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Understanding aquaculture certification¤

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Introduction

When consumers select seafood products from displays or from restaurant menus, they can easily base their choice on a quick assessment of key attributes such as price, quality, convenience and origin. But refining their choices further, based on food safety, ethical, environmental or animal welfare grounds, is more difficult because of a shortage of reliable, independent information (Wessells *et al.,* 1999). In essence, it is this information gap that opens the way for seafood certification and eco-labelling schemes. Such schemes have the potential to link a consumer's responsible choices with a producer's responsible practices and to deliver market rewards accordingly (Wessells *et al*., 2001, Philips *et al.,* 2003, FAO/ NACA 2007).

Well, at least that is the theory. In practice it is not clear if consumer choice alone is enough to drive and sustain all certification schemes. For example, as Mathew (2004) notes for fishery products, there is as yet no clear signal from the market that the price for eco-labelled fish could more than offset the costs of certification.

In the absence of consistent market incentives, the question remains as to what is actually driving the current proliferation of aquaculture certification programs? Of course there are underlying environmental and economic pressures that support the logic of certification, and these are discussed below in Sections 3 and 4. Some non-governmental organisations (NGOs) have adopted prominent roles as catalysts, mounting successful campaigns to draw public attention to negative environmental, health and social consequences of some aquaculture systems. Yet these groups, on their own, are not suited to establishing certification schemes because they lack the technical expertise and resources needed to deliver regular, reliable and independent assessments of aquaculture ventures.

Typically their campaigns are sporadic and, in the media attention they generate, important information is often lost among unsubstantiated or exaggerated claims. Although consumers are free to ignore messages from NGOs the same cannot be said of managers in the retail and food service sectors. The companies and brands they manage are highly sensitive to negative messages so they constantly strive to reduce vulnerability to external shocks, whatever the source. In addition, leading corporate players, rather than simply reacting to consumer concerns or NGO campaigns, actively encourage responsible and sustainable practices among their suppliers as part of their CSR (corporate social responsibility) agendas.

For example, some develop standards as part of internal purchasing policies in conjunction with

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NGOs (anon. 2007a), and others support 3rd party certification schemes by insisting on compliance with independent aquaculture standards (anon. 2007b). Thus the retail and food service sectors are taking the lead to push sustainability initiatives even in situations where the market pull from consumers would not, on its own, provide enough impetus to create self-sustaining ecolabelling schemes. Independent standard setting bodies have been established to respond to the requirements of retail and the food service sectors and to lay down criteria and indicators for responsible and sustainable aquaculture. And this has resulted in an array of different certification programs (Tables 1 and 2).

If such programs are to thrive in the long term they will also need to be supported by large-scale promotional campaigns, a consistent presence, visibility in the market and improvements in consumer education and awareness (Allen 2000, Macfadyen 2004). None of which are cheap, so not all programs can be expected survive. To succeed, schemes will need to be well designed and send clear messages to fish farmers about rising expectations for environmental performance, ethical standards and food safety. And ideally, given the importance of international trade in seafood products, certification should be based on internationally recognised standards that can be consistently applied across the world. In conclusion, it is possible to generalise that:

1. Ecolabels should not be viewed simply as awareness raising tools for consumers, but as a tools that communicate expectations and requirements to whoever is interested (UNEP, 2005).
2. The requirements of retailers and supply chains are becoming more important than direct consumer preferences.

Where do these developments leave the producers? After all, these are the agents that typically bear the costs of implementing certification schemes. Firstly it should be noted that, even without prompting, aquaculturists already know that it is in their best interests to deliver safe, wholesome products and to adopt sustainable practices to reduce problems with pollution and disease. They already have an incentive to progressively upgrade their operations, with or without market pressure for the adoption of voluntary standards. Indeed, leading producers are actively engaged in developing the improved practices that will eventually be codified and included in certifiable aquaculture standards. Their innovations are critical to the development of sustainable aquaculture but producers will only become enthusiastic supporters of certification programs if the standards are based on sound science, if they are clearly stated and realistic, and if verification costs are not excessive.

Of particular concern to many fish farmers is the fact that they are being asked to meet multiple different standards and to pay for multiple audits. For example, for *Pangasius* there are already 5 competing programs (from GAA, GlobalGAP, WWF, VietGAP, and AquaGAP) and a further organic standard from Naturland. If the legitimate concerns of producers are not addressed, the potential for aquaculture certification to accelerate the development of sustainable practices risks being squandered.

This chapter opens with a brief analysis of the sustainability concept that underpins aquaculture certification and then accounts for the capacity of aquaculture systems to respond to environmental and economic pressures. It then describes existing certification schemes and some of the international policy questions they raise.

Sustainable aquaculture

Since the objective of certification programs is to promote sustainable practices it is worthwhile to consider what sustainable aquaculture, or more generally, sustainable development, actually implies and how it might be objectively assessed. The definition that is most commonly referred to is the one framed by the World Commission on Environment and Development (WCED 1987): *sustainable development meets the needs of the present generation without compromising the ability of future generations to meet their own needs*. Although this definition leaves plenty of room for debate about the precise meaning of 'needs' it successfully captures the essence of concern for sustainability, i.e. that current

trends in economic development and resource use cannot be sustained indefinitely. Conway (1985) provided an alternative definition: *sustainability is the ability of a system to maintain productivity in spite of a major disturbance*. And, for sustainable agriculture, Keeny (1989) specified: *agricultural systems that are environmentally sound, profitable and productive and maintain the social fabric of the rural community*. By substituting the words 'aquaculture' for 'agriculture' and 'coastal' for 'rural', this last example can also be used to define sustainable aquaculture - *aquacultural systems that are environmentally sound, profitable and productive and maintain the social fabric of coastal communities*.

At the heart of much debate about sustainable development is the persistent split between anthropocentric and ecocentric rationales (Cornelissen 2003). An anthropocentric rationale considers sustainability to be a societal construct and emphasises the acceptability of society as gauged by the quality of life that society provides, e.g. through employment. An ecocentric rationale disputes such a subjective basis and claims that sustainability refers objectively and exclusively to the maintenance of life support systems, i.e. to society preserving the biological and physico-chemical processes that maintain the conditions necessary for life on earth.

Those adhering to an ecocentric rationale may be reluctant to also consider societal issues, as ecocentrism originates from the sense that anthropocentrism is at the very root of current concern for sustainability. In short, subjective elements are inherent in any definition of sustainability. To avoid confusion about the precise meaning of sustainability, some aquaculture certification programs aim for responsible practices instead of sustainable ones. All the same, they cannot ignore the importance of achieving sustainability – to do otherwise would not be responsible.

Apart from the question of what is meant by sustainability, there is also the important question of how to measure it, such that different aquaculture systems can be compared, temporal changes monitored and improved management practices identified. Unfortunately sustainability is not a measurable entity in itself so its analysis relies on indirect criteria or sustainability indicators. Ideally, sustainable development should be the result of fair negotiations among those who have a stake in the concern for sustainability.

Consequently, because stakeholders play a pivotal role in sustainable development, a definition of sustainability based on a 'consistent' set of sustainability criteria may be unattainable, mainly because public concern will be subject to change. If sustainability criteria change, then the emphasis in sustainable development will change accordingly, severely limiting the possibility of quantitative 'prediction' of future sustainability. The fact that public concern is easily subject to change is illustrated by the Nitrofen affair in Germany (EC 2002). After traces of the forbidden herbicide Nitrofen were found in eggs and chickens originating from organic farms in Germany, consumer organisations issued warnings, organic farms were temporarily closed and the credibility of certified organic agriculture, formerly considered sustainable, was seriously damaged.

Considering the importance of the concept of sustainability for development strategies as well as its temporal dynamics, it seems more useful to continuously monitor sustainable development than to try and predict sustainability. Thus, although it may not be possible to come up with a precise definition of sustainability that satisfies all interested parties, attempts at monitoring sustainability through the use of a broad set of well designed indicators are still valid and they can help to build a consensus among stakeholders. This realisation has driven initiatives to identify sustainability indicators for many systems including aquaculture in Scotland (SEERAD 2003) and aquaculture in Europe overall (CONSENSUS 2006).

However, identifying suitable indicators is just the starting point and major obstacles remain, largely in the form of inconsistent and costly methods of data collection. Herein lies one significant advantage of voluntary certification schemes. They typically require the collection of environmental impact data in a consistent format and, if they are well designed, these data can be compiled to generate informative environmental indicators - indicators that will be essential in the long-term quest for sustainable aquaculture practices.

Environmental pressure

The emergence of numerous certification schemes aimed at raising standards in aquaculture should not be viewed in a negative way as a reflection of the magnitude of the problems confronting the industry. Certification programs are also a means of capitalising on the industry's innate ability to react positively to environmental and social pressures and they hold out good prospects for reducing negative perceptions of the industry. Put simply, aquaculture can and does change for the better in response to environmental pressures (Asche *et al.,* 1999). In this regard, as a means of producing seafood, aquaculture has some fundamental advantages over capture fisheries. The global fishing industry has reacted slowly to environmental imperatives—chief among these being the near-destruction of some of the fish stocks that the industry depends on. This is because fishing typically takes place in open-access or poorly policed waters where individual players have an incentive to over-exploit a common resource with little regard to sustainability. In contrast, most aquaculture takes place in settings where stock ownership and farm sites are clearly defined, and in terms of efficient resource use, this makes it a much more appealing prospect than fishing because producers have an incentive to invest in the long-term viability of their farms, knowing that the benefits of good management will not be dissipated by outsiders.

The Norwegian salmon industry provides some good examples of how aquaculture can respond to environmental pressures. Furthermore, and somewhat counter-intuitively, the evidence from Norway supports the idea that industry growth actually has a positive relationship with environmental quality. Detrimental environmental effects of aquaculture that are not accounted for in market prices are by definition externalities, and it is the internalisation of these externalities that explains why some major environmental issues in aquaculture have been resolved. Data from the early 1980s to the early 2000s show that, as their industry expanded, Norwegian salmon farmers increased the degree of internalisation because of negative feedback effects from pollutants (Asche & Tveterås 2006). The development of more efficient feeds (largely attributable to feed companies) and the relocation of cages away from protected inshore areas to areas with more suitable hydrology, have cut pollution and associated disease problems. In 1980 it took almost 3 kg of feed to produce 1 kg of salmon but by 2000 this amount had fallen to just over 1 kg. Over the same period, the use of chemicals and antibiotics in the Norwegian salmon industry fell in absolute terms.

Total antibiotic use peaked at nearly 50 tonnes in 1987 but, following the development of vaccines and the relocation of farms, disease problems declined and total antibiotic use dropped to around 1-2 tonnes per year in the 2000s. Impressively, these improvements came against a background of rising annual output. At first it might appear that these advances can simply be attributed to industry regulation but this would be a false impression.

The great lesson from the Norwegian salmon industry is that the greatest environmental improvements do not rely on regulation, but on the self-interested behaviour of individual operators and their suppliers in a broadly coordinated industry. Negative environmental feedback will, particularly in a large and expanding industry, prompt innovation and it should be the aim of voluntary certification schemes to encourage the spread of innovation and resulting Best Management Practices (BMPs) to accelerate positive change. Beyond BMPs, where problems may not be efficiently internalised because of weak feedback effects, certification schemes provide a means to promote coordinated action and to reinforce existing legislation aimed at addressing these more recalcitrant externalities. In the salmon industry, problems associated with sea-lice and escaped salmon fall into this second category.

Economic pressure

The rapid growth of the aquaculture industry has stimulated criticism in some circles, with influential analysts questioning the merits of farming high-priced, carnivorous species, such as shrimp and salmon. Naylor *et al.,* (2000) reviewed the effects of aquaculture on world fish supplies and challenged the assumption that aquaculture automatically adds to net fish supply, noting that some important farmed species consume fishmeal that is itself derived from the output of wild fisheries. They urged the

aquaculture industry to adopt more ecologically sound management practices and called for coordinated action to reduce the negative external costs generated by farming systems.

Key parts of their analysis are undoubtedly true and the aquaculture industry must redouble its efforts to drive down external costs and to increase net production of fish and shellfish. Nonetheless, aquaculture should not be judged only for its impact on world fish supplies—it needs to be viewed in terms of its overall economic impact on society and its local impacts and community benefits. Aquaculture's opponents readily adopt the terminology of economic appraisal when they focus on negative external costs but they typically fail to balance this with an assessment of positive external benefits. These benefits are commonly significant and include:

1. Investment and wealth generation in some of the poorest parts of the world;
2. Consumer benefits from improved supply and downward pressure on prices; and
3. Reduced pressure on, and reduced negative impacts of, some important wild fisheries (although this effect may be masked by increasing consumer demand for fishery products).

International trade in farmed seafood provides good examples of the benefits of globalisation, with trade in products like frozen shrimp transferring wealth from consumers in rich nations to producers in poor nations. Tropical countries generally have a comparative advantage in the production of tropical aquaculture products so it is in their economic interests to exploit this advantage. However, in poor countries the production of high-value export crops like shrimp rarely increases the local availability of seafood directly. But even in this kind of setting aquaculture is still beneficial because of its ability to raise incomes and reduce poverty. And history has clearly demonstrated that poverty reduction is the most reliable way of reducing hunger and building food security (Baghwati 2004, Wolf 2005). In addition, although it does not guarantee success, raising incomes contributes to the potential for strong environmental stewardship, with economic vitality being one of the determinants of a nation's environmental performance (Esty *et al.,* 2005).

The power of aquaculture output to depress market prices, even against a backdrop of increasing demand for seafood, is well illustrated by examples from Europe. Rapid saturation of the seabream (*Sparus aurata*) market in the 1990s led to a 50% fall in price in 5 years; and an increasing output of Atlantic salmon led to a 50% drop in prices over a 10 year period (FAO 1997). Consumers benefit from falling prices as farmed products make inroads into luxury markets. Back in 1992 it was estimated that imports of farmed shrimp were depressing US shrimp prices by 41% (Keithly *et al.* 1992), and given the steady growth in shrimp aquaculture this price depression effect is sure to be far greater today.

The potential for aquaculture to reduce pressure on wild fisheries is also illustrated by the situation in the USA where low cost imports of farmed shrimp are challenging the economic viability of coastal shrimp fisheries, with fishermen lobbying for protectionist measures to keep their industry afloat. While scientific and technical progress drive competitiveness in the aquaculture industry, fishermen have to confront problems like rising fuel costs with limited hope of increasing their economic efficiency in weakly-managed fisheries.

The certification of high-value aquaculture products, including carnivorous species such as salmon, shrimp, seabass and sea bream, will send clear messages to farmers that these species must be produced in a sustainable way with proper regard to the environment and the concerns of local communities. As such it will provide assurances to consumers and others in the supply chain that externalities are being minimised and that these products can be promoted as wholesome and healthy foods without nagging doubts about negative impacts in producer countries. Certification can thus help to improve the sustainability of aquaculture systems and deliver important messages to concerned parties.

Aquaculture certification schemes

Before a certification scheme can be launched, requirements need to be written down and codified. The resulting documents may take the form of general codes of good practice or more precise

sets of quantifiable standards. There are many organisations that have taken on the task of creating these documents in respect of aquaculture. Some are producer or trade associations, or have close links to such associations, and they limit their attention to a particular species or to a species produced in a specific geographical area. This approach has produced a number of well-conceived, detailed standards tailored to the immediate and particular needs of producers and markets. However, the highly specific nature of many of these schemes limits their prospects for gaining widespread consumer recognition and for conveying wider, consistent messages about the sustainability of aquaculture practices globally.

There are two broad types of aquaculture certification schemes, non-organic (Table 1) and organic (Table 2). The various schemes differ in the species they cover, their geographical range, and the use of an ecolabel aimed at consumers. The schemes also vary greatly in the way they focus on one or more of five main issues—the environment, social and community impacts, food safety, traceability and animal welfare. They all cover environmental issues to some extent (except perhaps SQF 1000 and SQF 2000) but there are big variations with regard to coverage of social issues. Most organic standards and standards aimed at producers in developed countries have no social provisions at all.

Table 1. Aquaculture Certification Schemes (non-organic).

Scheme	Main geographic range	Aquaculture species covered	Eco-label for consumers?	Website
ISO 14001/ Environmental Management System	worldwide	Any species	no	www.iso.org
Safe Quality Food Institute: SQF 1000; SQF 2000	worldwide	Any species	no	www.sqfi.com
Best Aquaculture Practices/ Global Aquaculture Alliance/ Aquaculture Certification Council	worldwide	Penaeid shrimp, tilapia, channel catfish, (*Pangasius* and salmon in 2009)	yes	www.aquaculturecertification.org www.responsibleseafood.org www.gaalliance.org
GlobalGAP/ Integrated Aquaculture Assurance Standard	worldwide	Salmonids, tilapia, *Pangasius*, penaeid shrimp	no	www.globalpgap.org
Aquacuture Dialogues (coordinated by World Wildlife Fund)	worldwide	All major species to be covered	Probably yes	www.worldwildlife.org/cci/
Friend of the Sea	worldwide	Multiple species including shrimp, salmonids, seabream, and seabass	yes	www.friendofthesea.org
Carrefour Filière Quality	worldwide	Salmonids, penaeid shrimp, oysters	yes	www.carrefour.com www.carrefour.co.th
Label Rouge	France, Scotland, Madagascar	Seabass, oysters, salmon, turbot, penaeid shrimp	yes	www.label-rouge.org
Shrimp Seal of Quality	Bangladesh	Penaeid shrimp, *Macrobrachium*	yes	www.cdpbd.org/ssoq/ssoq_brief.htm
Tartan Quality Mark	Scotland	Salmon	yes	www.scottishsalmon.co.uk
Freedom Foods	UK	Salmon	yes	www.rspca.org.uk
SIGES/ Fundación Chile / CBPA	Chile	Salmonids	no	www.siges-salmonchile.cl
Thai Quality Shrimp/ Good Aquaculture Practices/ Code of Conduct	Thailand	penaeid shrimp, *Macrobrachium*	yes	www.thaiqualityshrimp.com
Malaysian Aquaculture Farm Certification Scheme	Malaysia	penaeid shrimp, *Macrobrachium*, fish, ornamentals, molluscs	no	www.fishdept.sabah.gov.my/aquaculture.asp

Table 2. Aquaculture Certification Schemes (organic).

Scheme	Main geographic range	Aquaculture species covered	Ecolabel for consumers?	Website
Naturland	worldwide	Salmonids, arapaima, milkfish, mussels, penaeid shrimp,	yes	www.naturland.org
Organic Food Federation	UK, EU	Cod (gadoids), salmonids	yes	www.orgfoodfed.com
Soil Association Scotland	Scotland, EU	Atlantic salmon, trout, shrimp	yes	www.soilassociationscotland.org
Australian Certified Organic	Australia	Fish, crustaceans, molluscs	yes	www.australianorganic.com.au
NASAA	Australia	Fish, crustaceans	yes	www.nasaa.com.au
Bioland	Germany	Freshwater fish	yes	www.bioland.de
Bio-grow	New Zealand	Fish, molluscs, crustaceans	yes	www.bio-gro.co.nz
Bio-Suisse	Switzerland	fish	yes	www.bio-suisse.ch
Debio/KRAV	Norway, Sweden	Salmonids, Perches, Gadoids	yes	www.debio.no www.krav.se

When it comes to procedures for auditing, most non-organic schemes, if they are not state run, rely on the services of independent, third party auditing companies because this adds to a scheme's credibility. Within organic certification schemes most standards are written to conform to the general principles of the organic movement as defined by international umbrella groups such as IFOAM (www.ifoam.org). Organic certification bodies usually take on the roles of setting precise standards and overseeing, more or less directly, the auditing process.

The ISO 14001 standard is a generic standard for environmental management systems that is not specifically aimed at aquaculture. It initially requires a comprehensive environmental risk assessment and then the development of an environmental management plan specific to each applicant. The SQF 1000 and SQF 2000 standards of the Safe Quality Food Institute are unlike the other schemes listed because they are primarily directed towards food safety and effective product traceability. The *Best Aquaculture Practices* (BAP) program of the Global Aquaculture Alliance (GAA), for which the Aquaculture Certification Council (ACC) is the auditing body, aims for a comprehensive treatment of environmental, social, food safety and traceability issues. It includes standards that are specifically drafted to address the problems associated with each aquaculture species. This leads to a simpler, more targeted approach than the generic ISO approach because it does not require farmers to devise their own risk assessments. Instead, farmers are lead through an analysis of the key risks by following the format of the standard and its guidelines.

Another certification scheme that also aims for comprehensive treatment of all issues and worldwide coverage is the GlobalGAP Integrated Aquaculture Assurance Standard. However, unlike the GAA, GlobalGAP does not employ an eco-label for use at the consumer level and it does not specialise in aquaculture alone, also producing standards for fruit, vegetables and livestock. GlobalGAP aims to promote sustainable farming and aquaculture practices worldwide by providing a business-to-business service linking producers and retailers and it has an established record of success, particularly with agricultural products. The Friend of the Sea program deals with a wide range of farmed species and is unusual in that it also produces standards for sustainable capture fisheries.

The World Wildlife Fund (WWF) has coordinated an extensive series of 'Aquaculture Dialogue' meetings to try and develop a broad stakeholder consensus on the content of aquaculture standards. They have targeted the major species, including salmon, *Pangasius*, tilapia and shrimp and expect to have some standards finalised in 2009. The WWF does not intend to manage the resulting aquaculture certification programs so it is still unclear exactly if it will delegate this role to an existing body (or bodies) or if it will create a new body specifically for this role.

Some large retail chains also have their own in-house ecolabelling schemes. Carrefour, a French multi-national, for example, has its own Filière Quality Line ecolabel that it applies to a selected range of its food products including farmed salmon, shrimp and oysters. Almost all supermarkets in the UK require, as a component part of traceability audits, investigation into environmental issues as well as guarantees of social/ethical conditions, but they may not have specific labels that advertise this fact. The Freedom Foods scheme, run by the UK's Royal Society for the Prevention of Cruelty to Animals, is unusual in that it aims to raise environmental and other standards primarily by focusing on issues that influence animal welfare.

Freedom Foods has been extended from livestock and poultry to also cover farmed salmon. Another label available for salmon is the Tartan Quality Mark. Although presented more as an overall quality mark than as an ecolabel, fish that carry this label come from farms that have been independently audited and comply with the Code of Good Practice for Scottish Finfish Aquaculture, which has many clauses detailing best practices for environmental management. The Label Rouge quality mark can be found on a wide range of French farm products including farmed oysters, turbot and seabass, and also on some imported aquaculture products such as Scottish salmon and Madagascan shrimp.

Some schemes are very country specific. For example, the Shrimp Seal of Quality (SSOQ) label has been developed for farmed shrimp and prawns in Bangladesh, and in Thailand the Thai Quality Shrimp label can be applied to product that conforms to the Good Aquaculture Practices (GAPs) laid down by the Thai Department of Fisheries. As its name implies, the Malaysian Aquaculture Farm Certification Scheme is also country specific. In Chile, salmonids can be certified to the Code of Good Environmental Practices produced by Fundación Chile and SIGES-Salmon Chile.

Organic aquaculture certification has an advantage over non-organic certification because the organic label is well recognised by consumers and many have shown they are willing to pay a premium price. Because of this, organic certification is already well developed for terrestrial farm produce. However, there has been much debate about how organic principles can or should be extended to apply to aquaculture, particularly for carnivorous species, and particularly in the USA. The US Department of Agriculture has until very recently not approved any organic aquaculture standards and has thereby blocked the use of the coveted 'USDA Organic' label. Tacon & Brister (2002) discuss the prospects of private and national organic certification schemes in more detail. The latest reports (Dominy 2008) attest to the difficulty of translating organic principles for important forms of aquaculture, such as salmon farming.

All the schemes listed in Tables 1 and 2 are voluntary and have requirements that either exceed or strengthen existing legal obligations. However, some certification schemes are mandatory and are more akin to operating permits than ecolabels. For example, the certification provided by the Florida Department of Agriculture and Consumer Services is a requirement for all aquaculture operations within the state. It covers a wide variety of systems for producing penaeid shrimp, sturgeon, shellfish, live rock and aquatic plants, and is based on compliance with a series of site requirements and defined Best Management Practices (BMPs) (www.FloridaAquaculture.com).

Unintended consequences

Concerns about the unintended consequences of aquaculture certification schemes have been raised in many quarters, particularly in respect to the developing world. Macfadyen (2004) has drawn parallels with problems that have arisen with certification initiatives for forestry products to illustrate how schemes devised largely in developed countries can pose problems in poorer regions. Thus, despite initiatives by the Forestry Stewardship Council (FSC), very little certification has been successful in the natural forests of the developing world. Problems have been attributed to:

1. NGOs from developing countries setting the FSC's agenda;
2. FSC certification favouring the management systems of developed countries;
3. The high costs of certification discouraging poor performers from applying;

4. The disproportionate benefits between producer and processor;
5. The benefits of certification (premiums, enhanced credibility or market access) often not being passed down to the producer but shared disproportionately within the supply chain;
6. The lack of certifying bodies from developing countries;
7. The certification challenges being too great for small operations in developing countries.

These obstacles to the success of certification schemes among small-scale producers in developing countries should not be underestimated and they are already influencing the spread of certification in the shrimp industry. For example, the majority of farms that have entered the Global Aquaculture Alliance's BAP program are large ventures, often parts of vertically integrated business structures (www.aquaculturecertification.org). Small-scale farmers, particularly common in Asia, are constrained because of the associated costs and because of the requirements for improved record keeping and new management procedures. The solution is for small farmers to come together in clusters or co-operatives and seek certification in groups, thereby spreading the costs of certification among many participants and promoting communal responsibility for the environment (Boyd *et al.* 2006). The BAP program is now actively promoting this solution in S.E. Asia including, very importantly, for shrimp farmers in Thailand.

Despite these concerns, and the natural reluctance of fish and shrimp farmers to warm to schemes that appear to be imposed by distant retailers and multi-national corporations, there is evidence that voluntary standards gradually bring tangible benefits. Iizuka (2006) analysed the impact of standards on the Chilean salmon industry, where she views them as a new platform of innovation and learning, concluding optimistically: "Although the process of compliance with standards begins with a one-way power relationship and associated flow of knowledge and information, such one-way flows may become consolidated into two-way inter-linkages when power balances themselves reverse with the development of local capability in 'catching-up' countries. In such a context, standards increasingly act as an interface where diverse knowledge from horizontal and vertical relationships – local and global, tacit and codified and user and producer – intercept and converge, becoming a platform of interactions and learning for those involved."

Significant public policy questions arise when third parties begin to certify private sector fish farming (Lee & Connelly 2006). These questions have already been raised with regard to the work of the Marine Stewardship Council, the leading independent body that sets standards for sustainability in wild fisheries. The issues that society should consider include these below.

1) governments have traditionally been responsible for managing their nations' natural resources. Part of the management responsibilities includes communicating to society the state of those resources and what plans are in place to address any user conflicts. When third parties become certifiers of private sector performance, do those third parties become the *de facto* communicators of the state of the resource? That is, if a certifier deems a fishery or fish farm to be unsustainable, will the public begin to rely more on the non-governmental groups for information?, 2) governments, representatives of the people in many countries, have a responsibility to manage society's public sector resources. Some standards systems, as a condition of certification, require government actions to be taken to remedy problems in certain areas. However, government is required to treat all demands on its resources even-handedly and determine for the common good which challenges must be addressed first. Is government ceding its responsibilities to manage public sector resources when acceding to demands for corrective actions demanded by third party certifiers?, 3) the Rio Declaration on the Environment and Development encourages assistance for developing countries. Seafood certification systems, though, require a higher level of performance than is sometimes required by governments. By requiring more stringent standards for production, are developed countries creating non-tariff barriers to trade? Are the certification systems designed so that only developed countries have the infrastructure to support companies' certification efforts? Or are developed countries shifting additional costs onto developing countries, at a time when they are trying to alleviate poverty in those countries? How

can certification systems balance the consumer nations' need for ensured sustainability with producer nations' needs to develop an aquaculture industry without excess costs?, 4) conversely, by creating new trading categories of higher value (certified products) are developed countries simply downgrading the bulk of existing, un-certified products and holding their prices down? This could effectively create a two-tier system and result in trade distortions.

Despite these important policy caveats, many international bodies such as the FAO recognise that Best Management Practices play an important part in the sustainable development of aquaculture, for both large-scale and small-scale producers (FAO 2005). At the same time, third party certification of compliance with these practices can help improve public confidence in the management of aquaculture facilities provided that the certification systems function independently of the standard setting organisations. Hopefully the rapidly expanding and evolving aquaculture industry, with the assistance of certification schemes, will continue to learn lessons from other industries and will increasingly follow the path towards environmental and social sustainability.

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