability criteria are not considered a high priority amongst consumers. Research points to the fact that very few consumers are aware of the issue of sustainability. An online seafood survey of 1,500 Canadians conducted by Leger Marketing in May 2011 – commissioned by The Janes Family Foods – found that only one in ten of those Canadians surveyed consider sustainability a factor in their choice of seafood products during shopping excursions to the grocery store or at a restaurant (Prado, 2011). Furthermore, only 17% of those surveyed were familiar with the MSC label (data may be extrapolated from other areas to aquaculture). Shoppers do not consider sustainability in their decision-making process, and yet producers and regulators are giving them sustainability labels to choose from. It appears from the survey that consumers continue to use taste (59%) and price (55%) as key motivators. While much of this data is collected based on wild capture fisheries, most indicators point to the fact that consumers make few distinctions between wild capture and farmed fish, and that they still see seafood as seafood; there are few indicators that consumers will apply the same decision-making factors for farmed seafood. This argument provides a rationale for including food quality and food safety in the necessary components of any good salmon aquaculture standard.

The components of a good standard are complex and numerous when utilizing data from the literature. The scope of this study does not provide for evaluating and comparing the components for each standard included in this study, and therefore the author has chosen three elements to assess: ambiguity, issue coverage and procedural versus measureable indicators. The reasons for and significance of this decision as well as the methodological process are explained in the following section.

3.5 The Roots and Significance of This Study

The inspiration for this study was born out of an internship with the World Wildlife Fund for Nature (WWF) undertaken by the author. WWF-Canada and WWF-US aquaculture and sustainable seafood managers wanted to know more about other salmon aquaculture standards in the market. The original purpose was to compare those emergent and established standards to those standards being developed through the Salmon Aquaculture Dialogue (SAD).

The scope of the current research goes beyond the parameters of the research initiated by the WWF, although it serves as the foundation for this paper. The author is aware of the inherent bias in the roots of this study and has attempted to address it throughout and to remove as much of the bias as possible.

3.5.1 Significance to Greater Literature

Comparing standards and certification schemes is relatively common fare within both peer-reviewed and grey literature. Discovering certain attributes as well as strengths and weaknesses of standards helps expose where further changes need to take place.

In agro-food sectors such as coffee, researchers have analytically compared standards in peer-reviewed literature (Tallontire, 2007; Ponte 2002; and Ruben and Zuniga, 2011).

This study falls in line with a number of other standard comparisons in the agri-food industry. Within the aquaculture and fisheries industries, a number of studies have been conducted in both peer-reviewed literature (Raynolds et al, 2007; Lee, 2008) and grey literature (WWF, 2007; CAAR, 2011, Corsin et al, 2007). However, no one has yet produced a comparison of specific salmon standards. In 2007, WWF produced a benchmarking study assessing all aquaculture certification schemes that resulted in a comprehensive report on certification schemes. The study included all certification schemes available at the time and resulted in a grading of those schemes (WWF, 2007). More recently (2011), the CAAR produced a comparison of salmon aquaculture certification schemes and created a relatively comprehensive study of the governance and procedural elements of the schemes. Neither of these studies examined the specific standards of the certification schemes in as detailed a way as the present study.

This study will contribute to the academic literature by investigating whether current salmon aquaculture standards contain a good balance between measureable and procedural standards, as stated by Ward 2008b. This is a similar study to Gulbrandsen's 2006 analysis, where he investigated whether standards were performance-based or management system-based. Conducting such investigations and comparisons has particular importance for such a young industry where farms must not only have a plan, but must also show results with regards to environmental, animal welfare and social standards.

CHAPTER 4: METHODOLOGY

The purpose of this qualitative comparison of emergent and established salmon aquaculture standards as a component of voluntary salmon aquaculture certification schemes was to determine which standards provide more concrete and measurable indicators of current salmon aquaculture practices. The process involved a selection of six salmon aquaculture standards, a selection of pertinent and relevant issues, and the creation of an analytical framework and the application of that framework to the standards to create an evaluative table. The results will reveal strengths and weaknesses of the assessed standards. This methodology was designed with guidance from industry experts and loosely based on other similar comparative analyses (Affisco et al., 1997; FAO, 2007; Lentijo and Hostetler, 2011).

4.1 Selecting the Subject

While more recent research suggests that salmon aquaculture may not have as many negative environmental impacts as once perceived (Volpe et al, 2010; Hall et al, 2011), there still exist a number of significant number of negative impacts – both real and perceived (FAO, 2009c, Volpe et al, 2010). Salmon aquaculture only makes up a small portion of the overall global aquaculture production (Marine finfish 7%), however, as discussed in the previous section, its exponential growth and expansion of wealth call for much attention. It is for this reason that this study investigates only standards related to the certification of salmon. Furthermore, because Atlantic salmon has become the largest sector of salmon aquaculture, this study will focus in on that species.

4.2 The Selection of Standards

The purpose of this study is to comparatively investigate a selection of the current and emergent salmon aquaculture standards and assess their performance against an evaluative framework. While there exists a wealth of salmon standards, those chosen for this study were picked for a number of reasons. With the initial roots of this study in the WWF internship, logic dictated the selection of standards of significance to the host organization, WWF. The intention of the WWF study was to investigate standards relevant to the organization's involvement with both Canadian and American initiatives related to salmon aquaculture, including the Salmon Aquaculture Dialogue. The decision was made to find a group of standards whose objectives may not align perfectly but whose presence provides some common threads for comparison. Furthermore, as will be explained, the analysis allows for some heterogeneity among the standards. Finally, the standards assessed in this study are all available online, save the Global Trust document. This document was provided to the author through WWF-Canada.

The majority of the standard choices came from the WWF-Canada offices. Looking further at the Canadian organic aquaculture draft standards (COADS) was critical, as their implementation would have significant influence on salmon production in Canada by introducing more emphasis on organic production, not prominent in the current Canadian industry. Along the same lines, choosing a prominent European standard to provide a direct comparison seemed appropriate. Naturland standards were chosen due to their wide use and familiarity in Europe. Further confirmation of their choice came from consultation with a number of the European WWF offices. The decision to include both organic standards is finally rooted in response to an increasing demand for both organic and aquaculture products in Canada. However, it must be noted that these two organic standards are more broadly geared towards all aquaculture production – explained in section 5.0 – as opposed to the others whose focus is specifically on salmon.

While far less known amongst consumers, Global Trust was chosen on the request from the WWF-Canada office. Global Trust certified a major Canadian salmon producer and an assessment of the standards was desired. The challenge with these standards stemmed from the division between salt water rearing, fresh water rearing and environmental standards – explained in a later section. The decision to separate the standards out from one another (salt/fresh and eco) was taken to ensure the distinction between these separate but related standards. This was the most efficient way to ensure fairness in the assessment.

The final two standards are more clearly aligned with multi-stakeholder processes but differentiate as an industry trade association – GAA – and conservation/environmental organization lead – SAD. The GAA standards in other aquaculture industries are widely used in North America, and the same will most likely happen with the release of their final salmon standards. In many ways, these standards are the most direct competition to the newly developing Salmon Aquaculture Dialogue Draft Standards (SADDS).

Finally, as the inspiration for this study came out of WWF, it was only logical to include the SADDS in the analysis. Much expectation surrounds the successful proliferation of the SADDS once they are operationalized within the newly launched Aquaculture Stewardship Council (ASC). This expectation is rooted in a number of elements including the success of the Marine Stewardship Council (MSC)'s successful expansion within capture fishery certification and the global participation during the multi-stakeholder process.

These six standards represent only a subset of all global aquaculture standards, but provide an important representation of current and emergent standards. Their scope, goal and content will be described in section 5.0 in order to gage their relevance to this study.

4.3 Selecting the Issues

Impacts were chosen based on previous assessments of the major impacts of salmon aquaculture. These impacts were clustered into environment, animal welfare and social categories. The environmental impacts revolved around energy, feed, biodiversity and escapes. The animal welfare impacts focused on mainly disease biosecurity, disease prevention and disease treatment, predator treatment and breeding and slaughtering practices. It should be noted that disease related items as well as predator interaction impacts could also be interpreted as environment, but for the purpose of this comparison are considered animal welfare issues. Finally, social impacts of salmon aquaculture were divided into community engagement, labour standards and interactions with first nation peoples (where applicable). Care was taken to use comparable or same issue categories as with the 2007 FAO study conducted by Corsin et al, 2007.

The following section takes a closer look at a selection of issues from those assessed using the evaluative framework (i.e. environmental issues (feed and escapes), animal welfare issues, and social issues (community engagement, first nations and labour)). This selection comes from an analysis of literature to determine the greatest threats as well as a familiarity of subject by the author (Volpe et al, 2010; Naylor and Burke, 2005; Bostick et al., 2005) and to reduce the scope of the project to a manageable degree.

Topics related to disease have been largely excluded. Although the issues of disease, antibiotic use, pollution and animal welfare issues are also of concern in salmon farming, the author has chosen to focus on other topics and only briefly summarize the related standards within the scope of this paper. Similarly, an analysis of the depth and breadth of controversy surrounding salmon farming with regards to sea lice, especially in the Canadian context, (please refer to Young & Matthews, 2010) has also been deemed beyond the scope of this paper. The findings from the comparison are presented, as is an analysis of what some of the findings show within the context of salmon aquaculture.

4.4 The Evaluative Framework

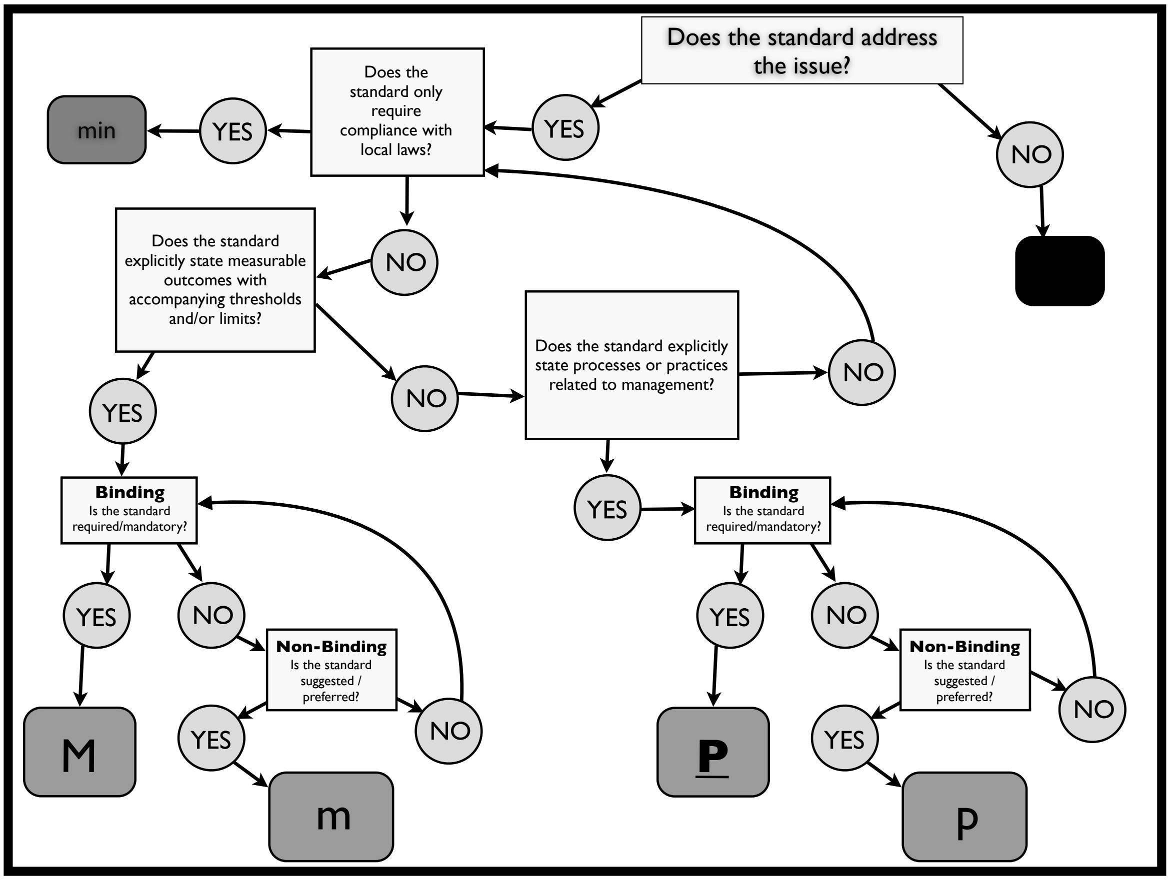

Figure 6: Evaluative Framework

The evaluative framework was created to assess the standards against specific questions – thus determining whether the standards are rooted in binding or non-binding language and whether or not they contain measureable indicators. The framework was created to help distinguish between standards that are based on plans – both required and suggested – and those standards based on outcomes, ultimately measuring the ambiguity inherent in the standards as well as their balance. For the purpose of this study, there is an important distinction for procedural standards between what are required (**P**) as opposed to what are merely suggested by certain certifying bodies as good practices (p). Ultimately, certain standards are found to be binding whereas other standards are found to be non-binding and suggestive.

Another important assessment criteria is whether or not the standards have any measurable, quantitative indicators, either non-binding (m) or binding (M). Both of these qualities were measured against the applied methodology for each standard. The results will show where there are weaknesses in the standards entailing merely suggestive language or a lack of measurable performance-based indicators. Furthermore, standards that do not address the issue within their criteria and standards that require only the minimum standards (min) without further requirements will be highlighted.

The standards were scrutinized and evaluated against this framework issue-by-issue and clause-by-clause. The clauses were separated out from the overall standard document and subjected to the framework questions. The final code was entered into a results table (see Section 6.0).

Process:

- Step 1: Gather the standard documents
- Step 2: Create excel sheet with issues on x-axis and standards on the y-axis
- Step 3: Separate standard clauses into appropriate cell
- Step 4: Apply evaluative framework to each clause cell
- Step 5: Enter clause code into the evaluation results table
- Step 6: Repeat for each of the standard documents

CHAPTER 5: OVERVIEW OF STANDARDS ASSESSED IN THIS STUDY

5.1 Canadian Organic Draft Standards (COADS)

Standard name: The Canadian National Standard for Organic Aquaculture

Organization/Affiliation: Canadian General Standards Board (CGSB), funded in part by the Canadian Department of Fisheries and Oceans (DFO).

Third Party Certification Body: Not Yet Determined

Current Status: In final public commentary period as of May 2011

Stages covered: All cultured animals: Pre-production farm preparation, smolt/hatcheries production, grow-out stage (species specific density number), harvest, transport and slaughter.

Scope: Environment, animal welfare

Intended Use of the Standard: Business-to-business

Goal of the Standard:

Organic aquaculture aims to protect and minimize degradation to the environment, maintain long-term biological stability, decrease pollution, ensure the humane treatment of animals, and emphasize careful processing and handling methods at all stages of production. These standards mainly focus on inputs into production and production methods as dictated by an organic mandate.

Overview of the Standard:

Organic Plan (GOC, 2011):

The operator of an enterprise shall prepare an organic plan outlining the details of transition, production, processing, handling and management practices, in accordance with this standard. **Record Keeping and Identification:** Records shall make it possible to trace origin and nature of the products and ingredients

(GOC, 2011); **Transition Period: Parallel Production and Buffer Zones:** established distinction between organic and non-organic production both land and water based,

Aquaculture of Animals:

6.1 Water Quality: No outside influenced pollution, recycled input and outputs, managed siting, and reduced negative impacts on water (GOC, 2011);

6.2 Species Origin: Indigenous species, organic broodstock (6.2.5), if organic animals are not commercially available, stock from non-organic hatcheries may be used provided that at least the final 90% of the biomass gain occurs under continuous organic management;

6.3 Reproduction: Assisted but without steroids or hormones or genetic modification;

6.4 Feed and Feeding: Fishmeal and fish oil derived from aquatic animals and other feed sources shall be organic (when commercially available), only natural additives and pigmentation;

6.5 Health and Welfare: Minimize impact on wild species, appropriate diet and adequate space, appropriate water quality parameters to meet needs, less invasive treatment of disease, limited list of allowable treatments and products, no synthetic compounds (GOC, 2011);

6.6 Cultivation Conditions: Limit escapes, Integrated Predator Deterrence Plan (non-lethal with exceptions);

6.7 Antifouling measures and cleaning of production equipment and facilities: Limited allowable cleaning substances;

6.8 Harvesting, Transporting Live Aquaculture Animals and Slaughtering: Tranquillizing chemicals, paralyzing toxins and carbon dioxide is prohibited, slaughter techniques cause immediate unconsciousness (GOC, 2011).

5.2 Naturland Organic Aquaculture Standards (NOAS)

Organization/Affiliation: Naturland

Third Party Certification Body: Naturland

Current Status/version analyzed: May 2010 version

Stages covered: All aquaculture: Preproduction, Hatchery, Grow-out, Slaughter, Processing, Post-production/labelling. Salmonid specific: Site selection, smolt, density, feeding, grow-out stage, transport.

Scope: For all organic aquaculture: Environment, food safety and quality, animal welfare, social/labor.

Intended Use of Standard: Business to Consumer

Goal of the Standard:

Adapted from agriculture: the obligation to treat the elementary basics of our lives with prudence and responsibility. The standards seek sustained management, the active protection of nature and the climate, safekeeping and preservation of the soil, air and water and the protection of the consumers.

<u>**Overview of the Standard:**</u>

General Regulations: Organic aquaculture general regulations require **1.Prerequisites for granting the producer contract, 2. Producer contracts, 3. Standards, 4. Conversion (**proof of sufficient knowledge and skills in the field of organic aquaculture), appropriate **6.Documentation** (inspections by personnel authorized by Naturland), and certified **9. Labelling and marketing** of final product (Naturland, 2010).

General Management Regulations:

1. Storage: No chemicals, secured storage;

2. The Sale of Purchased Merchandise: The labelling respects origin and method of production.

3. Purchase of Means of Production and Equipment: Preference given to natural substances (e.g. oils, fats);

4. Exchange of Farming Equipment Between Different Agricultural Operating Systems (certified organic/conventional): Organic fisheries and conventional operation exchanges permitted;

5. Use of Foil and Fleeces, Nets and Technical Mulching Materials: Decomposable matters are to be striven for, e.g. cotton, flax mats, mulching paper or organic foil;

6. Non-employment of GMO and GMO Derivatives;

7. Quality Assurance: Production in terms of these standards should allow for organic produce of high sensory quality and safety in regard to health. Records shall be kept of the complaint and corrective action taken (Naturland, 2010).

Social Responsibility: Following UN Human Right and ILO guidelines (Naturland, 2010).

Regulations Governing Organic Aquaculture (all species):

1. Selection of Site, interaction with Surrounding Ecosystems: Suitable preventive measures (escapes and effluents), do not adversely affect surrounding areas, local authority compliance, non-lethal deterrent methods, sustainability plan required (Naturland, 2010);

2. Species and Origin of Stock: Local and naturally occurring species preferred, the risk of escaping or introduction of species not naturally occurring in the region in open waters (e.g. by marketing as livestock) must be prevented, where suitable, polyculture shall be preferred (2.2); The stock (eggs or hatchlings, fries etc.) shall originate from enterprises run organically (2.3) with exceptions but no GMOs;

3. Breeding, Hatchery Management: Natural reproduction or spawn recovery (3.2);

4. Design of Holding Systems, Water quality, Stocking density: The husbandry conditions must enable the animal to behave in a way natural to the species; this refers, in particular, to behavioural needs regarding movement, resting and feeding as well as social and reproduction habits in respect of stocking density, soil, shelter, shade and flow conditions (4.1) (Naturland, 2010);

5. Health and Hygiene: Conventional medicine as last resort, certain mainly natural prophylactics permitted (5.2);

6. Oxygen Supply: ample oxygen to not cause distress;

7. Organic Fertilising: Applicable when combined with other animal husbandry;

8. Feeding: The animal components in feed shall, where acceptable for nutritional physiological reasons, be replaced by vegetable products. Where feed is used which is not produced in the course of the farm's aquatic food chains, the proportion of animal components in the feed shall be lower than 100%. Feed shall not be obtained from conventionally reared terrestrial or aquatic animals. In order to work towards a responsible utilisation of wild fish stocks, special standard requirements are set on the origin of fish meal/oil (Naturland, 2010);

9. Transport, Slaughtering and Processing: Slaughtering by incision of gills or immediate evisceration after anaesthetizing.

Supplementary regulations for Salmonidae: salmon Salmo in net cages:

1. Site Selection: water quality must be classified as I;

2. Prevention of Water pollution, Natural Design of the Ponds: The water quality should not become significantly deteriorated (2.1), re-use settled particulate organic matter, inspect sea bottom under cages, preventative measures to reduce escapes (2.5), no grow-out of fish in artificial tanks (2.6), juvenile stage growth permitted in tank;

3. Stocking Density: Stocking density shall not exceed 10 kg fish/m3, indicated by, among others, injured fish (Naturland, 2010);

4. Health and Hygiene: For controlling sea lice, wrasse as "cleaner fishes" is recommended (4.2), no chemical anti-fouling;

5. Feeding: Wild trout and salmon feed exclusively on other animals. Thus, for their adequate culture, feed prepared out of fishes is inevitable. The objective remains, nevertheless, to decrease the percentage of fishmeal/-oil in the feed composition as far as possible;

6. Transport, Slaughtering: adequate oxygen and density during transport.

5.3 Best Aquaculture Practices (BAP)

Organization/Affiliation: Global Aquaculture Alliance (GAA)

Certifying Body: Aquaculture Certification Council Inc. (Third-party auditing)

Current Status/version analyzed: Final - June 2011

Stages covered: hatchery, grow-out stage, harvest, transport and slaughter and processing (separate Feedmill BAP certification).

Scope: Salmon specific: Environment, animal health and welfare, and food safety, social/labour

Intended Use of Standard: Business-to-Business and Business-to-Consumer

Goal of the Standard:

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

Overview of the Standard:

Community:

1. Property Rights and Regulatory Compliance: Current documents shall be available to prove legal land and water use by the applicant; business and operating licenses; compliance with applicable environmental regulations and Area Management Agreements (GAA, 2011).

2. Community Relations: Demonstrate interaction with the local community to avoid or resolve conflicts through annual meetings; identify farm property lines; demonstrate dialogue with local native peoples; participate in or be working toward participation in an Area Management Agreement (GAA, 2011).

3. Worker Safety and Employee Relations: At a minimum, certified farms shall meet or exceed minimum wage rate, a safe working environment and adequate living conditions (standards are in alignment with ILO standards); provisions for medical treatment; an emergency response plan; a dive safety plan; appropriate housing (GAA, 2011).

Environment:

4. Sediment and Water Quality: provide documents that describe local standards for benthic impacts under salmon farms; monitoring of sediment conditions shall be undertaken at the time of peak feeding; results of sediment monitoring shall be reported to and approved by the appropriate regulators; data recorded and uploaded to the BAP database (GAA, 2011).

5. Fishmeal and Fish Oil Conservation: The applicant shall source feed from a BAP-certified feed mill. Interim: required 'plans of action' for responsible feed sourcing (based on FishSource, FAO or ICES); avoid IUU by-products and fish and by-products from "approved certified sources" specified by GAA; future (2015): 50+% of fishmeal (FM) & fish oil (FO) from "approved certified sources" (*MSC preferred);* calculate and record FCR for each year class; achieve a final fish in: fish out ratio of 2.0 or less (1.5 by 2016) (GAA, 2011).

6. Control of Escapes: Accountability and prevention under the Fish Containment Plan; no more than 5,000 fish escapes in any single episode; a maximum of 5,000 fish escapes can occur over 2 production cycles, with no more than 500 fish per episode, and no more than 3 episodes; appropriate equipment; no t*ransgenic (*GAA, 2011).

7. Predator and Wildlife Interactions: Wildlife Interaction Plan consistent with the implementation requirements; documentation that show the farm is not within geographic areas officially designated "critical" or "sensitive" habitat (or equivalent); favor passive and/or non-lethal methods of predator control; no controls, other than non-lethal exclusion, shall be applied to species listed as "critically endangered" or "endangered" on the IUCN Red List; if lethal control is necessary and justified, the applicant shall only use lethal methods of control that are legally approved; may only use acoustic harassment devices to control predators if verified by independent expert opinion (GAA, 2011).

8. Storage and Disposal of Farm Supplies: Material Storage, Handling and Waste Disposal Plan or standard operating procedures that meet the BAP requirements for proper handling and disposal as outlined in the implementation requirements; well protected, labeled, stored and marked inputs and outputs such as feed and fuel and solid waste (GAA, 2011).

Animal Health:

9. Health and Welfare: overseen and reported on by a designated fish health professional; exercise care in handling fish; Water Quality Management Plan; monitoring; stocking density criteria based on local conditions, which shall normally be at or below an average 25kg/m3 but may rise higher than this for 5% of the production cycle if the fish show other good welfare indicators; daily inspections; minimize distress during transportation; Prior to slaughter, fish shall be stunned humanely (GAA, 2011).

10. Biosecurity and Disease Management: Fish Health Management Plan overseen by fish health professional; written biosecurity and health management plans consistent with the implementation requirements; written biosecurity and health management plans consistent with the implementation requirements; all smolts shall be free from diseases and parasites, and vaccinated; drug treatments shall be based on authorizations by the fish health professional (GAA, 2011).

Food Safety:

11. Control of Potential Food Safety Hazards: Not use antibiotics or chemicals banned in the producing or importing country; documentation shall be available that states all fish in the farm have been grown from smolts reared without the use of banned medicines; documentation from feed manufacturers that antibiotics or other drugs are not present in non-medicated feed, and that levels of heavy metals and PCBs/dioxins in feed are below limits for those compounds set by the country in which the plants operate shall be available; no growth promoting antibiotics; potential nearby contamination checked in fish annually (GAA, 2011).

Traceability

Traceability records shall be maintained for each of the specified parameters for every production unit and every production cycle to allow tracing of fish back to the unit and inputs of origin (GAA, 2011).

5.4 Certified Quality Salmon (CQS)

Organization/Affiliation: Standards developed by Irish Sea Fisheries Board (BIM) with input by Global Trust

Third Party Certification Body: Global Trust

Current Status/version analyzed: Final (Issue 1 Revision 3 October 2009)

Stages covered: Fresh water rearing (smolt/hatcheries production), Salt Water (grow- out stage, harvest, transport and slaughter), Packing and Smoking (hygiene, HACCP)

Scope: Environment, Food safety, Food Quality, Animal welfare, Organic (Divided into Eco-standards; Freshwater; Saltwater; Packaging; Organic), social

Intended Use of Standard: Business-to-Business

Goal of the Eco-Standard: Eco-Standard: aims to assist members to demonstrate and prove their commitment to environmental sustainable development and conservation when producing and processing farmed salmon (CQS, 2009). N.B. The other standards do not hold themselves as environmentally focused standards.

<u>Overview of the Standard:</u>

Eco-Standards (CQS, 2009):

1.0 Environmental Management and Commitment: Understanding of and commitment to the principles of sustainability; conduct a baseline review; annual reviews; internal audit; established, documented, implemented, maintained and publicly available environmental policy; work and liaise with local stakeholders.

2.0 Site Selection and Management: Farms are easily identifiable; structures shall be properly installed and comply with engineering requirements; take part in any local area and Single Bay Management initiatives.

3.0 Environmental Aspects: Disinfectant, cleaning and other chemicals with an improved environmental profile used minimally; preventative maintenance, contingency plans for spills; reduce visual, noise and odor impact; preventative action feed management system.

4.0 Nature and Biodiversity: Minimize impact on biodiversity; aware of any nature conservation designations in and around licensed area; employ non-harmful predator deterrents; no GMOs; no hormone treatment; comply with National escapee codes; report and record escapes (CQS, 2009).

5.0 Cultural Heritage: Respect and protect the maritime and cultural communities.

6.0 Waste Management and Reduction: Minimise the amount of waste produced; seek recycling and re-use of equipment; appropriate waste disposal.

7.0 Resource Management and Conservation: Seek long-term sustainable operation sites; energy use minimized; feed components shall conform to the National feed regulations; Marine raw materials shall be sourced from fisheries having a defined total allowable catch (TAC) and quota based on a government recognised scientific evaluation and employing legal and responsible fishing practices (CQS, 2009).

Both Fresh water & Saltwater (except where indicated) (CQS, 2009b):

***General Management Practices*:** Document procedures; produce a written health and safety statement; environmental commitment to waste reduction, re-use and re-cycling; necessary and appropriately frequent fallowing practices (SALTWATER); Single Bay Management Strategies (SALTWATER).

Fish Health Management: Document prevention, monitoring, identification and treatment of fish diseases; vaccination programme established; cages for ongrowing shall be placed where there is sufficient water exchange to provide a supply of clean, well-oxygenated water (freshwater cage ongrowing); invasive wildlife control shall be carried out by a licensed contractor or by properly trained operatives with knowledge of pesticides and their use; anti-predator systems shall be effective, non-lethal, humane and aim to prevent wildlife entry (CQS, 2009b).

Rearing Practices: Feed shall be purchased from licensed and reputable fish feed manufacturers who have signed a 'Quality Feed Manufacturer's Declaration' (FRESHWATER); smolt supplied from CQS certificate (SALTWATER); salmon shall be held at a stocking density appropriate to the farming/containment system used; documented risk assessment pre-harvest programme (SALTWATER).

Broodstock and Ova Supply (FRESHWATER): broodstock selection programmes; maintain records of all egg and fry purchases and sales.

Disposal of Mortalities and Waste Disposal: Waste management plan, minimise risk of disease transfer, treated in accordance with relevant national legislation.

Grading: Fish shall be starved for an appropriate period but for a minimum of 24 hours.

Harvesting Practices: All fish contact surfaces shall be kept clean and hygienic; transport fish quickly and efficiently; slaughter systems do not result in prolonged out of water situations; cause less stress during transfer and slaughter (CQS, 2009b).

Traceability of Harvested Fish: A system to ensure that each batch of harvested fish can be traced back from point of sale to the harvest date, farm site and cage of harvest shall be established and documented. This information shall be made available to packing stations and selling agents contracted by the applicant (CQS, 2009b).

Customer Complaints and Product Recall: A customer complaint procedure shall be established to ensure that all complaints are dealt with promptly.

Food Safety and Quality Management System: Senior Management shall provide the human and financial resources necessary to implement the requirements of this CQS standard, continuous monitoring and analysis of the process, A system of all relevant legislation, food safety issues, legislative, scientific and technical developments, and industry codes of practice; internal audit at least once a year; Fish shall be packed according to customer specifications; labels shall allow for complete traceability of each box to the original packing date, fish farm and harvest site (CQS, 2009b).

5.5 Salmon Aquaculture Dialogue Draft Standards (SADDS)

Organization/Affiliation: Salmon Aquaculture Dialogue: Nine-member multi-stakeholder Steering Committee, WWF- initiated

Third Party Certification Body: Aquaculture Stewardship Council

Current Status/version analyzed: In second public commentary as of May 2011

Stages covered: Smolt, grow-out stage

Scope: Environment, social/labour

Intended Use of the Standard: Business to Consumer

Goal of Standard: Credibly develop measurable, performance-based standards that minimize or eliminate the key negative environmental and social impacts of salmon farming, while permitting the industry to remain economically viable (SAD, 2011).

<u>**Overview of the Standard:**</u>

PRINCIPLE 1: Comply with all Applicable National Laws and Local Regulations: Presence of documents demonstrating compliance with local and national regulations and requirements on land and water use, tax laws, labor regulations, and water quality regulations (SAD, 2011).

PRINCIPLE 2: Conserve Natural Habitat, Local Biodiversity and Ecosystem Function: Redox potential or sulphide level measured, faunal index score good to high, Allowable Zone of Effect defined within 3 years (2.1), more than 60% dissolved oxygen and nitrogen and phosphorous measured weekly (2.2), an assessment of the farm's potential impacts on biodiversity and nearby ecosystems with improvement measures, farm not near High Conservation Value areas (2.4), No acoustic deterrent devices (or phase out plan), less than 9 lethal predator killings permitted in prior 2 years with regard to certain conditions and no IUCN red-listed mortalities (2.5) (SAD, 2011).

PRINCIPLE 3: Protect the Health and Genetic Integrity of Wild Populations: Participate in Area Based Management (ABM), collaborative efforts, transparent sea lice monitoring with established maximum sea lice threshold , respect wild salmon migration and natural habits (3.1), species have to be established in farm region and no introduced non native species for other farm purposes (3.2), no transgenic salmon (3.3), no single escape events over 200 fish but escapes up to 300 per cycle allowed, transparent unexplained losses, reduce risk of escapes and preventative planning (3.4) (SAD, 2011).

PRINCIPLE 4: Use Resources in an Environmentally Efficient and Responsible Manner: chain of custody and traceability for feed (4.1), Fishmeal (m) <1.35/ Fish Oil (o) <2.95 Forage Fish Dependency Ratio (FFDR), Protein Retention Efficiency >35% (4.2), FM and FO from ISEAL accredited certified fisheries within 5 years of SAD publication, until then use FishSource scored fisheries, No IUU by-products or trimmings in feed (4.3), Responsible sourcing policy for other feed ingredients (4.4), energy use assessment including GHG records (4.6), no heavy cleaning of copper-treated nets in situ and copper monitoring (4.7) (SAD, 2011).

PRINCIPLE 5: Manage Disease and Parasites in an Environmentally Responsible Manner: Fish health plan, quarterly vet visits, all dead fish removed and recorded, reduction plan in place for the less than 40% unexplained dead fish allowed (5.1), documentation of chemicals and therapeutants, no primary salmon producing or importing country banned antibiotics or chemicals, parasiticide treatment index less than 6.8, no WHO critically important human medicine used (5.2), bio-assay resistance tests (5.3), secured transportation, no live transfer of fish between farms, management and culling for detected exotic disease and/or parasite (5.4) (SAD, 2011).

PRINCIPLE 6: Develop and Operate Farms in a Socially Responsible Manner: Along ILO guidelines, Freedom of association and collective bargaining (6.1), No child labor (6.2), no forced labor (6.3), no discrimination (6.4), health and safety records and training (6.5), basic wage paid (6.6), grievance procedures (6.8), corporate policies for social responsibility (6.12) (SAD, 2011).

PRINCIPLE 7: Be a Good Neighbor and Conscientious Citizen: Bi-annual and meaningful community consultation, complaint resolution mechanism, communicate therapeutic treatment usage via signage and consultation (7.1), indigenous groups consulted proactively and according to local and national laws, evidence of protocol agreement (7.2), no vital community access restriction (7.3) (SAD, 2011).

SECTION 8: Standards for Suppliers of Smolt (specific for Smolt): No allowance of producing or holding smolt in net pens in water bodies with native salmonids (8.24); benthic sediment monitoring (8.26) (open net); Regular monitoring of water quality (8.29), Metrics for Total Phosphorus released into the environment per ton of production per year (8.30), 70% Minimum oxygen saturation in the outflow (8.31) (closed system) (SAD, 2011).

CHAPTER 6: ANALYSIS OF THE STANDARDS

The following sections present findings from the evaluative framework applied to the selected standards. These findings are presented in an evaluation table codified to demonstrate the chosen qualifiers, as discussed in the methodology and background sections in this paper. While each of the issues that appear in the proceeding table are relevant and important, only the subset so chosen by the author will be further analysed. These issues include: feed, escapes and non-native species introduction, animal welfare, community engagement, labour, and first nations recognition. These issues provide a good cross-section of all the issues addressed in current salmon aquaculture standards. Some will appear more frequently (feed) while others less frequently, (first nations recognition) since they are not seen as necessary for all salmon aquaculture farms. However, as will be shown in the analysis, all issues are important and an examination of their application within standards will be essential for the subsequent discussions and recommendations.

Table 1: Evaluation Table: Evaluation of procedural (P) and measurable (M) aspects of select emergent or existent salmon aquaculture standards against issues of concern. Extent of application differentiated by use of P and p and M. Another distinction was made using the black cells where specific issues were not addressed and (min) was placed where standards solely required a minimal standard.

Issue		CANADIAN ORGANIC	NATURLAND ORGANIC	GLOBAL AQUACULTURE ALLIANCE BAP	GLOBAL TRUST CQS ECO-STANDARDS	GLOBAL TRUST CQS Saltwater and Freshwater	SALMON AQUACULTURE DIALOGUE
Environmental							
Biodiversity	Overall Biodiversity	P	P	P	P	P	P
	Benthic Biodiversity	p		min	min		P/M
Energy Efficiency and GHG	Reduce Energy Use		p		P	P^	P/M
Water Quality	Record Keeping	P	P**	P	P		P
	Quality levels	p	p/M**	min	min		M
	Non-Therapeutic Chemical Use: Anti-fouling	P	P**	P	p	P^/P	P
	Chemical/Oil Spill Risk Assessment	P		P	P		
Feed	Marine Feed Components (Sourcing FM and FO)	p	p	P/M	P	P^/P	P/M
	Fish in : Fish Out (Efficiency of feed)	p		P/M	P	P^	P/M
	Efficiency of Feeding System	p	P**	P	P	P^/p	P/M
	Non-Marine Feed Components		p organic	p			P
Escapes	Quantitative Threshold for Escaped Fish			M			M
	Prevention of Escaped Fish	P	P**	P	P		P
	Accountability for Escaped Fish	P		P	P		P
	Protection of Wild Salmon	P	P	P			P/M
Fish Stocking	Introduction of Non-Native Species	P	P	P			P
	GMO Fish	M	M	M	M		M
Predator	Prevention	P		p		P^/P	P
	Mitigation	min	p	P	P	P^/P	P/M
Health and Hygiene	Disease Prevention/Biosecurity	P	q	P		P^/p	P/M
	Disease/Parasite Treatment	P*organic	P/p**organic	min	p	p^/p	P/M
	Vaccination	P		P		P^/P	P
	Antibiotics	p	P	P/M			P/M
Animal Welfare							
Stocking Density	Conditions	P	p	p		P	
	Quantitative Threshold	M*organic	M** organic	min			
Reproduction	Natural	p*organic	p**organic	P		P	
	Hormone Usage	p	p		P/M		
Slaughter		P	P	p		P^	
Social							
Community Engagement			p	P	P	p	P
First Nation Recognition				P			P
Labour			P	P		p	P
		*organic specifc	**species specific			^saltwater	

6.1 Selected Environmental Issues

The following section will analyse the selected environmental issues chosen by the author: feed and escapes and introduction of non-native species. While there are clearly other environmental issues compared in the evaluation, only those in the following analysis were further assessed.

6.1.1: Feed

Wild-caught fish taken from the ocean and reduced into fishmeal (FM) and fish oil (FO) are critical to the ecosystem functions but many reduction fisheries are fished at capacity or overfished (Tacon et al, 2010). Fish protein is however essential to salmon development but reducing the conversion rate of feeding salmon is another serious challenge for farms. Non-marine sourced feed is also an issue because crops – such as soy – can make substantial demands on ecosystem services (Tilman et al, 2002). Fishmeal and fish oil are important because they provide long chain fatty acids that are only currently found in those sources (Tacon et al, 2010). There are concerns about using forage fisheries or feed fisheries as they divert the potential human consumable fish to the production of feed – resulting in a net drain on the ecosystem services (Naylor et al, 2000; Naylor and Burke, 2005). For salmon, a typical feed diet contains 25-33% fishmeal and 11-26% fish oil (depending on the country of origin of the feed) (Pelletier et al, 2009).

The feed conversion ratios (FCR) or fish feed dependency ratios (FFDR) are used in standards to facilitate the quantitative measurement of responsible aquaculture practices. These calculations essentially measure how much wild fish biomass is used to produce cultured biomass. Newer cultured carnivorous species tend to have higher ratios, until innovation in feed production improves the use of wild fish substitutes. Salmon feed is one area where ratios have decreased. In 2002, 2.13 kg of wild fish were required for each 1 kg of salmon produced, an improvement from the 3.16:1 ratio in 1997 (Naylor and Burke, 2005). However, not all calculations use the same conversion tools and can therefore produce varying numbers. An example of this will be found in the following analysis between BAP and SADDS. Improving this conversion ratio will largely be based on improved research and development in feed technology and the discovery of better substitutions for the fishmeal and fish oil currently used (Smith et al, 2010). However, innovation in feed production leading to a reduced overall utilization of wild fish meal and fish oil will only come if there is demand for it or the standards dictate. According to research conducted by Pelletier et al (2009), this is not always the case: "the high rate of fish meal and oil use in UK production partially reflects the demands of some domestic retailers for salmon produced on a "natural" high fish diet" (p.8735). Furthermore, an increased demand for "organic" salmon will have similar results as a "natural" diet is encouraged with these standards (explained in greater detail below).

COADS

The Canadian Organic standard does not provide any quantitative indicators for its feed standards. The standards for feeding salmon organically are based on animal welfare guidelines: "ready access to appropriate diet in sufficient quantities" and overall requirements for reduced environmental impact: "minimizes loss of feed to the environment" (GOC, 2011). The standards suggest a need to use either organic sources of feed inputs (when available) or to comply with general guidelines based on FAO Code of Conduct for Responsible Fisheries until those organic sources become available. However, the use of responsibly sourced feed inputs is merely suggested and not required. Furthermore, the standards do not address non-marine sourced feed inputs such as soy or other terrestrial inputs – not even with regards to their organic sourcing.

The final stipulation is that the standards require diets to be compatible with diets occurring in the "natural" environment, wording that is unclear and that can conflict with a need to move away from the use of fishmeal and fish oil. A feed source based on natural diets can potentially contain a very high feed conversion ratio to maintain consistency with what salmon, as a carnivorous species, eat in the wild. The goals of reduced "environmental impact" and naturally occurring diets have a great potential to contradict themselves.

NOAS

The main focus for the Naturland feed standard is that all feeds used in the culture of aquatic animals move towards plant based inputs where possible. The standard does not set feed conversion ratios, but refers instead to values "given in literature". The following feed sources are permitted: fishmeal/-oil from independently certified sustainable fisheries, from fish processing trimmings and capture by-catch of fish destined for human consumption. With regards to non-marine sourced feed inputs. The standards make suggestive guidelines to their organic nature but without binding requirements nor a direction for to where these organic inputs will come from (NB. The sourcing of organic soy products can be challenging and there are limited sources that meet international standards). Note that this is the only standard among those analyzed that allows for by-catch in feed.

BAP

The Best Aquaculture Practice document requires that salmon cultured in accordance with the standards comply with a 'Fish In: Fish Out' ratio of 2.0:1 or less. By the year 2015, this ratio must be 1.5:1 in order for farms to become certified. The salmon aquaculture BAP does not include feed sourcing standards directly in the standards and instead refers to another document called 'BAP Feed Mill Standards' (GAA, 2010). These separate standards focus largely on feed quality and safety. These Feed Mill standards stipulate that before 2015, certified farms "shall create and implement action plans" that include a provision for avoiding by-products from Illegal, Unregulated or Unreported (IUU) fisheries and from problem fisheries designated by one or all of the following authorities – FAO, International Council for the Exploration of the Sea (ICES), International Union for Conservation of Nature (IUCN), US National Marine Fisheries Service (NMFS) and Commission for the Conservation of Antarctic Marine Living

Resources (CCAMLR) (GAA, 2011). Before 2015 there are no specific percentages for responsibly sourced marine components to the feed, the standards simply require action plans. However, after 2015, a minimum of 50% of the marine-based-feed components “shall” come from “approved certified sources” by recognized certified fisheries (GAA, 2011)

CQS

These standards focus primarily on guidelines set out by the FAO Code of Conduct for Responsible Fisheries. As such, the source of the feed must come from fisheries “committed” to responsible fishing practices defined in the Code. Currently, the standards call for 100% Fishmeal and Fish Oil from certified suppliers of the International Forage Fish Organization (IFFO) Code of Responsible Practice for Fishmeal and Fish Oil Production by December 2010. The CQS standards focus rather heavily on the economic efficiency rather than a fish conversion ratio. Standards require systems to I be in place to avoid the spillage of feed into surrounding waters, but there are no quantitative indicators to accompany the standard within this regard.

SADDS

The Salmon Aquaculture Dialogue Draft Standards (SADDS) includes separate conversion ratios for fishmeal and fish oil. Specifically, the fish feed dependency ratio (FFDR) quantifies what percentage of the feed input comes from marine sourced wild fish. In other words, FFDR is the quantity of wild fish used per quantity of cultured fish produced and in these standards FFDRo calculations are for fish oil, while FFDRm calculations are for fishmeal (SAD, 2011). The levels that the thresholds are currently placed are set whereby it is estimated that approximately 20-30% of the salmon farming industry are able to meet (SAD, 2011). The SADDS stipulate that with five years of its publication as final standards 100% of FM and FO must come from wild-capture fisheries certified by an ISEAL-accredited eco-labelling organization. The source of feed must be derived from only certified fisheries and not just responsibly sourced marine inputs. In the interim, a recognized certification system called FishSource will be used. This system allocates certification rankings onto forage fisheries to deem them well managed or not. Finally, important non-marine based feed ingredients, such as soy, are also required to be compliant with environmentally responsible sourcing policies that include credible supply chain traceability.

Feed Conclusion

The two organic aquaculture feed standards considered are more concerned with ensuring that inputs to salmon feeds are derived from organic sources or are derived from "natural" sources in cases where organic production is impossible (e.g. wild fish sources) rather than the responsible procurement of fishmeal and fish oil. In addition, neither organic standard strongly addresses the issue of "fish in: fish out" or any conversion ratios related to feed. While both organic standards compared in this study make reference to responsible sourcing of input materials, neither one provides a clear indication to the binding nature of their sourcing policies nor to current best practices for responsible wild fish sourcing. There will ultimately continue to be a conflict between natural, and in the case of NOAS, potentially archaic sources such as by-catch and what are currently understood as responsible fisheries.

Organic feeds will potentially always inherently have a contradicting nature in salmon aquaculture standards. This is due to the fact that wild fish continue to make up the bulk of most carnivorous feed through the use of fishmeal and fish oil (PEW, 2007). "In principle, wild fish cannot be organic in the agricultural sense because the provenance of wild-sourced ingredients precludes the control over inputs and growing conditions that would make such certification possible" (PEW, 2007, p. 105). The organic aquaculture standards are attempting to use a well-known label "organic" and apply it to a product that will never be at the standard of what the label is known for; controlled and organic sources. Until there are 100% organic feeds that contain no wild-fish components what so ever, there will never exist organic salmon.

Out of the final remaining standards considered, the SADDS are noteworthy in that they stipulate higher standards for feed sourcing but not too high as to be unachievable. One somewhat unachievable goal was set out by CQS. The CQS standards required 100% of FM and FO from IFFO certified suppliers by 2010 – an unrealistic goal since there are still too few suppliers of FM and FO through these processes to date and yet the standard has not been updated to reflect this fact. Therefore, the marine-based feed sourcing of CQS certified farms potentially has no standard associated with it because there were no interim goals set in case 100% could not be achieved or until it could. The reference to the FAO Code of Conduct for Responsible Fisheries is the only guiding light for these standards but the binding and measureable attributes of this standard leaves it wanting.

The BAP salmon standards refer to BAP feed mill standards with regards to the feed sourcing and quality for certified farms. These supplementary standards are used as an overall reference for BAP certification. While one of the serious concerns of feeding salmon is ultimately the sourcing of the marine derived ingredients as well as the wild fish ratios, the feed mill standards are mostly focused on feed quality and efficiency of its distribution (GAA, 2011). These feed mill standards require action plans be drawn up for responsible sourcing, but require that at least 50% of marine-based-feed come from those "responsibly" sourced fisheries. This percentage is half the requirements laid out in SADDS even within a similar timeline. The SADDS require 100% "certified fishery" sources within 5 years of its publication for marine-based feed, as well as a measurable and quantitative interim standard using FishSource. The scores attained by forage fisheries using FishSource will serve as a fundamental base to ensure that the worst of the worst of these fisheries will not be sourced (SAD, 2011). SADDS is the only one of the standards considered to have binding requirements for the sourcing for non-marine based feed inputs such as soy; an ever growing component of feeds especially as the transition away from wild-fish inputs is encouraged by certain environmental groups.

6.1.2 Escapes and Introduction of Non-native Species

Escapees can adversely affect wild salmon and other wild fish. Where salmon being cultured are native to the environment in which production is occurring, interbreeding can alter the pool of genetic diversity (Einium and Fleming, 1997; Naylor and Burke, 2005). Where they are non-native, the risk of establishing populations becomes an issue (Naylor and Burke, 2005). In both situations, they compete with existing populations for food (Youngston and Verspoor, 1998; Schirber, 2004) and/or habitat and transmit disease (Fleming at al, 2000). The FAO stipulates in its Aquaculture Technical Guidelines: "whenever possible, native species should be used for culture and measures should be taken to minimise unintentional release or escape of cultured species into natural environments" (FAO, 2011).

COADS

The Canadian organic standards do not provide any quantitative limits related to escapes. The only standard relating to escapes refers to minimizing impact "to the migratory and reproductive patterns of local wild fish populations" (GOC, 2011, p. 4). It neither provides guidelines to do so nor further indicators on how to measure the successes of this "minimization". With regard to the introduction of non-native species, the standards stipulate in standard 6.2.1 that cultured organisms are to be "taken from indigenous species or adapted to rearing conditions." There are no further explanations as to what indigenous species are defined as nor what "adapted" to rearing conditions requires.

NOAS

The NOAS require that all certified farms undertake "suitable preventive measures" (Naturland, 2010, p. 18) to reduce the impact of escapes. The standards focus mostly on prevention and do not provide quantitative thresholds, against which success of preventing escapes can be measured. The "measures" described further in the standard contain required infrastructural and physical changes to the net-pens. These include ensuring proper maintenance of the nets as well as other farm infrastructure. The standards, however, do not state there to be accountability for escapes that may and most likely will occur. The standard associated with the introduction of non-native species are non-binding. NOAS states in standard 2.1 that "species naturally occurring in the region shall be preferred." There are no binding requirements to this end.

BAP

The BAP takes a management approach to escape prevention. In section 6.1, the BAP refers to an outlined three-part 'Fish Containment Plan', which includes procedures to prevent, monitor, reduce, respond and account for escapes. The BAP is very specific with the guidelines and practices it expects from certified farms through this BAP created plan. The standards permit no more than 5,000 fish escapes in any single episode. A maximum of 5,000 fish escapes can occur over two production cycles, with no more than 500 fish per episode, and no more than three episodes within those two production cycles (GAA, 2011). The introduction of non-native species for newly established farms is permitted as long as farmed salmon are "approved for farming" in that country (GAA, 2011). Where the species farmed is "not native" or "not already farmed" (GAA, 2011) a risk assessment conducted by the potential farm using the Code of Practice developed by the International Council on the Exploration of the Seas (ICES) must be approved by the local government. This is to ensure that new countries or regions are able to establish salmon farming if it is so deemed low risk by the governing body of that region.

CQS

The CQS standards address escapes in the eco-standards, but not in the fresh or salt water rearing standards. The standards geared towards freshwater and salt water facilities do not even mention the issue of escape. CQS standards focuses in on management prevention plans, largely related to infrastructure and equipment, but do not provide any explicit limits on the scale or number of escapes that can occur. Furthermore, the CQS standard relies heavily on “national codes for practice for the prevention of farmed escapes” (CQS, 2009) without providing any further requirements on preventive measures. The introduction of non-native species or more specifically the limits on their introduction is not discussed in the standards whatsoever. There is no mention of this issue in either the eco-standards nor the salt water or fresh water standards.

SADDS

The SADDS require transparent reporting and specific escape limits. Essentially, the standards are designed to hold farms accountable for demonstrating good management practices. In relation to farm site specific stock management, the limits are as follows: a maximum of 200 fish can escape at one time and no more than 300 salmon are permitted to escape from the farm over a whole production cycle. Escapes are monitored through counting technologies requiring a greater than 98% accuracy (SAD, 2011). The control for non-native species introduction requires applicant farm sites to show proof that salmon are “widely commercial produced” (SAD, 2011) in the area (hence the risk of establishment in those places has previously been reviewed). Where there is no proof of wide commercial farming, non-native species are not permitted unless they are sterile or in closed containment systems (SAD, 2011). The SADDS prevention training for all farm staff to ensure the least amount of fish escape as possible.

Escapes and Non-native Species Introduction Conclusions

Preventing farmed salmon escapes in open net pen aquaculture is currently the best practice for reducing the various impacts of these raised fish. These prevention practices are largely infrastructural and training-based to ensure nets are secure and employees know how to reduce risks. What raises GAA and SADDS above the other three with regards to escape prevention are their specific prevention planning and training. The organic standards both require more abstract and general preventative measures to minimize impact without the provision of clear specific guidelines.

Nevertheless, escapes are inevitable and the standards differ significantly with regards to both accountability and setting quantitative thresholds for escaped salmon. Only two standards considered set limits on number of fish allowed to escape in order to receive and maintain certification: SADDS and GAA. Of the two, the SADDS have set far more restrictive numbers than those set by GAA. While these numbers will be more challenging for farms to attain, setting lower thresholds is the more precautionary approach since uncertainty shrouds long term impacts of escaped farmed fish. The difference between 300 escapes (SADDS) and 5000 escapes (GAA) is particularly significant where wild salmon are threatened.

GAA conversely does stand out with its requirement that all certified farms have and implement a 'Fish Containment Plan'. Amongst other things, these plans require that all escapes are reported and efforts made to recover them are undertaken; holding farms accountable. This "Plan" calls for a move towards marking individual farmed fish by farm in the event of escape for traceability and recuperation efforts. While this is challenging and may be only achievable in the future, it demonstrates foresight within the standards.

On a final note, as mentioned above, the introduction of non-native species becomes an issue for salmon aquaculture only with regards to their escapement. The only two standards in this comparison to require serious restrictions for non-native species introduction are GAA and SADDS. Their indicators are comparable with regards to criteria; both could consider further defining the terms "widely commercially produced" (SADDS) and "approved for farming" (GAA, 2011) within their respective standards. These requirements are unclear and could be misinterpreted. However, standards for the future development of salmon farms and non-native species are much clearer and specific. SADDS do not allow for the introduction of sexually reproductive non-native species into the open ocean under any circumstances, while GAA's standard allows for a risk assessment through CITES resulting in potential introduction of non-native species into net-pen farms.

The introduction of Genetically Modified Organisms (GMO) is banned in all five standards as stipulated in the FAO guidelines (2010). There are no exceptions to the transgenic species allotment because the science is still unsure of their complete impact on the environment if they were to escape. One of the first studies of its kind found "that all the salmon (wild and modified) thrived as long as there was enough food to go around, but faced with food shortages, modified (by growth hormone in this case) individuals in the mixed group outcompeted their wild mates" (Peterson and Fronc, 2007, p. 448). The proliferation of genetically modified salmon in the wild might lead to serious and multiple ecological hazards.

6.2 Selected Animal Welfare Issues

Animal welfare issues are most closely addressed in the organic standards compared in this study. Most of the standards associated with these issues are procedural and process based as opposed to performance-based criteria (with the exception of stocking density). The most pressing animal welfare issues for salmon aquaculture are stocking densities, breeding conditions and transportation and slaughter and are those compared in this study. According to the recent report published by Conservation International, "adequate welfare standards are also required to minimize stress and reduce the incidence of disease and its consequent impacts on production and profits" (Hall et al, 2011, p. 59). It is therefore important to include these criteria in salmon aquaculture standards.

One specific issue not addressed in the SADDS or in the CQS eco-standards is stocking density. Excessive stocking densities may lead to increased stress levels and higher incidence of disease, threatening animal welfare and sustainability of aquaculture. However, the standard argue that density is covered by water quality and therefore not necessary. Another argument put forward by Lee (2008) on behalf of GAA is that restrictive stocking densities are "arbitrary and more intensive operations should not be excluded from eco-labelling schemes if they can satisfy compliance criteria. Indeed, it is often the more intensive farms that make technological advances in the efficient use of water, feed and seed" (p. 125). Furthermore, a lowered density may require more space for the aquaculture farm. This larger farm could potentially lead to greater impact from the mere size of it.

6.3 Selected Social Issues

The FAO COFI report emphasizes the need to include socio-economic aspects in aquaculture standards. It states that aquaculture should be conducted "in a socially responsible manner" while "having regard to the ILO-convention" and in respect of local communities (FAO, 2011). Often times with environmental standards, social aspects are excluded, as they are not directly linked to the environment. However, there is a strong community and labour component to salmon aquaculture that must be included in all standards. All but the Canadian Organic standards lay out some sort of community engagement management plans and ILO guided labour standards. First Nations rights are handled very differently and to a much lesser degree by the compared standards.

6.3.1 Community Engagement

Communities in and around salmon farms are affected by their development and operation. Local communities depending on subsistence activities may lose access to vital resources for their livelihoods through aquaculture facility and installations. In order to prevent and minimise conflict in current and future farm sites communities should be consulted. The standards in this comparison, except the organic standards COADS and NOAS, all acknowledge and require the need for community engagement. Through required procedures, the GAA and the SADDS, as well as the Eco-standards of the CQS, call for community engagement and open forums.

6.3.2 First Nations

The Aboriginal Aquaculture Association of Canada recently released a pilot project version of standards called "Aboriginal Principles for Sustainable Aquaculture". The standard states that it can "be applied to any aquaculture organization in Canada that wishes to include the values and interests of First Nations in the management of their operations and obtain use of the AAA Certified Sustainable logo" (AAAC, 2010, p. 1). This is a complimentary certification to be conducted, if desired, "at the same time as other audit processes (e.g. ISO 9001, GAA, ISO 14001)." (p. 2). The bulk of these standards lie in the First Nations Aquaculture Advisory Committee decisions with an emphasis on transparency, inclusiveness and an incorporation of local First Nation values and interests. They include, social, environmental and economic principles.

First Nation rights are particularly important to address in Canada (Young and Matthews, 2010) but should be considered in all certification schemes. Or should there be a separate certification scheme? The standards compared in this study do not include sufficient standards with regards to First Nation rights and inputs. The SADDS attempts to include the standards relevant to First Nations and while it makes a good effort there would need to be further discussion and engagement for standards to truly raise the bar with regards to these issues.

6.3.3 Labour

Only NOAS, GAA and SADDS provide adequate labour standards in alignment with the International Labour Organisation (ILO). These labour rights recognise forced labour, child labour, worker safety and health, discrimination, discipline, working hours, freedom of association, wages rights and must be encompassed in responsible aquaculture. These standards are challenging to measure quantitatively and therefore rely on management processes. It is the language of the SADDS and the GAA that make them stronger standards but still do not go much further than what ILO requires.

CHAPTER 7: DISCUSSION AND RECOMMENDATIONS

Standards are put in place so that farms are held accountable. The way that the standards attempt to develop accountability, however, depends on the standard. Ultimately, there are two ways that standards can go about this, and this is the standard dilemma.

A simple analogy for understanding the standard dilemma may be taken from the world of sports, and specifically from the Olympic games. In this Olympic analogy, the goal is to increase wellness through fitness and enjoyment of sport. Holding the Olympic games raises the bar to dramatic heights that fewer than 2% of the active population can achieve, although all admire. Everyone may aspire to such high standards, but more than 98% of the population fall short of such high goals.

The awareness of high achievement in sport sets the bar very high; we think that setting the bar that high will encourage people to run about more, be more active and ultimately be healthier and achieve a higher level of wellness.

An argument could be made, however, that sometimes one would want to set the bar lower, not higher, so that people have more realistic goals for achieving health and wellness. This kind of encouragement would result in more people simply being active, and therefore healthier, so instead of a 2% of the population being super fit and raising the motivational bar, one might expect the other 98% to become somewhat more fit. Which is an overall larger gain for humanity?

And so similarly, the dilemma exists in the aquaculture standards world. Does one set the bar very high, with rigorous and unattainable standards? Where a 20% or 30% of the given fisheries population might attain them, but where the other 80% or 70% do not?

Setting rigorous standards for salmon aquaculture ensures meeting very good levels of process and outcome in sustainability in this small proportion that succeeds in meeting them. The fear is that the rest of the industry may not even bother to try to achieve them, because they know at the outset that such standards are beyond their current operational and financial capabilities and abilities.

Given that the goal is sustainability, with global importance, would it not be better to have somewhat lower standards but greater participation within the industry? But at what cost?

A glaring problem with lowering standards lies in the inherent cost of setting thresholds too low, where the rate of potential improvement may also be too low. The obvious question is then how to keep sight of raising the bar while at the same time setting it low enough to increase participation? This is the standard dilemma, and we do not yet have the solution.

What is clear is that the solution does not lie in lowering standards through ambiguous or vague language and subjective criteria that are poorly defined. What is also clear is that setting the criteria objectively and creating very stringent standards is also not the solution. There needs to be some sort of compromise, where standards are set with binding, measurable criteria, but set in the middle ground, at a level that more than 20% or 30% of the industry can achieve. Sadly, none of the standards assessed in this study do that.

Less than satisfactory examples of standards at both ends of the continuum exist. The GAA sets lower standards with lower thresholds, but does so through the use of much ambiguous language. Since the GAA standards are accessible to a larger percentage of the industry, their adoption is becoming more and more widespread. SADDS on the other hand sets the bar very high, with the intention of becoming the standard of reference, a notch above the rest, but with the potential consequences of creating both elitism and inaccessibility. Furthermore, if the goal is overall sustainability, justifying the SADDS approach in the short-term time frame makes little sense. How can an elitist and inaccessible standard over the longer time frame help improve overall sustainability, where the intent is for everyone to achieve high standards?

On a side note, the organic standards are involved in a different race, whereby organic aquaculture is trying to fit into a framework established by organic *agriculture*, that is not compatible with organic aquaculture. As long as salmon are fed wild fish, organic salmon aquaculture makes even less sense within the context of sustainability.

We are left with the question of where do we go from here. Along the continuum of inaccessibility to absence of rigour, few existing solutions present themselves. The analysis of the language of standards conducted in this study nonetheless suggests some recommendations for the way forward.

Recommendations:

1. Future directions need to consider scale and size of salmon aquaculture farms, a topic that is not taken into account in current standards. Regardless of what standards are set, they need to incorporate scale and size of salmon aquaculture farms as well as the growth of salmon aquaculture farms. This is in line with the GAPI report with regards to salmon aquaculture which states that large production of better performing species could create more environmental damage than a single poorly performing farm (Volpe et al, 2010).
2. Addressing the standard dilemma requires assurance of more collaboration among standard holding and standard setting bodies and a distancing from the goal of financial gain. Standards must be separated from the lure of financial gain through marketability or encouragement by supermarkets; ideally, standards would be determined amongst themselves according to their definition of what the ultimate goal is. Playing into market driven demand can lead to unintended and undesirable consequences, such as larger production and the desire for fewer producers with greater competitive advantage. Aquaculture farms and farmers have a potential interest in being highly regulated, since the

incentives inherent in ownership means that farmers can invest in the long term viability of their farms (Lee, 2008).

3. Standards must be comprehensive; there is no room for narrow minded interests and thinking. Standards must include all aspects related to environment, food safety and quality, animal welfare and social well-being, regardless of the standard setting body. No excuses for not addressing any of these components are acceptable.
4. Work on standards must be an ongoing priority. The marketability of eco-labelling cannot camouflage the essential nature of the standards they are based on. Standards must not be overlooked or underemphasized by the financial gain or desirability of consumer awareness of products based on the showy nature of the labels. Furthermore, there must be a continuing improvement plan to adapt standards as data collection is done and technology improves.
5. Finally, reducing the negative impacts of salmon aquaculture must continue to be a concern for everyone, since salmon aquaculture is here to stay and growing at significant rates globally. To take an opinion or a stance to reduce or eliminate the practice of farming predator fish who require feed, management and containment, is altogether unrealistic and unhelpful. A collaborative effort is needed by everyone – industry, not for profit sector, academia, and the business world with its supermarkets and marketing engines. There is an urgent need to find solutions and reach consensus on issues related to reducing the negative environmental aspects and advancing the social potential this industry provides.

CHAPTER 8: CONCLUSION

Today, fish from traditional wild capture fisheries in the ocean are less able to feed the growing human population due in large part to overfishing (Myers and Worm, 2003). In response, and to maintain a constant supply of seafood to a demanding population, aquaculture production has increased exponentially in the last thirty years. With the growth of aquaculture, comes environmental and social impacts needing regulating and monitoring. In particular, salmon aquaculture growth has far exceeded other cultured species to become one of the higher grossing food production methods. However, the current salmon standards are potentially not keeping up pace with the growth and not providing adequate means to encourage sustainable salmon production in the entire industry.

As an integral part of certification schemes – along with accreditation and certification – standards are the backbone and the meat that the rest of the scheme is based on. Without solid standards the label and the promises are mute. The eco-certification of aquaculture products has been gathering speed and there is a growing body of certification schemes globally. However, as a young industry, the salmon farming standards that many of these schemes are based on have not been assessed or properly evaluated. Knowing where these standards are and where they are taking the industry and the state of sustainable production is important to the furthering of aquaculture regulation. Are the standards encouraging overall sustainable practices or simply advancing a small percentage of the industry in the right direction? Furthermore, are voluntary eco-certification schemes enough to change the entire salmon industry into better management practices and clearer improvements to the traditional negative environmental and social impacts it creates.

The following study aims to take apart a selection of global salmon aquaculture standards to assess them against an evaluative framework. The study will involve a background on aspects related to standards and aquaculture, an overview of the standards assessed, scoped down standard analysis as well as a discussion and the author's recommendations. In the end certain conclusions will be drawn based on the assessment and other findings. A number of questions will be answered but a number of questions will be posed for future research and assessments.

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