7 Certifying farmed seafood

A drop in the ocean or a 'stepping-stone' towards increased sustainability?

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Introduction

Seafood[1] is an important component of the world's food basket and provides 3.1 billion people with about 20 per cent of their daily intake of animal protein (FAO 2016). It is particularly important for the world's poor where fish eaten whole constitute a crucial source of essential micronutrients (Beveridge *et al.* 2013; Béné *et al.* 2015; Thilsted *et al.* 2016). With 90 per cent of global wild fish stocks being either overfished or maximally utilized, seafood extraction from the wild has reached a ceiling (FAO 2016) and even if fisheries are fully rebuilt (Sumaila *et al.* 2012; Costello *et al.* 2016), the continued expansion necessary to meet expected future demand of seafood must come primarily from aquaculture. This increasing need, as well as its potential positive contribution to the overall food portfolio (Troell *et al.* 2014), has led to aquaculture being the fastest growing food production sector in the world. Despite signs of slowed growth its contribution to the future seafood supply is expected to double within 30 years (Waite *et al.* 2014).

Such rapid development can, however, also come at a price, with negative environmental and social impacts including direct and indirect habitat destruction, biodiversity loss and wasteful resource usage through detrimental fishing for feed ingredients and also social displacement (Naylor *et al.* 2000; Cao *et al.* 2015). Brackish water aquaculture on terrestrial land suitable for agriculture can lead to soil salinization (Paprocki and Cons 2014) and conversion of coastal wetlands, e.g. mangrove forest (Hamilton and Lovette 2015), to loss of key ecosystem services, for instance fisheries production, carbon sequestration, water purification and protection from storms (Barbier 2007; Walters *et al.* 2008; Mcleod *et al.* 2011). A steady supply of environmentally sustainable feed from terrestrial and marine origin is also a key challenge for a continued growth of the aquaculture sector (Gephart *et al.* 2017; Troell *et al.* 2017). Additional negative environmental challenges include leakage of nutrients and chemicals (Islam 2005; Burridge *et al.* 2010), spread of invasive species (Beveridge *et al.* 1994), diseases (Krkošek *et al.* 2007) and emissions of greenhouse gases, for instance related to energy consumption (Pelletier *et al.* 2011).

While aquaculture can be touted as an overall low-impact animal protein, particularly in comparison to red meat (Tyedmers 2004; Tilman and Clark 2014), simple operational errors including but not limited to overstocking and improper siting, have continued to promulgate the image of aquaculture being an environmentally harmful food production system. In addition, different species and systems also vary in performance from an environmental and resource management perspective (Troell *et al.* 2014). Although the hope is that animal food production systems continually improve over time, one of the more recently highlighted challenges related to farmed animals, besides its dependency on feed resources, is over reliance on antimicrobials that may lead to antimicrobial resistance (Jorgensen *et al.* 2016). This is also true for farmed aquatic species (Henriksson *et al.* 2017). Therefore, a future expansion of future aquaculture production must strive for ever increasing sustainable production methods and a focus on less environmentally demanding species.

The sustainable seafood movement (Konefal 2013; Silver and Hawkins 2014) was born partly from a perceived failure of public policy instruments to address the increasingly evident environmental challenges related to fisheries and aquaculture. This was particularly evident in the developed world's impression of regulatory oversight of production in the developing world. Market-based tools such as eco-certification have been one of the main sustainability mechanisms used in the sustainable seafood movement. Implementation of aquaculture certification was gradual with organic farmed seafood (IFOAM) (Bergleiter 2008) and the Global Aquaculture Alliance's (GAA) Best Aquaculture Practices (BAP) standard (Lee 2008) being the first established schemes on the market (1996 and 2004, respectively). The latter was originally solely focusing on eliminating the worst performing shrimp farms (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification 2012) (Table 7.1). GlobalGAP, primarily a business to business scheme, label products as GGN and in collaboration with the Friend of the Sea (FoS) by allowing use of their logo on packages, started certifying farmed seafood in 2004 and today accounts for the largest portion of eco-certified farmed seafood available on the market (Potts *et al.* 2016). In 2010, the Aquaculture Stewardship Council (ASC) was born through a collaborative effort between the Dutch Sustainability Trade Initiative (IDH) and the World Wildlife Fund, WWF. As of January 2018, 569 farms with a total annual production of 1.28 million metric tonnes were certified against the ASC standard (ASC 2018a). In contrast to the evolution of certification schemes in other sectors, most aquaculture and fisheries schemes, e.g. the MSC, GAA/BAP and ASC, were established on a global level rather than starting off with local activities (Auld 2014). Volumes of certified farmed fish and shellfish constitute about 8 per cent of global aquaculture production (76.7 million tons, 2015).

Alongside the spread of private, global eco-certification schemes, state-initiated national certification programmes for aquaculture have developed. Examples of standards for shrimp farming include the Good Aquaculture

Table 7.1 Major aquaculture certification schemes

Scheme	*Year of establishment*	*Volume certified (million tons)*	*Species certified*
ASC	2010	1.28	abalone, bivalve, pangasius, salmon, shrimp, tilapia, trout
GAA BAP	2004	1.80	(key groups) catfish, pangasius, salmon, shrimp, tilapia, trout
FOS	2008	0.70	(key groups) cod, clams, oysters, pangasius, salmon, sea bream, shrimp/prawn, trout, other
GLOBALG.A.P	2004	2.10	(key groups) pangasius, salmon, shrimp, tilapia, trout, sea bream, sea bass, meagre
IFOAM Organic	1996	0.19	(key groups) carp, mussels, oysters, pangasius, rainbow trout, salmon, seabass, shrimp/prawn, trout

Source: data on volume certified from ASC (2017a), BAP (2018) and the remaining schemes from Potts *et al.* (2016). Production volume data from 2017 (ASC, GAA/BAP), 2015 (GlobalG.A.P), 2014 (FOS) and 2013 (IFOAM).

Practice (GAP), Code of Conduct (CoC) and the GAP-7401 (TAS-7401) in Thailand (Samerwong *et al.* 2018), the National Standard on Good Aquaculture Practices in Vietnam (VietGAP) and IndoGAP (CBIB) in Indonesia (Tlusty *et al.* 2016). Contrary to most international programmes focusing on the best performing farms within a certain sector, these schemes generally target a large portion, if not the majority, of producers in a given country and have been perceived as less stringent in terms of scientific rigour than most international schemes (Samerwong *et al.* 2018). While fewer requirements can imply that a larger portion of producers are attracted to join, sector-wide progress towards sustainability requires that standards are continually improved. In order to increase the understanding of how national and international shrimp schemes compare, Tlusty *et al.* (2016) used statistical tools to assess six schemes (three state-initiated and three international) with respect to the number of factors covered (breadth) and the compliance mechanism applied (depth). Expectedly, results showed that the international schemes (ASC, GAA and GlobalGAP) had both greater breadth and depth than the national schemes (VietGAP, TAS-7401 and CBIB). Additionally, there was a substantial overlap between the international schemes, mainly due to similarities in factors covered in the standards. To strive towards greater horizontal diversification among the more rigorous global schemes, i.e. differences in requirements for compliance between standards, could be an important mechanism for including a larger set of producers without compromising scientific rigour and credibility of the standards.

Aquaculture is an important source of nutrition in the developing world (Béné *et al.* 2016; Belton *et al.* 2017) and has even been described as being a 'pro-poor' engine (Toufique and Belton 2014). The seafood sustainability movement began targeting environmental impacts (Haugen *et al.* 2017), largely without a lens on the social sustainability dimension (Bush *et al.* 2013a). Yet recently, the social dimension of seafood sustainability has gained increased attention, in both fisheries (Hilborn *et al.* 2015) and aquaculture (Krause *et al.* 2015). The FAO technical guidelines on aquaculture certification (FAO 2011) as well as the Ecosystem Approach to Aquaculture (EAA) have social factors embedded within (Soto *et al.* 2008; Tlusty *et al.* 2016) but a preponderance of literature suggests that additional work needs to occur in order to fully integrate the social into the ecological sustainability assessment (Krause *et al.* 2015). While there is much work to do, it is encouraging that one aquaculture certification, GAA BAP, was recently found to be compliant to the Global Social Compliance Programme criteria (BAP 2017). Despite the increased focus on the social, the focus in this chapter is on environmental sustainability and no thorough review on earlier work on social effects has been conducted.

Positive environmental effects of aquaculture certification: what is the evidence?

The general purpose of any certification is to ensure production occurs to a specific standard. For eco-labels, the environmental metrics should be set so that on average the certified producers have fewer impacts than those that are uncertified. Until now, only a few studies on the effectiveness of aquaculture eco-certification (shrimp and pangasius (Striped catfish)) in improving production practices have been published. Given that seafood certification programmes have been around since early 2000, and little effort was made two decades ago to assess the baseline condition, surprisingly few studies on the effectiveness of these programmes in reducing negative environmental and social impacts have been conducted.

Tlusty and Tausig (2014) investigated the effectiveness of the GAA Best Aquaculture Practices (BAP) programme in improving the performance of shrimp farms. In total, 323 audits between the years 2005–2012 from 192 shrimp farms located in 11 countries was used as the basis for evaluation. This study found that approximately 25 per cent of nonconformities (standard criteria that needed to be improved prior to obtaining certification) included environmental metrics. However, this was distributed over seven metrics, and therefore it was difficult to calculate the overall change in, for instance, nutrient discharge as a result of certification. In addition, this study showed that 10 per cent of farms exited the certification programme without becoming certified. It is not clear why these farms exited, yet this points to the fact that farms participating in certification schemes are self-selected. Undertaking an audit process is a business venture by the farms, and as such, it behoves the farm to not fail. The corollary to this is that the rigour of a certification programme cannot be determined by the percentage of farms that fail, as the process by nature self-selects for successful applicants. Similarly, the authors point out that one of the main challenges of measuring impacts from aquaculture eco-certification is that changes and improvements in production practices likely occurred prior to the first audit, thus at the early stage where an operation chose to enter the certification process. Lack of a systematic approach to gather these baseline data thus limits the extent to which we can understand the role of eco-certification in improving the environmental performance of aquaculture (Tlusty and Tausig 2014) as well as other sectors, e.g. forestry (van der Ven and Cashore 2018).

Jonell and Henriksson (2015) used a different approach by investigating whether mangrove-integrated shrimp farms certified as organic performed better from a Life Cycle Assessment (LCA) perspective than noncertified farms. Results indicated slightly better performance by the certified farms across all environmental impact categories investigated (climate change, eutrophication potential and acidification). The differences in performance could, however, not be attributed with high certainty to certification. Instead certified farms were assumed to have been better performing already before certification was implemented (Jonell and Henriksson 2015). Similarly, some of the uncertified farms performed equivalently to the certified operations. Nhu *et al.* (2016) also applied LCA to assess differences between ASC certified and noncertified pangasius farms. Water, land and total resources (including feed inputs) were evaluated together with global warming potential, acidification, freshwater and marine eutrophication. Results indicated lower environmental impacts for ASC certified farms, particularly for global warming, acidification and eutrophication potential. It should be noted that none of the studies cited above, however, applied any of the techniques to assure that a credible counterfactual was used (types C–F in Table 7.2, Box 7.1). Difference in performance and potential environmental impacts were found between certified and noncertified farms for both studies, however attribution to certification is inconclusive given existing performance and environmental impact of farms prior to certification.

Box 7.1 How to measure effects?

Three circumstantial and methodological challenges related to measuring impacts of aquaculture certification appear. First, as certification standards for farmed seafood have existed for a relatively short time period, some of their effects may not yet have been realized. Second, as many schemes are practice-based rather than results-oriented, using audit data as the basis for evaluation limits the extent to which long-term environmental outcomes can be assessed. Here an additional step of evaluating whether a certain practice has effects on the environment and surrounding ecosystems is necessary, but seldom prioritized by certification programmes (Steering Committee of the State-of-Knowledge

Assessment of Standards and Certification 2012). Third, the general challenge of ensuring credible counterfactuals, i.e. when determining whether implementation of certification has had an effect on environmental performance, what would the outcome be of a certain operation given that it would not have been certified (Blackman and Rivera 2010, 2011). A summary of credible and non-credible counterfactuals for evaluating effects of certification standards is presented in Table 7.2.

Ideally, certification will improve conditions of a baseline. However, there have been no studies that, together with an evaluation of the performance of certified farms have randomly assessed how farms operate in the complete absence of certification. From an experimental perspective, the ideal method to analyse the impact of certification would be the Before-After-Control-Impact (BACI) design (Table 7.2, Blackman and Rivera 2010). This would be a base case where a group of very similar farms would be assessed (the before). Half the farms would be randomly allocated to a control group (would not be trained/educated to be certified) while the other half would be trained/educated

Table 7.2 Summary of non-credible and credible counterfactuals that can be used to assess effects of certification. A counterfactual outcome can be defined as an estimate of the performance of an operation given that eco-certification would not have been developed

Counterfactuals for assessment of impacts from certification			*References*
Non-credible	A	Differences in performance of an operation over time. Environmental impact (t = 0) – Environmental impact (t = T) = effect certification	
	B	Comparison certified and noncertified operations. Impact (noncertified farm/fishery) – Impact (certified farm/fishery) = effect certification	
Credible	C	Approach using 'matching'. Impact (noncertified farm, incl. matching) – Impact (certified farm, incl. matching) = effect certification	Ruben and Fort (2011); Blackman and Naranjo (2012)
	D	'Instrumental variables' Use factors that co-vary with the likelihood that a unit of assessment is certified, but not with environmental outcomes. Otherwise like B.	Bolwig *et al.* (2009)
	E	'Difference in differences' or Before-After-Control-Impact (BACI) design	Bertrand *et al.* (2004); Blackman (2012)
	F	Experimental approach requiring that producers are randomly selected for certification. Otherwise like B.	

Source: Table adapted from Chaplin-Kramer *et al.* (2015), Supporting Information.

to be certified (the impact group). After the impact farms were certified, they would be assessed again, and certification would be demonstrated if the impact: after metric was significantly different than the other metrics (impact: before, and all control values). One complicating factor will be controlling uptake, adoption of better practices by uncertified farms over the study period. Where this isn't possible, shifting baselines will have to be allowed for within study models.

The potential of aquaculture certification to transform the seafood sector: a discussion on potentials and limitations

In addition to the aforementioned studies on the effectiveness of aquaculture certification to reduce negative environmental impacts, a separate body of literature has explored the potential of aquaculture certification to have effects on the global scale and on the fish farming sector as a whole (Bush *et al.* 2013a; Jonell *et al.* 2013). If the former section of this chapter focused on the evidence for certification to improve individual operations, the current elaborates primarily on its role in pushing the overall aquaculture industry towards sustainability. Important to note here is that the authors recognize that certification is only one of many existing governance mechanisms to improve the performance of the aquaculture sector and that other more conventional approaches such as state-led regulation may be more effective in reducing negative impact. The aim here is thus not to evaluate certification in relation to other instruments, but to outline how the effectiveness of this specific tool could be improved.

A number of barriers for seafood certification to significantly improve the aquaculture sector have been highlighted. For instance, limited coverage of species and markets targeted, exclusion of small-scale and poor performers and a too narrow focus on only a few sustainability dimensions. Furthermore, the limitation of certified units not being incentivized to improve beyond the required performance level has also been suggested to be a key limitation (Bush *et al.* 2013b; Tlusty and Thorsen 2016). In this section of the chapter, the earlier identified barriers are turned around and defined as prerequisites (I–V) for aquaculture certification to have long-term, substantial effects on global aquaculture production and growth. In other words, what are key prerequisites for certification to deliver major impacts? While this section uses aquaculture as a case, it should be noted that most barriers and opportunities could be applied to other commodity standards aiming for an improved environmental performance of production practices at sector level. The five prerequisites outlined in this section are summarized in Figure 7.2.

I Global coverage: production and consumption

Aquaculture is a tale of two worlds. The global north (here including Europe, North America, Australia and New Zealand) has for a long time preferred high value farmed species for instance salmonids and shrimp while farmed seafood consumption in the global south (primarily Asia, but also Africa and Latin America) has been centred on freshwater species such as carp, pangasius and tilapia (Belton *et al*. 2017). While the demand for high value species such as salmon is predicted to increase also in Asia, for instance by a staggeringly 25 per cent per year in China (The Fish Site 2017), the bulk of farmed seafood consumption in the region still consists of lower trophic freshwater species. Global aquaculture production is, by volume produced, dominated by the freshwater fish carp (29 million metric tonnes in 2015, 38 per cent of global aquaculture production, seaweeds excluded), followed by marine bivalves (15 million metric tonnes, 20 per cent) and miscellaneous freshwater fishes (nine million metric tonnes, 12 per cent) (FAO 2018).

Although the lion's share of global aquaculture production consists of low trophic species, current eco-certification programmes for aquaculture primarily target species groups preferred and sought after in markets in North America, Europe, Australia and New Zealand (Table 7.3, Jonell *et al*. 2013). This despite that the appetite for seafood is high in Asia with the per capita fish consumption (average 2013–2015) being 58.4 kg per person per year in the Republic of Korea, 50.2 kg in Japan, 39.5 kg in China, 35.4 kg in Vietnam and 35.0 kg in Indonesia, compared to the global average of 20.2 kg per person and year (FAO 2016).

Table 7.3 Rankings of top seafood species in the US (based on volume consumed), the EU (based on volume sold), and global production (million metric tonnes produced)

US 2015 – volume consumed[a]	*EU 2015 – volume sold*[b]	*World 2014 – production (mmt)*[c,d]
Shrimp	Tuna	Grass carp (5.5)
Salmon	Cod	Silver carp (5.0)
Canned tuna	Salmon	European carp (4.2)
Tilapia	Alaska pollock	Manilla clam (4.0)
Alaska pollock	Herring	Nile tilapia (3.6)
Pangasius	Mussel	Whiteleg shrimp (3.6)
Cod	Mackerel	Alaska Pollock (3.2)
Catfish	Hake	Anchoveta (3.1)
Crab	Squid	Skipjack tuna (3.1)
Clams	Tropical shrimp	Chub mackerel (1.8)
		Atlantic herring (1.6)

Notes

a www.aboutseafood.com/about/top-ten-list-for-seafood-consumption/.

b www.eumofa.eu/the-eu-fish-market.

c www.statista.com/statistics/240231/principal-fish-species-for-global-fishery/.

d www.statista.com/statistics/240268/top-global-aquaculture-producing-countries-2010/.

An emerging body of literature has been investigating the demand for eco-certified seafood in Asia (e.g. Xu *et al.* 2012; Uchida *et al.* 2013; Fabinyi 2016). In China, most efforts towards sustainable seafood have been in the form of campaigns against certain traditional eating habits, e.g. consumption of shark fin soup, and less on promotion of eco-labelled options (Fabinyi 2016). However, seafood eco-labels have also gained increased interest, particularly those focusing on food safety issues and signalling organic production practices (Fabinyi 2016), indicating that food safety is the prominent driver in the region. Despite the fact that eco-labelled seafood has slowly started to enter Asian markets, several hurdles for increased uptake have been identified. First, the region has no or little tradition of 'green consumerism', implying altruistic consumer action towards a greater good rather than being able to rely on ideas of benefit for the individual consumer (Liu *et al.* 2017). Second, in some nations, for instance China, a general perception appears to be that the government rather than the individual consumer should be responsible for environmentally sound production practices (Fabinyi 2016). While the view that consumers are less obliged to engage in seafood sustainability than other key actors, such as the state or the private sector, appears to be evident also in high income countries (Jonell *et al.* 2016), the superior role of the state in for instance China and Vietnam likely makes consumers even less susceptible to the message of the individual's role as a change agent (so-called consumer effectiveness, Vermeir and Verbeke 2006). The strive towards an 'eco-civilization', laid out in the Chinese 13th Five Year Plan, can potentially change the Chinese consumers perception with respect to environmental sustainability (Central Compilation & Translation Press 2016).

While most certification programmes nowadays can be applied to a large set of species groups, the drive by 'Western' or developed-world markets to engage in certification is limiting its overall effectiveness. The currently certified portion still consists mostly of species preferred primarily in these markets, and missing out on e.g. carps, the most cultured finfish by volume globally (Table 7.3). The consequence is that many species and systems that could be improved are not (e.g. carps) and that species with a potentially small environmental footprint (e.g. many freshwater species) are not targeted for certification (see also Prerequisite V). If certification is to have any substantial effects at scale, schemes need to engage Asian markets and consumers to a higher extent. The limited consumer interest for eco-labelled seafood products in Asia certainly implies certain challenges, but engaging large retailers and wholesalers active in the region to source more eco-labelled seafood may be a feasible way forward. Moreover, given the important role of the state in many nations in the region, engagement with governments will also likely be of pivotal importance.

II Inclusion of a critical set of producers

The exclusion of worst performing farmers (Tlusty 2012) and small-scale producers (Belton *et al.* 2010) risks limiting positive effects of aquaculture certification on the global scale. At the time of writing, few theoretical models on how eco-certification could improve the environmental performance of individual aquaculture farms and the sector as a whole have been suggested. One exception is the pull-threshold model by Tlusty (2012), proposing that only producers performing just below the certification threshold for a certain environmental variable can be expected to change their practices. Put differently, a key limitation with current schemes is that it remains only the producers performing relatively well and where the requirements for certification are plausible to reach that will improve their practices as an outcome of entering a certification programme. The worst performing producers, on the other side, will not attempt certification if the requirements are too demanding. Instead, a multi-threshold approach, i.e. horizontal differentiation between schemes (Tlusty 2012) or vertical differentiation within a certain scheme (Bush and Oosterveer 2015) (Figure 7.1), are suggested as potential mechanisms to increase the pull and thereby improve a standard's effectiveness in reducing negative environmental impacts. Similarly, Bush *et al.* (2013b) stress the challenge of seafood certification schemes to balance the three assets of credibility, accessibility and a continuous improvement of standards (see also Prerequisite III below), together conceptualized as a 'devil's triangle'. Echoing the conclusions drawn by Tlusty (2012), the authors argue that schemes should strive for a multitier mechanism to ensure that both worse producing performers currently not able to enter certification are included and producers willing to go beyond set requirements are incentivized to improve further (Bush *et al.* 2013b).

Challenges to reach small-scale producers in certification programmes are not unique to aquaculture. Instead, examples of exclusion of small-scale producers not able to pay for certification audits, technical improvements or general updates in production practices can be found from a number of sectors. Aquaculture Improvement Projects (AIP) and the counterpart for capture fisheries (FIP) facilitate for sequential improvement with the ultimate aim to get certified. These programmes are generally not tied to a specific certification scheme, but can rather be defined as an alliance of value chain actors, including e.g. producers, processors and retailers, striving to improve practices. AIPs constitute recent transformability interventions that have been suggested to be a viable means to attract small producers and those not yet compliant with eco-certification. Little research has, however, been conducted on the effectiveness of AIPs, and lack of transparency and independent third-party assessment has been suggested to limit the potential for these tools (Sampson *et al.* 2015). Certification schemes are developing improver programmes (e.g. the iBAP programme of GAA, Towers 2016), but these are too recent for results to be evaluated.

The certified portion of global aquaculture production amounts to around 8 per cent of the total production (Table 7.1). While it remains uncertain

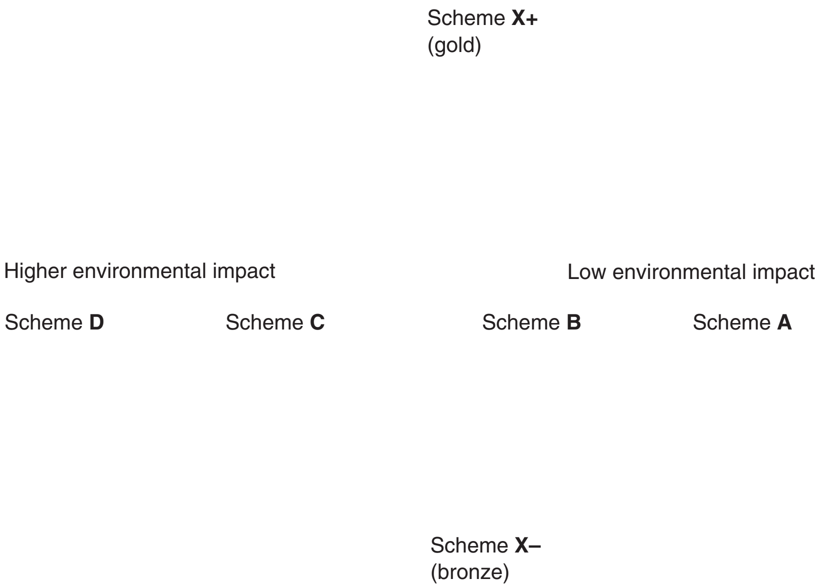

Figure 7.1 Vertical (scheme X– and X+) and horizontal (schemes D–A) differentiation within and between schemes could be a mechanism to increase accessibility of certification for less well performing farms (Higher environmental impacts) and create incentives for better performing producers (Low environmental impact) to improve further.

what extent of an increase by volume and producers would be needed to create substantive 'pull' on a sectoral level, it can be assumed that if an insignificant share of the global aquaculture industry is certified, effects will be limited. If aquaculture certification is to ramp up and account for a more significant portion, schemes need to better include both small-scale producers (both better and worse performers) and worse performing farmers who are currently far from the certification threshold. Horizontal differentiation and multitier approaches within one certification programme implies certain challenges, e.g. potential confusion around what constitutes sustainable production or best choice, but may be the most promising approach to increase the global portion of certified farmed seafood.

III Mechanisms in place for a continuous improvement of standards

As important as it is to assess the state of aquaculture pre-certification, it is equally important to routinely address standards against audit data, and to incorporate improvements to performance into new versions of the standard.

ISEAL's impacts code indicates in section 9.2, 'Improving Monitoring and Evaluation Effectiveness', that scheme owners should create a system to ensure 'results from performance monitoring, outcome and impact evaluations and the learning from these activities are used to inform a periodic review and refinement of the intended change and of the M&E strategy' (ISEAL 2014a). This is a key step in creating a system of continuous improvement necessary to reduce the negative impacts of aquaculture products (Tlusty 2012).

A prerequisite for certification standards to have effect on a sectoral level is for them to continually improve and adapt as science develops or when new technologies becomes available. Continual improvement has been suggested to theoretically take place at two levels, (i) producer level where operations show improved environmental performance over time after compliance with certification standards, and (ii) strategic/systemic or standards level where an increased ambition is expressed as stricter or more difficult criteria for compliance with certification standards (Bush *et al.* 2013b). The latter level is affected by external influences such as technical development and also internal processes related to the standard's strategies for improved credibility. Ideally, standards should be revised based on M&E data on actual farm improvement over time (Tlusty and Tausig 2014). Important to note, however, is that a continual improvement could imply a particular challenge for small producers struggling to afford technical investments potentially needed to comply with the updated standards. Continual improvement will also be challenging from a business standpoint as increasing metric rigour may result in the loss of farms that are no longer in compliance. One way to address this could be vertical differentiation within a scheme where less well performing farms could stay certified at a less demanding level of compliance.

A brief review of material available on standards' websites indicates that standards generally are continuously updated but with little transparency on revisions made or how often updates are needed to take place. The BAP standard for shrimp for instance remained the same for almost a decade before being harmonized with the finfish standard (Tlusty and Tausig 2014). Recently, the GAA process for updating standards has been formalized and occurs every three years (BAP 2017). Sustainability standards being members of ISEAL (ASC for aquaculture) are obliged to review a standard every fifth year to ensure that it is relevant and that standards have effects on the water (ISEAL 2014b). This includes an evaluation of audit data, and the incorporation of the learning from these data into the improved standard. Currently, data management systems for aquaculture standards are only first being developed if at all, and thus a database approach to standards revision has not yet been implemented. ASC have decided to review standards even more regularly on a three-year cycle (ASC 2018b). A formal revision process needs to take place and schemes ought to highlight the improvements incorporated into the standards. Even though some schemes, e.g. the ASC, are more transparent in terms of policies for when revisions are to be made and the content of such standard revision (ASC 2015), it still remains unclear how schemes make sure that all relevant new scientific knowledge is considered when reviewing and revising standards. In 2015, ASC commenced the process of updating its pangasius, tilapia and salmon standards due to feedback from producers and ASI (Accreditation Services International) (ASC 2015). A number of potential risks were identified prior to revision, for instance resistance from producers. Interestingly, the strategy for dealing with this concern was to 'make sure that the standards or changes are applicable and accessible'. To what extent such an approach stands in conflict with increasing standard credibility through raising the bar for sustainable production remains unclear. Note that the main focus on ASC above reflects more transparency in terms of publicly available documentation rather than a need for specific scrutiny.

IV Additionality to conventional state-led regulation

A key precondition for aquaculture certification to have positive environmental effects is for standards to go beyond what is required, and enforced, by national regulations. The term 'additionality' has been defined as 'outcomes beyond business as usual' (Garrett *et al.* 2016) and is conditional on eco-certification standard goals and local circumstances. A precipitating factor in the advent of aquaculture certification was the overall distrust that developing world national regulations were sufficient to limit environmental impacts of a growing food production platform. This is still present today as voluntary standards tend to be of greater breadth and depth than national standards (Tlusty *et al.* 2016). Any national standard will definitionally be less robust given that nation-states need to ensure for the economic well-being of their constituents. A nation that enacts aspirational regulations with regard to sustainability will likely, at least initially, be limited in production that will concomitantly limit the number of citizens that can participate and benefit in the industry. Thus, standards that are nationally focused will most likely be less aspirational than voluntary standards that can operate across multiple countries. This can be exemplified by the shrimp sector where voluntary certification programmes were of greater breadth and depth than national certifications (Tlusty *et al.* 2016).

V Ability to support 'truly sustainable' seafood production systems

One of the greatest challenges facing humanity today is how to feed a growing and more wealthy world population without increasing the pressure on the world's ecosystems (Garnett 2016). A large and growing body of literature is stressing that we need to considerably change what we eat and how food is produced in order for humanity to stay within planetary boundaries (Campbell *et al.* 2017; Gordon *et al.* 2017). The need for a biosphere-based sustainability science has become evident under the Anthropocene, the age of mankind, by recognizing that biosphere capacity serves as the foundation for human well-being (Folke *et al.* 2016). How increased aquaculture production can add resilience to the world's food portfolio has specifically been discussed (Troell *et al.* 2014). One question of relevance for aquaculture and sustainability standards communities is therefore how aquaculture certification systems can contribute to this major, and much needed, transformation.

Marine aquaculture production offers opportunity for opening up new regions for food production that are not directly dependent on land use (Troell *et al.* 2017). However, while expanding aquaculture, it will be important to consider a full suite of impacts as it compares to other proteins. Defining sustainable seafood production and products and clarifying its potential role in the future global food basket is a first step in the process of identifying the role of certification and other market-based tools. A potential criterion to explore further is whether the product or production system adds a net input to human food/protein/key nutrient provisioning, i.e. implies no net loss through excess use of fish meal and oil or terrestrial ingredients. Other examples include nutrient budgets in balance to avoid food systems to push the planetary boundaries relating to leakage of nitrogen and phosphorous and use of renewable energy sources.

Unfortunately, the bar for truly sustainable seafood (from systems characterized by strong sustainability) will vary based on the nature of the discussant. Tlusty and Thorsen (2016) argue that there is a risk associated with labelling seafood products to be 'sustainable enough' as this may prevent further improvements in production practices. The seafood industry needs to acknowledge that not all species are the same and have the same suite of impacts. In creating a more sustainable and food secure future, some species perform better and some worse than terrestrial proteins. What is the message being sent by a global market that sanctions the eco-labelling of fed aquaculture products, while many of the unfed products (filter feeders and plants) do not have a relevant label? As consumers concerned about ocean health generally look for eco-labelled alternatives, this may lead to the best alternatives being set aside. For instance, recent work showed that consumers perceive eco-labelled salmon to be a better environmental choice than non-eco-labelled farmed blue mussels, this despite the smaller footprint of the latter (Jonell 2016). In this context, eco-labelling is all about supporting, approving and marketing production practices with acceptable environmental and social impacts. The ambition to reduce a variety of impacts is positive, but caution and scrutiny is needed to avoid the mistake of automatically putting this on a par with most sustainable practices.

The discussion about what production systems and species are suitable for certification boils down to how the 'theory of change' of market-based instruments is described. All eco-certification programmes need to balance the two somewhat contradictory objectives of being inclusive and thereby attracting a large enough portion of a certain sector to stimulate substantive change, and having stringent enough standards to ensure that production practices comply with crucial sustainability criteria (Jonell *et al.* 2013). The former perspective is illustrated by Jason Clay (Senior Vice President, Food & Markets, WWF) who states in his TED-talk on using market mechanisms to improve food production globally 'We can't just focus on identifying the best; we've got to move the rest' (Clay 2010). Certification programmes that openly state that they aim to initially be within reach for a certain portion of the market (e.g. ASC aiming to set standards that around 15 per cent of best performing producers can reach at the time of launching a standard (ASC 2017b)), also is well in line with the more inclusive approach. Setting standards that can be reached by a large portion of the industry may lead to substantial net reductions of total negative environmental impacts, but at the expense of certifying individual farming systems that are very distant from sustainable practices. This 'legitimization of the unsustainable' may lead to consumer mistrust and discredit of market-based instruments such as eco-certification. If standards become too weak and inclusive, it could also be questioned whether this is the role and mandate of eco-certification schemes to address rather than relying on governance, institutional regulation and legal frameworks to be responsible for setting and enforcing baseline standards.

Functionally, this is a discussion of whether aquaculture standards should be absolute or relative. An absolute aquaculture certification would select a

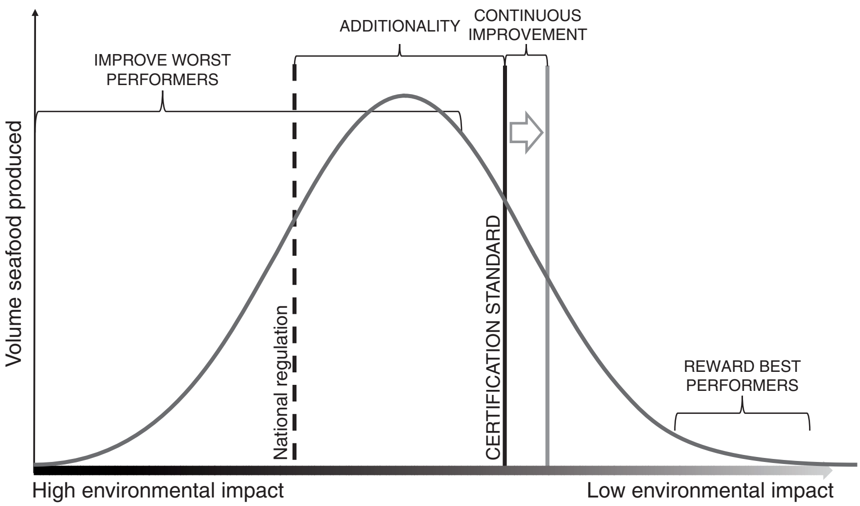

Figure 7.2 Conceptual figure demonstrating the environmental performance of the aquaculture sector (x-axis) and the volume of seafood produced (y-axis) together with prerequisite II–V. For simplicity, the curve is normally distributed and presents no multi-dimensionality with respect to environmental impacts. In order for certification to have substantial effect, it needs to stimulate improved performance of both worst performers (prerequisite II) and reward and incentivize improved practices among best performers (V). Moreover, certification standards need to continuously improve (III) and be more rigorous than national regulation (IV).

suite of common metrics (e.g. focused on planetary boundaries such as energy, GHG, P and N effluents, impacts on biodiversity and resource appropriation), and would set the standard at some level. This level would likely include all of some species, while other species would not be able to achieve the bar. For example, if N and P effluents were the selected metrics, then all seaweed and shellfish would be above the cut off (given they are primary producers and filter feeders respectively), whereas species with very high feed conversion ratios (e.g. Bluefin tuna) or production systems emitting substantial amounts of excess nutrients, would not be included. Current developed country market-based initiatives can, however, be defined as relative given that any species can be certified, also those from production systems highly criticized for unsustainable practices, e.g. tropical shrimp farming. In other words, certification currently helps consumers identify the best option in each species category but provides no assistance in distinguishing the seafood, or food, option with the smallest environmental footprint.

Future research needs

More work is needed to fill the knowledge gap on effects of aquaculture certification. Creating a metrics and evaluation framework that will encourage elucidation of the environmental and social gains made through certification will be paramount to raise certification beyond being a barrier to accessing specific markets. The trade-offs between two tentatively contradictory objectives of eco-certification (i.e. lowering impacts vs promoting sustainable practices) also need to be unravelled and better communicated. This is of relevance from the perspective of a range of value chain actors such as retailers and consumers, but also environmental NGOs aiming to advise consumers and others on the better environmental seafood choice. Moreover, insights for when certification leads to reduced environmental impacts is crucial for revising and updating certification standards (Tlusty and Tausig 2014) and is therefore also highly important for standard-holding organizations. Furthermore, broader systemic insights with respect to potential negative effects and impacts from certification are needed. For instance, whether certification may increase consumer demand for inherently more environmentally impactful products, incentivize producers to shift from a low-impact species or system not targeted by certification to more demanding species groups where certification can be achieved and thereby access to attractive export markets. These are important questions as they put emphasis on potential unwarranted effects from certification that can result in critical negative trade-offs. Thus, besides the pressing need to better understand when and how aquaculture certification has effects, there is also a need to go beyond measuring direct impacts and instead consider indirect spillover effects on noncertified units (Gutierrez *et al.* 2016).

There is also a need for increased knowledge on general institutional and social conditions that influence whether a scheme is successfully implemented and drives long-term improvements of practices. Recent work by Thorlakson *et al.* (2018) investigating the effectiveness of a retailer-led certification standard in improving agricultural practices for instance suggested certain characteristic uncommon in conventional certification programmes to have been crucial for effectiveness on the ground. For instance, a lack of strict certification criteria together with a unique focus on capacity building rather than traditional auditing processes was suggested to be a key success factor. A close relationship between producers and the retailer chain responsible for the scheme was also highlighted to be of high importance (Thorlakson *et al.* 2018). Findings from this study are well in line with earlier work (e.g. Poynton 2015), stressing that there is a need to think beyond conventional certification and strict controlling systems and instead push for collaboration, transparency and stepwise learning. This emerging body of literature also calls for broader research on the role of the private sector in driving substantive change (Österblom *et al.* 2017), the role of market-based governance mechanisms beyond traditional eco-certification, e.g. effects of AIPs, and the linkages between corporate-led sustainability initiatives and state-led governance (Bailey *et al.* 2018)

Note

1 Here used as a broad term for fish, crustaceans and other aquatic species from both marine and freshwater production systems.

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