

Session 2: Challenges

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Safety of aquaculture products: consumer protection, international regulatory requirements and traceability

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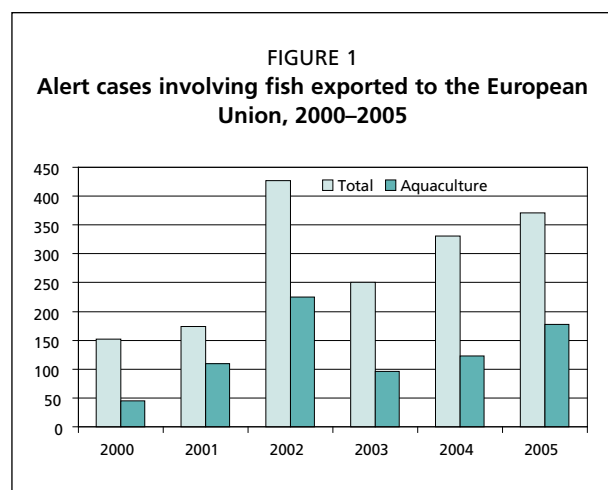
ABSTRACT

International fish trade has expanded significantly from US\$8 billion in 1976 to approximately US\$78.4 billion in 2005. Aquaculture production, especially of shrimp, salmon, tilapia, catfish and bivalves, contributes significantly to this trade. Fish and seafood represent a commodity that is widely traded internationally, with a major contribution from developing countries, including in the form of aquaculture products. In fact, the net receipts of foreign exchange from fish trade by developing countries (i.e. deducting imports from the value of exports) increased from US\$3.7 billion in 1980 to US\$21.0 billion in 2005. This was greater than the net exports of other agricultural commodities such as rice, coffee, sugar, tea, banana and meat combined. Over 75 percent of exported fish and seafood is destined to three major markets: the European Union, Japan and the United States. These three markets are characterized by stringent and exacting requirements for consumer protection and food safety. As a result, the increase in international fish trade has been accompanied by new trends, emerging issues and requirements for market access. These issues comprise i) ecolabelling and environmental protection as a result of the decreasing landings from capture fisheries and the increasing role of aquaculture for fish supply; ii) consumer protection and food safety requirements; iii) traceability along the value chain and consumer information; and iv) the increasing role of retailers and the development of market standards and certification schemes. This paper analyzes these emerging trends and their impact on the future of international trade in aquaculture, the international regulatory framework for food safety and quality and provides some recommendations on how to reconcile promotion of responsible international trade in aquaculture with consumer protection objectives in a transparent manner.

INTRODUCTION

Unlike capture fisheries, aquaculture production has continued to increase markedly. Its contribution to global supplies of fish increased from 3.9 percent of total production by weight in 1970 to 32 percent in 2004. Aquaculture is growing more rapidly than all other animal food-producing sectors. Worldwide, the sector has increased at an average compounded rate of 8.8 percent per year since 1970, compared with only 2.8 percent for terrestrial meat farming systems (FAO 2006).

Total world trade of fish and fishery products has undergone a tremendous development during the last three decades, increasing from a mere US\$8 billion in 1976



to an export value of US\$71 billion in 2004 and an estimated value of US\$78.4 billion in 2005. In real terms (adjusted for inflation), exports of fish and fishery products increased by 17.3 percent during the period 2000–2004, 18.2 percent during 1994–2004 and 143.9 percent between 1984 and 2004. Products derived from aquaculture production contribute an increasing share of total international trade in fishery commodities.

Developing countries play an active part in international fish trade, accounting for nearly 50 percent of exports (in value terms). The net receipts of foreign exchange by developing countries (i.e. deducting their

imports from the total value of their exports) increased from US\$3.7 billion in 1980 to US\$21.0 billion in 2005. This was greater than the net combined exports of the other agricultural commodities (e.g. rice, coffee, sugar, tea, banana and meat).

Globalization of food trade, coupled to technological developments in food production, handling, processing and distribution and the increasing awareness and demand of consumers for safe and high-quality food have put food safety and quality assurance high in the headlines. This is exacerbated by the recurrent food safety scares since the 1990s.

Consequently, internationally traded fish products in general and aquaculture products in particular have been subject to close scrutiny for their safeness for consumption. For example, the European Union (EU) alert system for food and feed indicated that fish and fishery products have been often responsible for a large proportion, and sometime being the largest (up to 25 percent), of food safety and quality alerts during the period 2000–2005. Of these, aquaculture products were involved in 28 to 63 percent of alert cases (Figure 1), mainly because of the presence of high residues of veterinary drugs, unauthorized chemicals and bacterial pathogens. For example in 2005, 177 alert cases were due to aquaculture products that contained bacterial pathogens (37 percent), nitrofurans (27 percent), malachite green (20 percent), excess residues of sulfites (13 percent) and unacceptable residues of veterinary drugs (3 percent). Similar safety problems have been reported by the control authorities of other major fish importing countries.

The trade volumes of the incriminated shipments to the EU varied from 1 082 tonnes to over 6 137 tonnes at a value of US\$3.8 million to over US\$26.5 million (Table 1). Although relatively low compared with the overall value of imports to the EU, the impact can be very damaging to the reputation of a company, a sector or even a country.

To preserve the safety and quality of aquaculture products, the responsibility for the supply of fish that is safe, healthy and nutritious should be shared along the entire chain from primary production to consumption. Producers, processors and distributors are responsible for the development and implementation of good aquaculture practices (GAP), good hygienic practices (GHP) and hazard analysis critical control point (HACCP) systems. Government institutions should develop an enabling policy and a regulatory environment, organize the control services, train personnel, upgrade control facilities and laboratories and develop national surveillance programmes for relevant food safety hazards. Support institutions (academia, research, extension, trade associations etc.) should conduct research on quality, safety and risk assessments, and provide training and technical support to personnel engaged in production, processing and distribution.

In the case of bivalve molluscs, filter feeders that can concentrate pollutants, biological agents and biotoxins, there is a need to control and prevent contamination from chemical pollutants and biotoxins through the implementation of appropriate monitoring and surveillance of the growing and harvesting areas.

International harmonization of safety and quality requirements and equivalence of certification systems can facilitate international fish trade and prevent the use of these requirements as disguised barriers to trade. On the other hand, the safety requirements should be based on sound science to provide the appropriate level of consumer protection. Reconciling both objectives requires an international regulatory and technical framework to support the development of harmonized standards and equivalence recognition systems.

TABLE 1
Estimated volumes and costs of alert cases involving fish exported to the European Union, 1999–2005

Year	Estimated volume (tonnes)	Estimated cost (US\$1 000)
1999	1 721	7 116
2000	1 341	5 060
2001	1 082	3 821
2002	3 271	14 435
2003	6 137	26 507
2004	2 897	13 211
2005	5 439	19 327

INTERNATIONAL FRAMEWORK FOR FISH SAFETY AND QUALITY

Several regional and international organizations have been mandated to develop agreements, codes of best practice, standards and guidelines for food safety and quality. The most relevant to fish trade are the World Trade Organization (WTO) and its two binding agreements, the *Agreement on Sanitary and Phytosanitary Measures* (the SPS Agreement) and the *Agreement on Technical Barriers to Trade* (the TBT Agreement), and the *Codex Alimentarius*.

The WTO was established in 1995 as the successor to the *General Agreement on Tariffs and Trade* (GATT), founded after World War II. WTO was established following the final act of the Uruguay Round of negotiations, which began in Punta del Este, Uruguay in September 1986 and concluded in Marrakech, Morocco in April 1994. The Uruguay Round was the first to deal with the liberalization of trade in agricultural products, an area excluded from previous rounds of negotiations.

Significant implications for food safety and quality arise from the Final Act of the Uruguay Round, especially from two binding agreements: the SPS and the TBT agreements.

The SPS Agreement confirms the right of WTO member countries to apply measures necessary to protect human, animal and plant life and health. However, these measures must be consistent with obligations prohibiting arbitrary or unjustifiable discrimination on trade between countries where the same conditions prevail and must not be disguised restrictions on international trade. It requires that, with regard to food safety measures, WTO members base their national measures on international standards, guidelines and other recommendations adopted by the Codex Alimentarius Commission (CAC), where they exist. This does not prevent a member country from adopting stricter measures if there is a scientific justification for doing so, or if the level of protection afforded by the Codex standard is inconsistent with the level of protection generally applied and deemed appropriate by the country concerned.

The SPS Agreement requires that SPS measures should be based on an assessment of the risks to humans using internationally accepted risk assessment techniques. Risk assessment should take into account the available scientific evidence, the relevant processes and production methods, the inspection/sampling/testing methods, the prevalence of specific illnesses etc.

The TBT Agreement is a revision of the agreement of the same name first developed under the Tokyo Round of negotiations (1973–1979). The objective of the TBT Agreement is to prevent the use of national or regional technical requirements, or standards in general, as unjustified technical barriers to trade. The agreement covers standards relating to all types of products, including industrial products, and quality

requirements for foods (except requirements related to SPS measures). It includes numerous measures designed to protect the consumer against deception and economic fraud.

The TBT Agreement basically provides that all technical standards and regulations must have a legitimate purpose and that the impact or cost of implementing the standard must be proportional to the purpose of the standard. It also states that if there are two or more ways of achieving the same objective, the least trade restrictive alternative should be followed. The agreement also places emphasis on international standards, WTO members being obliged to use international standards or parts of them except where the international standard would be ineffective or inappropriate in the national situation. Both the SPS and TBT agreements call on WTO member countries to:

- promote international harmonization and equivalence agreements;
- promote the use of scientifically sound risk assessment to develop SPS measures;
- facilitate the provision of technical assistance, especially to developing countries, either bilaterally or through the appropriate international organizations; and
- take into consideration the needs of developing countries, especially the least developed countries, when preparing and implementing SPS and quality measures.

The Codex Alimentarius Commission (CAC) was created in 1962 to implement the Joint Food and Agriculture Organization of the United Nations (FAO)/World Health Organization (WHO) Food Standards Programme. The primary objectives of the CAC's work are the protection of the health of consumers, the assurance of fair practices in food trade and the coordination of the work on food standards.

The CAC is an intergovernmental body with a membership of some 165 Member Governments. In addition, observers from international scientific organizations, food industry, food trade and consumer associations may attend sessions of the Commission and of its subsidiary bodies.

The work of the CAC is carried out by several committees: nine general subject matter(s) committees that deal with general principles, hygiene, veterinary drugs, pesticides, food additives, labelling, methods of analysis, nutrition or import/export inspection and certification systems, and 12 Commodity Committees that deal with a specific type of food class or group, such as fresh fruits and vegetables, fats and oils, or fish and fishery products.

The work of the committees on hygiene, fish and fishery products, veterinary drugs and import/export inspection and certification systems are of paramount interest to the safety and quality of internationally traded fish and fishery products, including aquaculture fish.

In the environment of the SPS/TBT agreements, the work of the CAC has taken on unprecedented importance with respect to consumer protection and international food trade. The Codex standards are meant to be voluntary and adopted by consensus. But under the new SPS/TBT agreements, the Codex standards cannot be called voluntary, nor are they fully mandatory, falling in an area in between that looks like voluntarism under duress. This is why the Codex has been undergoing significant reforms to improve its standards' setting and management procedures and the participation of developing countries to its deliberations. Tables 2 and 3 present the most relevant Codex codes and guidelines relevant to aquaculture.

CERTIFICATION AND PRIVATE STANDARDS

As a result of the globalization and expansion of international food trade, the food industry has experienced significant consolidation and concentration in the industrialized countries. This has led to the emergence of fewer but powerful food firms, with substantial bargaining *power vis-à-vis* other players up and down the supply chain. Although wholesale and restaurant chains still play an important role in

TABLE 2

Codex Code of practices and guidelines relevant to aquaculture feeds and veterinary drugs

Code	Title	Year of adoption	Revision or amendment
CAC/RCP 54	Code of practice on good animal feeding	2004	
CAC/GL 16	Codex guidelines for the establishment of a regulatory programme for control of veterinary drug residues in foods.	1993	
CAC/RCP 38	Recommended international code of practice for control of the use of veterinary drugs	1993	
CAC/MISC 5	Glossary of terms and definitions (Residues of veterinary drugs in foods)	1993	Amended 2003
CAC/RCP 61	Code of practice to minimize and contain antimicrobial resistance	2005	
CAC/MRL 2	Maximum residue limits for veterinary drugs in foods	2006	2006 Update

TABLE 3

Codex Alimentarius principles, guidelines and standards relevant to the safety of aquaculture products and certification

Code	Title	Year of adoption	Revision or amendment
CAC/RCP 52-2003	Code of practice for fish and fishery products (Section 6 deals with aquaculture)	2005	
CAC/GL 20	Principles for food import inspection and certification	1995	
CAC/GL 26	Guidelines for the design, operation, assessment and accreditation of food import and export inspection and certification systems	1997	
CAC/GL 34	Guidelines for the development of equivalence agreements regarding food import and export inspection and certification systems	1999	
CAC/GL 47	Guidelines for food import control systems	2003	Rev.1-2006
CAC/GL 53	Guidelines on the judgement of equivalence of sanitary measures associated with food inspection and certification systems	2003	
CAC/GL 60	Principles for traceability/product tracing as a tool within a food inspection and certification system	2006	
CAC/GL 38	Guidelines for generic official certificate formats and the production and issuance of certificates	2001	Rev.1-2005
CAC/GL 48	Model certificate for fish and fishery products	2004	
CODEX STAN 1	General standard for the labelling of prepackaged foods	1985	Rev.1-1991
CAC/GL 27	Guidelines for the assessment of the competence of testing laboratories involved in the import and export control of food	1997	

fish distribution in many countries, the power has been shifting to the end point of the supply chain, the retailers. This is the result of increased consolidation of retailers *inter alia* into supermarkets and the growth of goods produced under a retailer or private label. This supermarket system is expanding rapidly to developing countries in Latin America, Asia and Africa (OECD 2004).

These global developments have been taking place against a setting of increasing influence of civil society and consumer advocacy groups over the agendas of governments, companies and international organizations on different aspects of the food systems. Food demand has been changing with the evolution of lifestyles, demographics and increase in household incomes. Consumers expect transparency in food systems that leaves a trail as the product moves from the producer to the consumer and that makes it possible to trace the origins, the quality and the environmental and social impacts of food production and distribution.

As the last link in the supply chain between producers and consumers, retailers aim at translating and transmitting these consumer demands back through the supply chain to producers and processors. To achieve this, retailers have developed standards that encompass quality and safety, as well as other process and production aspects such as environment protection, labour conditions or animal health and welfare, to reflect their increased responsibility towards consumers and to prevent any risk to their reputation. In addition to regulations and consumer demands, the standards may also cover commercial requirements such as quantities, quality consistency, delivery punctuality and flexibility.

The market standards being currently developed or used in international fish trade primarily address consumer protection and resource sustainability. Small market niches are governed by specific standards such as “*label rouge*” in France, “*Quality Mussels*” in Ireland or Canada or “*organic farmed fish*” labels. Furthermore, some countries and producers’ associations have established labels to certify implementation of best practices or codes of conduct¹. This unprecedented development in market standards raises the following major issues:

- If trade liberalization is to bring benefits to all, including to developing countries, then rising market standards should not constitute a barrier or additional impediments for entry to major markets by producers and processors from developing countries.
- In the absence of regulatory frameworks, the setting of market standards by a company or a coalition of companies or retailers with significant market power may increase the risk of anti-competitive behaviour and the companies may use this power to impose lower prices throughout the supply chain.
- How are the boundaries defined between public regulations on the one hand and private market standards on the other? And who is responsible for what? While governments that use standards as trade barriers can be challenged through the rules of the WTO, what mechanism should be set to deal with companies whose standards constitute technical barriers to trade?

Some argue that meeting and adhering to market standards can have a positive effect, including for developing countries, in particular by spurring new competitive advantages and investments in technological capacity. But some governments and producers’ groups fear that these standards may disguise underlying intentions to protect domestic industries and restrict market access or add a new layer of constraints upon their competitiveness by duplicating or adding to existing food safety and quality requirements. Also, the burden of complying with these standards may fall disproportionately on small suppliers for whom the cost of achieving certifiable status is relatively higher.

Furthermore, as certification programmes proliferate, consumers and producers face choices as to which certification programmes carry the most value. Competing certifying claims may confuse consumers, causing them to lose confidence in standards and thus depriving the approach of its value. It also raises questions about which certification programmes best serve consumer protection, the environment, the public and the producers. Thus, the credibility of the standards and of their certification and accreditation bodies is of paramount importance.

The development of market standards and labels and their potential impact on international trade have been the subject of recent debates in many international fora. Sanitary and quality issues are the subject of regular debates within the SPS and the TBT committees of the WTO². Market standards have also been debated at The Nordic Council of Ministers (NTWGFEC 2000), The Commission of the European Communities³, the International Center for Trade and Sustainable Development

¹ Examples include the Global Food Safety Initiative (GFSI) standard (www.ciesnet.com), the Federation of European Aquaculture Producers’ Code of Conduct for Aquaculture, the British Retail Consortium (BRC) standard (www.brc.org.uk/standards), the Aquaculture Certification Council (ACC) (www.aquaculturecertification.org), the Eurep GAP standard (www.eurep.org) the WWF aquadialogues (www.worldwildlife.org/cci/aquaculture_dialogues.cfm), the Thai Marine Shrimp Culture Codes of Conduct and the Code of Good Environmental Practices for Well Managed Salmonoid Farms by Fundacion Chile. The latter are a result of the requirements of importers and retailers.

² http://www.wto.org/english/news_e/news07_e/sps_28feb_1march07_e.htm

³ Communication from the Commission to the Council, The European Parliament and the European Economic and Social Committee. Launching a debate on a Community approach towards eco-labelling schemes for fisheries products.

(ICTSD 2006), the FAO Committee on Fisheries (COFI) (FAO 2007) and the World Aquaculture Society⁴.

The debates in these fora highlight that while market-driven standards and labels can offer opportunities to spur competitive advantages and investment in technological developments to expand market shares and extract more value, many developing countries and small-scale enterprises fear that these standards can disguise underlying intentions to protect domestic industry or create additional burden to already highly demanding existing regulatory requirements. The following are possible actions to mitigate the concerns:

- *Increased transparency*: For some exporters, business can be riskier and uncertain because of market standards imposed by importers. Increased consultation and transparency in the development and application of these standards would reduce the risks that exporters confront and enhance market access.
- *Harmonization and equivalence*: Regional and international cooperation is necessary for the development of harmonized and transparent standards and compliance procedures, building on the work of the *Codex Alimentarius* (safety and quality), FAO (ecolabelling, organic fish farming) and ISO (certification, accreditation). More attention should be given to opportunities for mutual recognition of standards and simplification of compliance procedures. This in turn should lead to cost reduction, especially for developing countries and small-scale producers.
- *Technical assistance and phase-in for developing countries*: International efforts to manage the negative impacts of standards could be coupled with similar efforts in regional and bilateral economic arrangements. External funds are needed to support implementation and compliance in developing countries. Where possible, standards could be accompanied by phase-in periods for producers in developing countries.

TRACEABILITY

Traceability is “*the ability to trace the history, application or location of that which is under consideration*” (ISO 9000 2005). When considering a product, traceability relates to the origin of materials and parts, the processing history and the distribution and location of the product after delivery.

In the case of food safety, the *Codex Alimentarius* defines “*traceability/product tracing as the ability to follow the movement of a food through specified stages of production, processing and distribution*” (CAC 2004).

This definition has been further refined into a regulation by the EU to signify “*the ability to trace and follow a food, feed, food producing animal or substance intended to be, or expected to be incorporated in a food or feed, through all stages of production, processing and distribution*” (EC 2002).

Further on, traceability can be divided into internal and external traceability. Internal traceability is traceability of the product and the information related to it, within the company, whereas external traceability is product information either received or provided to other members of the supply chain.

Similarly to a batch, a lot or a trade unit, a traceable unit can be one fish (e.g. one tuna fish), one catch, the catch of a day or of several days, the crop of one pond/cage or of several ponds etc. The larger the unit, the lower the cost of tracing but the higher are the economic and reputational consequences in case of a recall. Inversely, the smaller the traceable unit, the higher the costs and the lower the economic and reputational consequences in case of recall.

⁴ World Aquaculture Society. The 2006 Annual Meeting and Conference. May 9–13, 2006. Florence, Italy.

The EU produced a Guidance⁵ on how to implement traceability. This guidance indicates clearly that the traceability provisions of the regulation do not have an extra-territorial effect outside the EU. The provisions cover all stages of production, processing and distribution in the EU, namely from the importer up to the retail level, but do not extend to food business operators in non-EU exporting countries.

Before 11 September 2001, the United States traceability systems tended to be driven by the industry, motivated by market incentives and relied significantly on third party safety/quality auditors to verify and substantiate claims on credence attributes. The development of large retail chains has pushed for increased traceability and better food supply chain management to prevent stock-outs or overstocking. However, in 2002, the United States Congress passed the *Public Health Security and Bioterrorism Preparedness and Response Act*, resulting in the United States Food and Drug Administration (US FDA) issuing a ruling (US FDA 2004) in December 2004 requiring all links in the food supply chains and food transporters to establish and maintain records to trace and track their suppliers and buyers by 9 December 2006, although implementation began with large companies in 2005. This regulation requires that domestic and foreign facilities that manufacture/process, pack or hold food for human or animal consumption in the United States, register with FDA and submit electronically prior notice to FDA before the shipment is due to arrive into the United States.

Both EU and United States traceability regulations require food and feed business operators to be able to trace back to the supplier of food, feed or ingredient and track forward the business to which their product has been supplied (also known as “*the one step back, one step forward system*”).

Many other countries, both developed and developing, have passed similar legislation mandating traceability in all or some of the links in the food supply chain, including aquaculture production.

Traceability can use either paper or electronic systems, although most are a mixture of the two (Table 4). Paper traceability systems are widespread and have been used for a long time throughout the supply chain. This is a good solution if the number of products is limited. It is cheap and changes can be easily made. However if the number of records becomes too large, it is time consuming, especially to retrieve records, and requires large storage space.

Electronic traceability uses either the bar code systems or the more recent radio frequency identification (RFID) systems. Bar code systems have been in use since the 1970s and are well established in the food industry. RFID technology uses tags that send identification codes electronically to a receiver when passing through a reading area. The tags do not have to be in line-of-sight, and many tags can be read simultaneously. This makes it possible to scan a whole pallet in seconds while passing through a reading area. However, RFID technology is more expensive and is thus a less widely used technology.

One advantage of electronic traceability systems is their ability to handle large amounts of data in a precise manner. For example, records and reports regarding traceability can be adapted to a specific situation, such as a recall of a specific lot.

In summary, traceability systems can be applied to ensure food safety, but also quality or other credence attributes that consumers cannot detect (e.g. organic fish, fair trade). Regardless of whether they are voluntary or mandatory, traceability systems can improve food supply chain management, safety and quality control and minimize the cost of product recalls and withdrawals. Traceability is however not the only means to these objectives, and it alone cannot achieve any of them. Simply knowing where a product is or has been in the supply chain does not improve supply management or

⁵ “Guidance on the implementation of specific articles of Regulation (EC) No 178/ 2002 on General Food Law”.

TABLE 4
Comparison of traceability systems

	Paper traceability	Electronic traceability
Advantages	<ul style="list-style-type: none"> • Based on existing quality assurance/stock control documentation systems. • Inexpensive to implement • Flexible in terms of the processing systems to which it can be applied • Data input is easy and precise 	<ul style="list-style-type: none"> • Data input can be automatic • Easy to link additional information (e.g. temperature) • Real time availability of information • Reports and records can be prepared quickly and adapted to the situation • Easy transmission of information to other links in the supply chain
Disadvantages	<ul style="list-style-type: none"> • Manually intensive • Rely on correct procedures and operations • Trace back information time consuming • Records are not easy to review 	<ul style="list-style-type: none"> • Expensive equipment • Paper bar code easily damaged in harsh and moist environments • RFID technology not yet widely used

safety/quality unless it is well paired with a good delivery system and/or with a safety quality assurance programme.

Noticeable developments in food logistics supported by more refined traceability systems have appeared in the recent decade. Today these are seen as an integral component of the global food distribution system, leading to efficiencies and thus lower prices. These improvements in the food and fish supply chains are also apparent in many cities of developing countries, which has contributed to the expansion of the international fish market during the last decades.

CONCLUSIONS

The globalization and further liberalization of world fish trade, while offering many benefits and opportunities, also presents new safety and quality challenges. The influence of civil society and consumer pressure on producers, processors, retailers and governments to improve management is increasing. Thus, in addition to safety and quality, other issues of global concern such as environmental protection and social requirements are increasingly likely to govern market access and market entry.

The growing influence of wholesale, retail and restaurant chains that control fish markets seems to indicate a trend for increasing use of market standards and certification schemes. However, the extent and implications of this influence and increase for fish trade governance are not known and need to be studied, taking into consideration regional specificities. Should market standards become important measures for fish trade governance, it is imperative to develop an international plan of action to ensure transparency, science-based criteria, harmonization and equivalence, and technical assistance to developing countries and to small-scale producers to ensure coherence with WTO trade measures. *The Guidelines for Responsible Fish Trade* and the *Guidelines for Certification in Aquaculture* currently in development by FAO should take these issues into consideration.

Fish safety and quality assurance in the new millennium will require enhanced levels of international cooperation in promoting harmonization, equivalence schemes and standards-setting mechanisms based on science. The SPS/TBT agreements of the WTO and the benchmarking role of the Codex provide an international platform in this respect.

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Melanie Siggs joined the Seafood Choices Alliance in 2006 to work on development of the programme in Europe, where they are working across suppliers, retailers, processors and non-governmental organizations (NGOs) finding solutions for a sustainable fish industry. Her background lies entirely in the corporate sector, predominantly working in natural resource businesses such as agriculture, food, waste and forestry, most recently with one of the world's largest forest products groups, Finnish conglomerate UPM-Kymmene. Melanie has a breadth of professional experience in strategic positioning, corporate affairs, reputation and brand, as well as a personal passion for responsible business, a subject in which she holds a Masters degree.

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Consumer assurance: market-based quality schemes, certification, organic labels, ecolabelling, retailer specifications

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ABSTRACT

In response to a strong call for responsibly supplied fish, the European marketplace now has a number of ecolabels, some globally recognized and others specific to the retailer or country. This paper gives an overview of the current labels being applied to European fish and fish products, explores their efficacy and necessity, and considers what the label “market” might look like in the future. The majority of these labels apply to wild-caught fish. What labels are being applied to farmed fish? How meaningful are they? Furthermore, the author has sought input from a cross section of leading European retailers and processors on what their requirements are, and their “top tip” for suppliers of farmed fish in the future. The challenges for suppliers to the European market are considered, and the catalyst, strength and authenticity of the sustainable fisheries movement in the European industry are addressed. Most activity has centered on wild-caught, fresh fish, but there is increasing energy now questioning the farmed sector. What is driving this and what might it mean in the future? Finding ways to match responsible (economically, socially, environmentally and ethically sustainable), traceable production with high quality and good value are the demands of the European industry – but are the requirements and the commitment enough to enable the management, investment and possible change that might be necessary?

INTRODUCTION

Before this paper begins, a proposal of terminology is made: it is proposed that these labels, as referred to in the title of the paper, be collectively referred to as “Assurance Labels”, which seems to succinctly capture the essence of what they all do. The presentation that preceded this paper was made in Qingdao on 29 May 2007 and sought to give an overview of the following, with contributions made by a number of leading European retailers and processors:

¹ The Seafood Choices Alliance is a global association working on the issues surrounding ocean-friendly seafood. Founded in the United States in 2001, the Alliance works across the seafood industry – from fishermen and fish farmers to distributors, wholesalers, retailers and restaurants – to help create an environmentally and economically sustainable marketplace. The Alliance would like to thank a network of retailers and processors in the United Kingdom and France who contributed to this paper. Farmed fish are an inevitable part of the fisheries portfolio of the future. The industry can offer economic hope to developing countries while making an important contribution towards helping preserve wild stocks and feed a growing global population. Working together we can do it right.

- the label, certification and assurance scheme status in Europe;
- what is expected of an aquaculture label in Europe; and
- is sustainability important in the European market, and why?

THE LABEL, CERTIFICATION AND ASSURANCE SCHEME STATUS IN EUROPE

In Europe, we are privileged to enjoy an extraordinary range of choice of foods, at all levels, from fresh produce to ready-made chilled meals for busy people. As such, for fish buyers and other food buyers across Europe, it is no longer sufficient to supply a diverse range of foods 52 weeks of the year. Ethical pressure and the need to add value and integrity have created a market that increasingly demands to know where that food has come from and how it was produced – the industry is beginning to take responsibility for its choices.

We no longer want value for money, but values for money.

Professor Tim Lang, City University, 2007

The onus of that responsibility is important. Consumers, overwhelmed by information, short on time and wanting to rid themselves of difficult decisions and guilt simultaneously, are tending to shift their responsibility to the retailers where they shop. Given the immense buying and political power of these retailers, this may not be inappropriate, but they cannot take the responsibility alone; it must be shared throughout the supply chain. The retailers are now expected to take front-line responsibility for ensuring that food is not only of high quality and appropriate value, but also ethically produced, has had minimum negative environmental impact and is “fair” to the producer. In return, it is considered that such measures will lead to sustainable business for all; that is economically, environmentally, ethically and socially.

Assurance labels take away a lot of the work and risk for buyers. Credible, robust certification is a Godsend, and where it does not exist, retailers – and other outlets – are actively seeking it. Evidence of this can be seen by the massive – indeed catalytic – statement by Wal-mart, the world’s biggest food retailer, that within five years of their announcement, all of their wild-caught fish will come only from Marine Stewardship Council (MSC) certified sources. And such pledges have been made, in different forms, by most of the major retailers – and as such through the supply chains – and now are beginning to be adopted by the food service sector. Commitment to the delisting of so called “red listed” fish – those deemed as the most “at risk” – has been almost universally carried out. We see more MSC and more organic fish coming to market, and a high level of energy at all levels, retailer to scientist, to better understand the state of our seas.

According to the Food and Agriculture Organization of the United Nations (FAO), farmed fish now makes up some 43 percent of the fish supply to meet consumers’ growing appetite, while there is much debate over the dwindling wild stocks, as well as the environmental impacts of fishing methods and the wider impacts on crucial ecosystems. So is farmed fish the panacea that can save the wild fish, meet consumer demand and – as some 98 percent of farmed fish comes from developing countries – shift monies into poorer economies? Maybe, if appropriately raised and supplied – and therein lies the difficulty; defining “appropriately”. In truth, assurance schemes serve to aid both buyer and supplier by clearly laying out the requirements – assuring one, creating clear goalposts for the other and helping develop confident access to market. In this paper, we will look at what some of the existing schemes look like, explore what the buyers and nongovernmental organizations (NGOs) expect from an aquaculture assurance label and outline some of the work in progress.

We have alluded here to the benefit of a credible assurance label to the buyer, in terms of establishing a product’s provenance and appropriateness, but there is another

side to this coin – the buyer's company's brand and reputation are at risk if the fish (or other product) is not appropriately sourced.

Selling appropriately sourced food is a deal breaker in protecting and enhancing a company's brand and reputation. Economists say that a company can recover quickly from a financial faux pas, but it takes much longer, if ever, to recover from a reputational faux pas. In George Williams' paper (this volume), he touches on this for his company, Darden, in the food service sector. George aims to put a dollar value on the company's reputation, i.e. to identify in terms of economic risk, the value of the company's brand and reputation – and in this example this is a one-off figure, whereas the impact of any reputational error will be longer lasting than a momentary dip in financial value and is unlikely to take into account the investment to have achieved said reputation.

So robust, credible assurance labelling can significantly help a company on its road to responsible business, thus meeting its own ethical values while helping to safeguard reputation, but one of the big challenges of labelling is working out who you are trying to talk to and what you are trying to say. What is the audience's interest?

To date it has proved impossible to create criteria for a label that cover all possible aspects as robustly as specifically interested parties might want. For example, the MSC label does not address social responsibility or air miles criteria, although these are being considered. The label Freedom Food (operated by the Royal Society for the Prevention of Cruelty to Animals (RSPCA)² in the United Kingdom) addresses only animal welfare issues, which, for some consumers, particularly in Northern Europe, is of paramount importance. Of course, that must de facto touch on other issues such as disease control, but the emphasis is on welfare, and the public knows that if they see a product with the Freedom Food label on it (it is currently on some salmon products), then the animal has been raised, handled and slaughtered in accordance with strict criteria that seek to ensure its well being. Their conscience is clear. What is also interesting to note here is the importance of the brand of the label itself. The RSPCA is a very well known brand in the United Kingdom where the Freedom Food label is seen, and has very high, unprompted recognition awareness at consumer level – this helps to add to its value from the retailer's perspective.

Other labels, such as the Soil Association logo, assure the customer that the product has been produced organically, i.e. within very strict environmental criteria, while the EureGap label is a business to business label, unseen by the consumer (all the others would likely be seen on the packaging at consumer level).

Box 1 gives the principle labels currently operating in Europe. It is not proposed to go through the criteria and purpose of each of these labels; such information is widely available, online, through FAO or via the bodies themselves. These labels cover wild-caught fish.

There are many, many more labels in use (see Box 2 and Table 1) – there are retailer-specific, country-specific and even region-specific labels all in use at the current time. Of course, their credibility and acceptance – and target audience – varies greatly, and only

TABLE 1
Number of products, by label, by country
(March 2007)

Countries	Number of products ¹
Switzerland	69 MSC
Sweden	44 MSC + 2 KRAV
France	13 MSC
United Kingdom	87 MSC
United States of America	93 MSC + 7 Ecofish
Japan	14 MSC
Germany	63 MSC
Spain	2 MSC
Italy	25 FOS, 3 MSC

¹ MSC – Marine Stewardship Council, FOS – Friends of the Sea

² The seventh most valuable charity brand in the United Kingdom. The RSPCA has probably been one of the most loved charities in the United Kingdom since its establishment in 1824. Someone calls the RSPCA every 25 seconds for help about preventing cruelty to animals, and it successfully rehomes nearly 7 000 animals each year through its network of 174 branches. This substantial support increases the RSPCA's relevance to the public and helps drive its brand value of £ 94 million.

BOX 1

Types of labels**Business to Business**

- Compliance, regulation; reassuring buyers of a minimum standard of governance

**Business to Consumers**

- May look at specific set of criteria such as animal welfare, or be a regional quality/provenance label

**Certification**

- Tends to go beyond compliance, a continuous improvement process, pushing the industry standards across environmental impacts and other criteria such as animal welfare, ecosystems, social responsibility



BOX 2

Principal labels currently operating in Europe

- Marine Stewardship Council (MSC)



- Earth Island 'Dolphin-safe' International Dolphin Conservation Programme



- Friends of the Sea



- Krav (Sweden)



- Naturland

those that have 3rd part certification processes that are fully transparent, with true stakeholder engagement, that meet the FAO guidelines and that challenge themselves with continuous improvement programmes are seen as credible and robust enough to be fully accepted by the buyers, processors and NGOs across the industry.

The most widely used of these labels is that of the Marine Stewardship Council (MSC). The “Dolphin Friendly” labels that are widely seen on tuna products (some 300) are also prolific – again an example of a label that addresses a very specific area of interest but doesn’t touch on other emotive issues such as stocks, wider environmental impacts or other by-catch species.

Friends of the Sea are based in Italy, which may account for some of their success there, but the label has its critics, predominantly due to its lack of 3rd part certification, stakeholder engagement and a perceived lower standard of certification. The NGOs have not given it their support, and we may well see action by them that will challenge this label’s credibility.

MSC has the most successful certification label – because it meets all the aforementioned criteria. The scheme is not without fault, and the MSC acknowledge mistakes made during their formative years – faults that lessons may be learnt from for the development of future certification schemes. Their process and development make the label compelling, and the more stakeholders are engaged with them, the more it can be challenged to be the ongoing scheme it needs to be for the future; continuous improvement applies to assurance labelling as well as fisheries! Additionally, as the number of products grows and consumer awareness increases, recognition of the MSC logo at a point of purchase increases. That said, it still comes under criticism on two particular counts: a relatively narrow field of criteria and cost. Regularly held up as a “gold standard” and adopted by many of the leading businesses as the label of choice, its status and cost have been seen by some as a barrier. However, MSC is working on a number of ways to make its certification more accessible, while recognizing fisheries in the process of achieving certification.

The lower numbers of products in Spain and France (Table 1) mark two countries where the sustainability has yet to really take a broad hold on the food industry agenda.

The MSC is an example of a certification scheme achieving a good level of international success, but MSC does not have a certification scheme for aquaculture and has publicly announced that it will not be developing one in the foreseeable future. They intend to focus their efforts only on wild-caught fish. So who is going to certify farmed fish to this level of integrity?

ORGANIC LABELLING

According to Datamonitor, sales of organic food in the United Kingdom are rising by some 30 percent a year. The popularity of organic produce is high across Europe, and this is now extending to fish and fish products.

As regards organic aquaculture, there are currently no harmonized regulations at an international level. Certification is carried out mainly based on regulations developed by national or private bodies. Some countries have well-defined, largely accepted organic schemes, such as the United Kingdom’s Soil Association, which first recognized farmed fish in 2006. According to FAO, there are currently some 25 organic aquaculture certification bodies. The principle organic certifiers in Europe (see Table 2) are

- Naturland,
- Krav,
- Soil Association, United Kingdom, and
- Bioland

A major issue in the development of harmonized organic aquaculture standards at a European level is the fact that, within the European Commission (EC) organic

TABLE 2
Principle organic certifiers in Europe

Country/certifier	Current product
Naturland, Germany	Shrimp, carp, trout, blue mussel, salmon
Krav, Sweden	Salmon, rainbow trout, brown trout, arctic char, fish from the perch family, blue mussel
Soil Association, United Kingdom	Shrimp, salmon, trout, cod
French Ministry of Agriculture	Trout, salmon, seabass, seabream

production is the responsibility of the Directorate General (DG) Agriculture while aquaculture is the responsibility of the DG Fisheries. Currently, the EU regulations on organic agriculture are undergoing a review, and DG Agriculture is discussing a new Action Plan. The EC is committed to include regulations on organic aquaculture in the revised edition of European organic standards. This commitment has already been approved by the European Parliament and the Council of the EU.

Such confusion at a European level has not prevented the development of products carrying organic labels certified at a national level, but there is controversy over them – particularly relating to feed; should it be organic feed or, in the case of fishmeal, how can it be proven to be from sustainable stocks?

Typical organic standard criteria address:

- sites regularly replenished with pollution-free water;
- fish of natural origin and selection (absolutely no genetically modified organisms (GMOs) or hormonal treatment);
- feed based on controlled meals, oils and so on (no GMOs);
- limited and monitored treatment with medicines (preference for natural remedies);
- low breeding/stocking density;
- longer rearing periods; and
- continuous monitoring of environmental impacts.

WHAT IS EXPECTED OF AN AQUACULTURE LABEL IN EUROPE?

The objective of a good assurance label might therefore be summarized as:

- to provide reassurance of origin through robust traceability; and
- to reassure that appropriate management is in place to minimize negative impact and maximize positive impact, in turn helping to enable responsible practice through the supply chain, protect brand and reputation, and ensure sustainable businesses, throughout the supply chain, for the future.

Beyond this, a credible assurance body does not “stand still” but continually seeks to improve its own operations to ensure positive change through its label and to work to promote its own brand. A good label can build a business case across the three pillars of sustainability; it should help provide:

- an *economic case*: by providing buyers with confidence, and consumers with a clear conscience, i.e. labelling can provide improved access to markets while creating economic advantage at a production level. For example, lower stocking rates often mean less disease, while an emphasis on humane slaughtering, which lessens stress in the animal, has been shown to provide a better quality end product.
- an *environmental case*: seeking to minimize negative impacts, whether through improved siting of ponds or cages, better management of waste, minimizing escapes, limiting the use of chemicals and antibiotics or strict guidelines as to the source of feed stuffs. Appropriate environmental management can help both to protect the immediate environment of the farm and the wider impacts and importantly, help safeguard a long-term future for a robust, viable and “fair” business; and
- a *social case*: social responsibility initiatives have been drilling into the food agenda and take an increasingly greater role in consumer awareness and in generating

concern for the people involved in producing our food. The most visible response in Europe has probably been the enormous growth of the official FAIRTRADE label, now seen across some 20 different commodity products and now being seen on value-added foods as well.

FAIRTRADE certification focuses on people and community welfare, fair prices, working conditions, reinvestment and stakeholder involvement – it concentrates on the social and economic case, but also has significant environmental requirements. Coffee, tea and fruit are predominantly where FAIRTRADE labels are seen, but there is work afoot to consider its possibilities in fish and fish products.



The approval of the NGOs in Europe, and in particular in the United Kingdom (which acts as something of a trendsetter across the European retail scene) is essential for the success of any assurance label seeking credibility beyond the regional level. The environmental campaigning NGOs are strategically powerful, laying the challenge for change. They often take direct “peaceful” action, such as displaying tables of by-catch for the public to see in Central London or hanging banners “UNITED KINGDOM’S WORST FISH RETAILER” over an outlet. They also use “naming and shaming” techniques, and it is within this category that one of the most successful tools to create change has been seen in the Greenpeace League Table. The table ranks retailers according to their fish procurement policy and species sold (Figure 1 and Table 3). There are now two such league tables produced by different NGOs, and while some retailers are committed to remaining at the top, others have simply sought hard to move away from the bottom. The effect is the same – all retailers took action and continue to do so. Many of these retailers and processors now work in close partnership with one or more of the NGOs (typically the Marine Conservation Society, the World Wide Fund for Nature (WWF), the North Sea Foundation and Greenpeace). The retailers are ranked according to the rating given to their buying policies and codes of practice:

- all retailers now have a responsible fish sourcing policy;
- most processors now have a responsible fish sourcing policy; or
- most companies with a responsible fish sourcing policy engage in multi-stakeholder engagement across the supply chains

CASE STUDY – SAINSBURY’S

Sainsburys are the second biggest retailer in the United Kingdom, with an annual turnover of around £ 17 billion and employing over 150 000 people. Sainsburys currently have around 20 percent market share of the United Kingdom’s

FIGURE 1
Example of a table ranking retailers according to their fish procurement policy and species sold

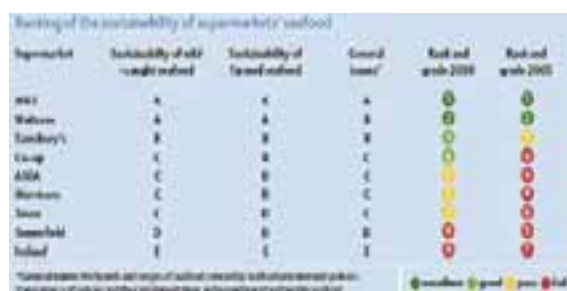
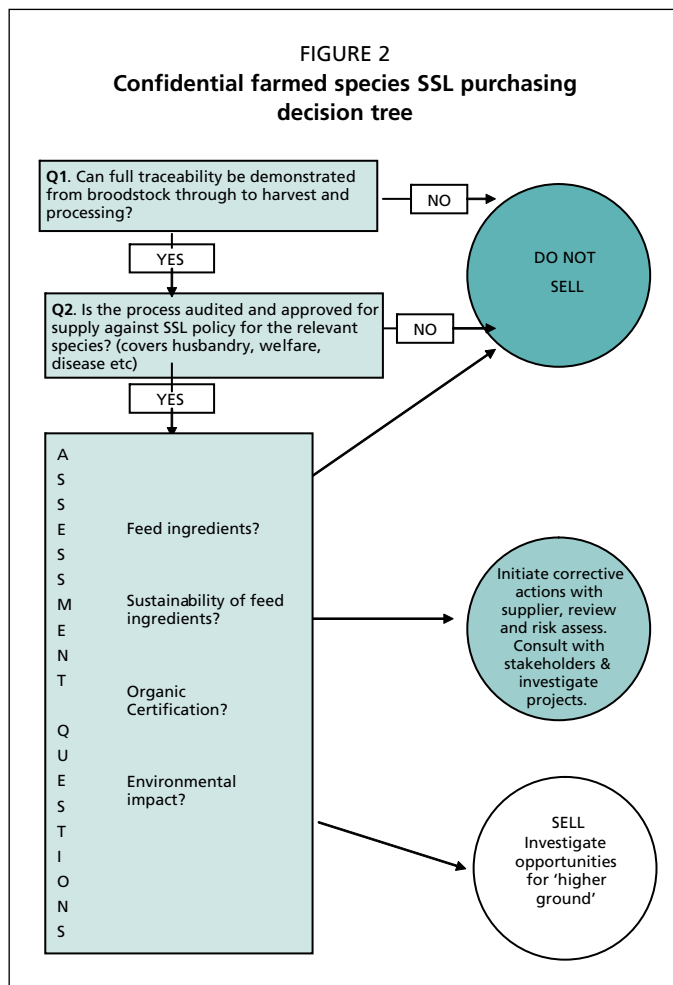


TABLE 3
Ranking of retailers in League Table, 2006 and 2007

Supermarket name	Position in League Table 2006	Position in League Table 2007
M&S	1	1
Waitrose	2	1
Sainsbury's	3	4
Tesco	4	3
Co-Op	5	7
Morrisons	6	6
ASDA	7	5
Somerfield	8	–, No response
Iceland	9	8
Lidl	10, No response	–, Not Contacted
Booths	–, Not contacted	–, No response



fresh fish market (value and volume) second to Tesco.³

Part One – Creating a Procurement Process⁴

The decision tree (Figure 2)

“The decision trees were developed in collaboration with our key suppliers, covering both the farmed and wild caught sectors. The process took several meetings as we wanted to ensure that the final wording for each of the questions were as clear as possible, and not subject to ambiguity. We also needed to make sure that the decision trees just covered the process relating to either farming or wild caught fish, and that we didn’t confuse the issue by overlaying some of the social responsibility concerns as these are covered by other policy requirements

As well as ensuring we covered all the technical aspects of the process (whether farmed or wild caught), we also needed to consider the customer perception relating to each of the issues raised by the questions. We also tried to ensure that the flow was logical, not just with regards the process, but also to the relative importance of the issues (hence there are several questions on feed within the farmed decision tree as

the specific issues raised by each of the questions had different relative importance, either to us, our customers or NGOs)

Once we had agreed on the format and final wording for the questions, we then asked for external review by some of the NGOs to ensure that we hadn’t ‘missed’ any areas that maybe we should have considered.”

Alyson Anderson, Technical Manager, Fisheries, Sainsburys (part of the Wal-mart group of companies)

Taking policy to the next level, we can explore some of the specific criteria that will be needed to be included in a successful global label for aquaculture – that can meet the objectives, the procurement policies and fulfill the ethical drive of these major buyers. The following is a list of the key requirements that the retailers, processors and NGOs, are looking for in an assurance scheme for farmed fish. Amalgamated from different sources it is unlikely to be exhaustive, but might be what a final scheme is likely to contain, as a minimum:

- operating in an environmentally and socially responsible manner, including

³ Source: TNS.

⁴ Information about policies of some other retailers and processors in Europe can be found via the following Weblinks: <http://www.lyons-seafoods.com/environmental.htm>; http://www.youngsseafood.co.uk/youngs/corporate_responsibility.asp; <http://www.marksandspencer.com/gp/node/n/46526031/202-0623220-7695843?ie=UTF8&mnSBrand=core>; http://www.waitrose.com/food_drink/foodexpertise/meatandpoultryatwaitrose/fishatwaitrose.asp#where; <http://www.carrefour.com/cdc/responsible-commerce/our-commitment-to-the-environment/responsible-sourcing/sourcing.html>; http://asdacares.gpalm.co.uk/environment/environment_load.html

- addressing environmental impact from farm site and management;
- complying with legal restrictions on farm size, discharges, environmental monitoring etc;
- escapes prevention management;
- food safety controls, i.e. veterinary medicines, pigments, feed safety, contaminants;
- positive welfare, including handling, stocking densities and slaughter practices;
- ethical farming – no GMOs, feed sustainability; and
- working/social standards of employees.

As you read this, you cannot help but notice the enormity of the scope of these “headings”. It is possible that at least two tandem and complimentary schemes might be needed. One might be a minimal compliance or governance level – still demanding, still robust and still being continually challenged to improve, but perhaps more readily achievable and likely to be taken up by a high percentage of suppliers (indeed at such a level it could become a requirement of entry to market in some countries). The second would go beyond compliance and be that which challenges the former to progress. Those certified to the second level might expect to supply the premium product; or it may be that there is a recognized interim level for those working to move towards Level 2 from Level 1. Buyers need to have suppliers whose business is underpinned by integrity and who are committed to improvement. The frame of such labels might look something like that shown in Table 4.

For the hypothetical labelling system shown in Table 4, label 1 compliance is a level that all producers/suppliers might be required to reach to supply European markets. It could possibly be a business to business label and might supply standard product. Label 2 compliance is a level that might attract a “premium product” status, differentiates itself and is more likely to carry an identification at a consumer level. The additional role of label 2 is also to be the level (the category of supplier and buyer) that will continue to push the standards and push for ongoing improvement in the industry. As the standard is raised so is the compliance level, thus ensuring the cycle of continuous improvement. Within such a system there might also be a process of acknowledging those who are committed and demonstrating a shift from Level 1 to Level 2. Organic status would be likely to sit with a different certification body.

TABLE 4
Hypothetical framework for labelling

For basic compliance (level 1)	Beyond basic compliance/ organic standards (level 2)
Environmental impact controls	
<ul style="list-style-type: none"> • Permits for capacity/chemical use to control pollution • Escape prevention by risk-assessed cage design and net testing • Disease control by permissible vaccines and lice control, in conjunction with preventative measures 	<ul style="list-style-type: none"> • Site selected against special criteria • Detailed annual benthic biodiversity survey • Restricted chemical use • Require strategic lice control agreements
Welfare	
<ul style="list-style-type: none"> • Stocking densities defined • Set maximum feed withdrawal period • Handling and slaughter methods specified 	<ul style="list-style-type: none"> • Low stocking densities • Short feed withdrawal • Specific pumping and stunning methods of slaughter
Food safety/health benefits	
<ul style="list-style-type: none"> • Veterinary medicines and chemicals control by prescription • Feed legal for contaminants/pigments 	<ul style="list-style-type: none"> • Restricted list of antibiotics/chemicals • Specify feed pigments and select, for example, high omega-3 and low PCB/dioxin oils
Ethical farming	
<ul style="list-style-type: none"> • No GMO seafood grown • Key working conditions (facilities, minimum wages, hours) • Feed-sourcing guidelines • Approved management plan, including “continuous improvement mechanism” 	<ul style="list-style-type: none"> • Feed fish from sustainable fisheries/sources • Social responsibility audits; working conditions, stakeholder engagement, community benefit

Running across all of these categories, within both labels, must sit the process operating principles of schemes that are traceable, 3rd party audited, transparent and have full stakeholder engagement – essential for credibility and acceptance.

One of the challenges to certification not yet touched on here is global harmonization; particularly mutual recognition of different country's schemes, which could be key to ensuring better access to certification for small farmers. The Forest Stewardship Council has somewhat successfully tackled this issue, as their global standards transcend into mutually recognized certification at national and even regional (to pick up small woodlands) levels. They would admit that there is more work to continue to improve this, but their model could help demonstrate how an aquaculture label in development could take advantage of its start up to embrace empowerment at a local level – without, of course, lowering standards.

ORGANIZATIONS WORKING ON AQUACULTURE CERTIFICATION

Organizations that have international aquaculture labels currently are the Global Aquaculture Alliance (GAA) and EurepGap.

EurepGAP⁵ is a private-sector body that sets voluntary standards for certification. It started in 1997 as an initiative by retailers. It is a business-to-business label and is not directly visible for the consumers. They have developed harmonized standards of good agricultural practices (GAP), and existing assurance schemes that have completed a benchmarking process are recognized as equivalent to EurepGAP. In aquaculture, they have a standard for salmon and are developing standards for shrimp and several white fish. The shrimp standard is the first to include social standards (i.e. working standards – functional rather than “well being”). EurepGAP is designed to be an equal partnership of stakeholders. All committees have 50 percent retailer and 50 percent producer/supplier representation. It is one of the very few globally operating standardization organizations that enjoys a high level of political acumen, and farmers or farmer groups can only be certified against the EurepGAP criteria by authorized certification bodies, to ensure financial independence.

EUREPGAP

The Global Aquaculture Alliance (GAA)⁶ (Box 3) is a United States based group and, as part of a suite of tools for the industry, provides the only internationally recognized aquaculture certification label at the current time. As such it is used by buyers, and indeed Wal-mart has embraced it for their farmed-fish products. Lyons Seafood, the United Kingdom's biggest importer of shrimp, and other European companies do use it as a Best Practice label, but for buyers generally and for the NGOs, it doesn't go far enough. Could it be developed into the label and brand that stakeholders seem to feel is needed? Probably – indeed it's not so far from that place now, but it will need to reach a place of positive dialogue with the NGOs and, as it stands, is unlikely to provide the leading certification scheme that is required by European buyers.



The brand of the label itself can be important. Consumer recognition is very useful (MSC, FAIRTRADE; labels with high consumer awareness) to buyers and adds value to the certification.

There are also other initiatives, such as the International Principles for Responsible Shrimp Farming 2006, as developed by the Consortium on Shrimp Farming and the Environment (Food and Agriculture Organization of the United Nations (FAO), Network of Aquaculture Centres in Asia-Pacific (NACA), United Nations Environment Programme (UNEP)/GPA, the World Bank and World Wide Fund for Nature (WWF)), but this is not a label or certification scheme. However, such frames

⁵ http://www.eurepgap.org/Languages/English/index_html

⁶ <http://www.gaalliance.org/>

BOX 3

The Global Aquaculture Alliance

The Global Aquaculture Alliance has developed practices for responsible aquaculture products starting with marine shrimp. These practices are called Best Aquaculture Practices (BAP) and for shrimp cover the four areas of production, processing, hatcheries and feed production. The BAP standards for shrimp were developed with input from all stakeholders, to include members of the NGO communities and have been endorsed primarily by United States based retail and food service operators.

BAP standards require independent certification by qualified certifiers – in this case, that certifying organization is the Aquaculture Certification Council (ACC). While buyers may want to endorse the standards, suppliers must pass the initial certification examinations and be recertified on an annual basis to assure compliance with BAP. Only then can products carry the certification mark of BAP.

GAA recognizes the following:

- 1) The importance of sustained involvement of all stakeholders of aquaculture products in the process of standards development and the improvement of those standards over time.
- 2) The need to broaden the number of BAP aquaculture species to meet the assurance needs of retailers and food service operators. To that end, draft standards for salmon, tilapia, catfish and *Pangasius* will now proceed through the transparent process of final development so that those species might also be eligible for certification.
- 3) The realities that aquaculture production in many countries is conducted by a very large number of small farmers. Standards for aquaculture products need to accommodate all producers in what is still a developing industry in developing countries.

Source: Wally Stevens, Global Aquaculture Alliance

can undoubtedly feed into the development of an appropriate international assurance scheme.

There are few stakeholders in the European industry that would advocate the development of more ecolabels or certification processes, which can be confusing and weaken existing schemes. However, slow development, non-acceptance across borders and differing areas of interest or priorities mean that there are already many labels – international, national, regional, area specific, broad ranging and product specific – both in use and in development. This can be confusing both for buyers and consumers. If something can be developed on aquaculture that meets the criteria of demanding North American and European buyers and consumers, has international recognition and ideally, that allows national schemes to feed in to it (like the FSC forest certification scheme mentioned earlier), and possibly even allows other standards to feed in (i.e. ISO standards), then the result may be something extremely useful and appropriate at all levels, without adding to the confusion or reinventing some wheels which already exist, that allows access to market and helps develop a sustainable industry on a global basis. Working with one of the organizations already active in this area that has some traction and a brand in place may be a route to more rapid success, and EurepGap and GAA, or a turnaround of decision by MSC, all offer opportunity for this.

European Commission activity

Aquaculture in Europe grew rapidly over the past 10 years, but that growth has recently stagnated. The EU recognizes the economic opportunity of farmed fish and wants to

address how to develop the business further. As part of this development, the Commission is in stakeholder consultation.⁷ It is highly likely that the need for a robust label, as discussed, will come through these consultations, and the EU will add its weight to developing such a scheme. However, that's a great weight that takes a considerable time to move!



It is worth emphasizing that the EU is a union of countries with very different views, cultures and heritage, and not without some internal competition. As very obvious as that sounds, we are always a little guilty of referring to the EU as though it behaves as one united entity, but the truth is there is considerable diversity across the European countries, which means that agreeing upon standards and principles can often be a very lengthy process; at an individual level, each country has its own views and behaviour. For example, in France – with a few notable exceptions such as Carrefour and Findus who are very active in the sustainability arena – the market tends to be more interested in French-produced/local produce, has an emphasis on quality rather than provenance, and prefers French-based initiatives (labels) over international ones.

World Wide Fund for Nature (WWF)

WWF has been actively and strategically working across stakeholders on the development of standards for the industry. They recognize the possibilities for farmed fish to both take the pressure off wild-caught stocks and to feed a growing global population. However, as Dr Jason Clay (Vice President, Global Solutions, WWF) puts it, it will only help if its done right.⁸ WWF firstly set about researching and studying the industry and its potential – key species and key impacts. They then formed “dialogue groups” to address each of these impacts – what standards are realistic and achievable, and can industry work with them while still protecting the outcomes. All activity has impacts, but how best to minimize those negative impacts? Those dialogues continue, and it is thought that some outcomes should be seen in 2008. That said, the dialogue, the outcomes and the action all need a “home”, and WWF is also exploring the options for where the standards might sit.



EurepGAP

Using their Good Agricultural Practice Business to Business certification schemes as a model, EurepGap has already established governance-style standards in the aquaculture arena and is keen to continue, not least because their members are key European buyers. EurepGap is currently certifying salmon and developing GAP standards for shrimp and some white fish.

There is also action at a country level and at a retail level, keen to safeguard their own products and to put an appropriate label on their produce for consumer reassurance. In reality, a myriad of labels is unlikely to be a positive move, as it generally leads to confusion and “weakens” the impact of the offering certification makes. We are seeing farmed product come through with other labels, for example, welfare and organic.

IS SUSTAINABILITY IMPORTANT IN THE EUROPEAN MARKET, AND WHY?

Should we ask ourselves if this strong move towards responsible business is here to stay? Do we need to develop these frames that help us to work within a more

⁷ For details on these consultations see the following Web sites: <http://ec.europa.eu/yourvoice/ipm/forms/dispatch?form=CertifAqua>; http://ec.europa.eu/fisheries/cfp/governance/consultations/consultation_240407_en.htm

⁸ Dr Clay's presentation, which includes a table on the impacts and their relative importance, entitled “Strategies for Sustainable Aquaculture”, given in Norway September 2006 can be found at: www.aquavision.org/files/Jason%20Clay%20AquaVision%202006.pdf

responsible arena, that allow transparency and demonstrate sustainable practice, or is it a passing fad which will go away if we keep our head down long enough? None of us can accurately predict the future, but what we can be sure of is that we cannot take away that which is done. Business, not fisheries or food-specific business, has made mistakes and has been held accountable for its behaviour, and the western consumer has had her eyes opened to the world of responsibility. Knowingly or otherwise, there is an under current of need to understand where things come from and if they were produced responsibly. It certainly feels as if, not only is it here to stay, but that the level of awareness, the demands for accountability and the scope for delivery of information are probably a long way from even peaking. Many businesses are responding very robustly, and an example of that is Marks & Spencers in the United Kingdom (Box 4). As an own-brand operation, this means that Marks & Spencer's pledge will extend to over 2 000 factories, 10 000 farms and 250 000 workers, as well as millions of customers visiting over 500 stores in the United Kingdom.

In the United States, the ongoing public commitment of the world's largest retailer continues to make headline press, and thus challenge other businesses and raise consumer awareness. Wal-mart employs 1.8 million people worldwide through its 42 000 stores (Box 5).

So, it's not just about fish, but looking specifically at consumer's attitudes to fish we learn from a survey carried out by Seafood Choices Alliance in 2005 that 80 percent of people are concerned about the oceans when asked, and 56 percent are very aware of over fishing; and from Tesco supermarket research, that Tesco focus groups confirm that more customers than ever before are concerned about environmental impact; and from the IGD that over 50 percent of consumers are buying at least one or two higher-welfare products a week.

In an EU survey on the attitude of consumers towards the welfare of farmed animals conducted in 2005, results showed that consumers are:

- concerned about animal welfare,
- looking for welfare-friendly products,
- willing to pay more for them, and that
- 50 percent are very likely or quite likely to switch retail outlets if a higher-welfare alternative is not available. (YouGov, April 2006).

This focuses on the specific aspect of Animal Welfare, but it reflects the growing feeling, and perhaps more importantly, the promiscuity, of consumers. For companies

BOX 4

Marks & Spencers' plan

Marks & Spencer has announced "Plan A", a business-wide £200 million "eco-plan" that will have an impact on every part of M&S' operations over the next five years. The 100-point plan means that by 2012 M&S will:

- become carbon neutral,
- send no waste to landfill,
- extend sustainable sourcing,
- set new standards in ethical trading, and
- help customers and employees live a healthier lifestyle

Source: <http://www.marksandspencer.com>

BOX 5

Wal-Mart CEO Lee Scott unveils "Sustainability 360"

On February 1, Wal-Mart President and CEO Lee Scott unveiled "Sustainability 360" – a company-wide emphasis on sustainability extending beyond Wal-Mart's direct environmental footprint to engage associates, suppliers, communities and customers. The announcement was made during Scott's keynote lecture at the Prince of Wales' Business and the Environment Programme in London.

"Sustainability 360 takes in our entire company – our customer base, our supplier base, our associates, the products on our shelves, the communities we serve," said Scott. "And we believe every business can look at sustainability in this way. In fact, in light of current environmental trends, we believe they will, and soon."

now, this is a business of ethics that affects their brand and reputation. It appears that the consumer increasingly wants the retailer to take the responsibility for their decisions – the purchasing decisions. He or she wants to know that if they shop at Retailer X, they can do so with a clear conscience and without having to make further consideration as they shop; they want to know and trust that retailer. Focus here has been excessively about retailers, as that's where the purchasing volume sits, but the food service sector (restaurants, public-sector catering, take away outlets, schools and universities) is also rising to the challenge, and let us not forget that the retailers cannot achieve this level of accountability without the full participation of the producers, importers, distributors and processors – traceability is key. The business of sustainability is here to stay, albeit that it will change and develop, and be adopted in different ways.

There are plenty of ethically led companies with responsibility running through their veins right now, and many who are playing catch up, but overall the business base has shifted and it can't go back, only forwards to new places. Everyone will have to be a part of that shift to survive. The questions are no longer what is sustainable business and is it on the agenda to stay, but: How far will industry be brave enough to go to balance the pillars of economic, environmental and social responsibility? How will it be done? And how will we manage the regional differences in such an internationally complex industry?

CONCLUSIONS

In conclusion this paper proposes the following headlines as the “take aways”:

- There is huge potential for farmed fish, and if it's “done right” it can be a sustainable industry that can help alleviate pressure on wild stocks and feed a growing population.
- There is a need for an internationally recognized, transparent, 3rd party-certified, stakeholder-participative label; working to FAO guidelines as a minimum with a continuous improvement driver. It will need to:
 - be multistakeholder driven for credibility with buyers, NGOs and thus consumers;
 - be based on economic, environmental and social pillars; and
 - ensure traceability throughout the supply chain.
- It will be important in the protection of brand and reputation, but will need also to develop its own brand to add value to its offering.

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Aquatic animal health management in aquaculture

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ABSTRACT

Aquaculture has been practiced for over 3 000 years, the earliest record being from China, where common carp was kept. Since then aquaculture has developed in various places all over the world, from a basic practice to super-intensive culture. Market demand for seafood and aquatic animals is one of the factors boosting dramatic change in world aquaculture. Intensive aquaculture is becoming a common practice to achieve maximal production from a single crop. This practice introduces stress to the animals, which in turn causes health problems. Inevitably, chemicals and antimicrobial products are subsequently used to solve the problem, resulting in drug residues in the final products. To avoid these problems, the principles of aquatic animal health management should be applied as an intervention, including assuring good site selection, good water supply, appropriate feed, suitable stocking density, a closed aquaculture system and the use of vaccines. Moving live aquatic animals can also cause transboundary disease outbreaks such as white spot syndrome (WSS) and Taura syndrome (TS) in shrimp, epizootic ulcerative syndrome (EUS) in fish and koi herpes virus disease (KHVD) in common carp. Therefore, a proper programme of quarantine should be strongly applied to prevent this problem.

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Aquaculture development and environmental capacity: where are the limits?¹

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ABSTRACT

Aquaculture relies on many renewable and nonrenewable resources similar to any other food-producing sector in the world. Sustainable development and management of aquaculture thus require a good understanding of the conflicts and interactions between the resource use and resource users. Such understanding contributes to improving governance in resource use, which is an important prerequisite of sector sustainability. Aquaculture is now considered as the “solution” for bridging the supply and demand gap of aquatic food globally. As aquaculture is highly complex, its impacts on the environment will continue to be discussed, debated and scrutinized by the public. While the environmental impacts of aquaculture cannot be generalized, it is important to recognize problems where they occur and ensure that they are redressed or ameliorated locally. Although the major environmental concerns of aquaculture still remain the same as compared to a decade ago, the sector has adopted technologies and various management solutions for mitigating them, including bringing the social environment into greater consideration. The awareness of the importance of better management is increasing. However, there exist many practical difficulties. Improving environmental management and maintaining aquaculture within the limits of the capacity of the environment will only be possible with sound sector management. If the sector is to perform well, resource use conflicts must be adequately managed and effective enabling policy and legal environment must be provided at all levels. The “enabling environment” for sustainable aquaculture must be a result of a comprehensive dialogue and consultation among all stakeholders, government and private, and self-empowerment and self-governance must be considered as viable options while creating it.

INTRODUCTION

Global production from aquaculture has grown substantially, contributing in ever more significant quantities to the world’s supply of fish for human consumption. It

¹ This manuscript is based on recent FAO research and reviews on global aquaculture development trends and prospectus and also contains some excerpts from the FAO Fisheries Technical Paper No. 500 – *State of the world aquaculture 2006* (FAO 2007).

now accounts for nearly 50 percent of the world's food fish. This increasing trend is projected to continue in forthcoming decades with the vision that the sector will contribute more effectively to food security, poverty reduction and economic development by producing with minimal impact on the environment and maximal benefit to society, 83 million tonnes of aquatic food by 2030. Aquaculture is now perceived as having the greatest potential to meet this growing global demand for fish (FAO 2007) and will become increasingly important in, to quote a recent popular press story, "this last century of wild seafood"².

AQUACULTURE AND THE ENVIRONMENT

Aquaculture is a diverse sector spanning a range of aquatic environments spread across the world. It utilizes a variety of production systems and species. While the impact of aquaculture on the environment cannot be generalized, it is important to recognize problems where they occur and ensure that they are redressed or ameliorated. The environmental "footprint" of aquaculture will almost certainly have to be substantially reduced if it is to meet its potential as the major global source of aquatic products for the world's population. According to FAO (2007), identified cases of negative environmental and natural resources interactions that have been associated with aquaculture include:

- discharge of aquaculture effluent leading to degraded water quality (eutrophication, concern over red tides, low dissolved oxygen etc.) and accumulation of sediments rich in organic matter in farming areas;
- alteration or destruction of natural habitats and the related ecological consequences of conversion and changes in ecosystem functions;
- competition for the use of freshwater;
- competing demands with the livestock sector for the use of fish meal and fish oil for aquaculture diets;
- improper use of chemicals raising health and environmental concerns;
- introduction and transmission of aquatic animal diseases through poorly regulated translocations;
- impacts on wild fisheries resources through collection of wild seed and brood animals;
- effects on wildlife through methods used to control predation on cultured fish; and
- social issues related to the environmental impacts of aquaculture.

Over the past five years, considerable progress has been made in the environmental management of aquaculture, addressing many of these key concerns and improving the efficiency of farming systems. Public pressure as well as commercial or common sense has led the aquaculture sector to improve management, and increasingly it is recognized that aquaculture has many positive societal benefits when it is well planned and well managed. The interactions between the environment and aquaculture include:

- a more efficient use of energy and other natural resources as compared to many other forms of animal production;
- an alternative source of aquatic animal protein that can be less environmentally damaging than some fishing and over-fishing practices; and
- improvements in water and environmental quality through aquaculture farming systems and practices such as integrated farming, low-intensity herbivorous fish culture, seaweed and mollusc farming, and others.

During the past decade, global awareness and sensitivity to the environmental issues related to aquaculture have increased significantly. As a consequence, policy and regulation governing environmental sustainability have been put in place in many

² <http://news.bbc.co.uk/2/hi/science/nature/6108414.stm>.

countries requiring aquaculture producers to comply with more stringent environmental mitigation/protection measures. In some countries, these changes were even initiated by the aquaculture sector itself, usually within the more organized private industry sector to ensure its sustainability and protect operations from poorly managed activities. The private sector has made tremendous advances in the management of its activities, and there are many examples of better management of farming systems that have reduced environmental impacts and improved efficiency and profitability in all regions.

Major environmental concerns

The major concerns related to the negative bio-physical impacts of aquaculture on the environment are associated with wetland and other habitat utilization, abstraction of water, sediment loading into waterbodies, nutrient loading through effluent discharge and resulting eutrophication, groundwater contamination, exotic species introduction, wildlife and biodiversity, and social issues related to resource utilization and access. These will remain major concerns in the coming years, while new concerns will arise that are associated with the increasing interventions in open-ocean aquaculture. Some of the major challenges to open-ocean aquaculture are selection of appropriate species and culture techniques; high start-up costs, particularly due to the need to design and construct culture facilities that can withstand high-energy ocean environmental conditions; the need to obtain financial assistance due to the risk and uncertainty associated with operating under exposed ocean conditions; the need to stay competitive in global markets, the complexities in regulatory framework in permitting; and the lack of knowledge on potential environmental concerns owing to limited experience (Borgatti and Buck 2004).

Land and water resources

Water and land resources are clearly key factors in aquaculture development, and they are commonly used as the primary focus for resource use assessment. In the long term, the continued growth of aquaculture will be constrained by the availability of water and land. These two resources are already in short supply in many leading aquaculture-producing countries due to increasing population pressure and the demands of irrigated agriculture. In particular, information on freshwater resources, including their availability and use is becoming increasingly important given that the degraded state of water use in some areas has resulted in the emergence of regional water scarcities and has highlighted the need to improve water use efficiency. Moreover, aquaculture has to compete for water with other sectors such as irrigated agriculture and industrial and domestic consumption. Irrigated agriculture is currently the largest user of freshwater and will remain so in the future.

Approximately 95 percent of the world's tropical ecosystems and 70 percent of the coastal zone are found in developing countries (Sorenson 2002), some of which are leading aquaculture-producing countries. In the developing world, the population growth rate in coastal areas is significantly higher than in inland areas, and development demands will exert increasing pressure on the utilization of coastal habitats. Aquaculture, along with felling for charcoal and conversion to salt beds and agriculture, and overexploitation by coastal dwellers, has contributed to the destruction of coastal mangroves and associated wetland habitats. Globally the proportion of mangrove destruction attributable to aquaculture is not high, but it remains as a significant causative factor in some parts of the world (Primevera 2000). On the other hand, open-ocean aquaculture or offshore aquaculture, which is broadly defined as the rearing of marine organisms in exposed, high-energy ocean environments beyond significant coastal influence, will tend to increase.

Compared to low-cost fertilized systems, fed aquaculture systems generally make more efficient use of water and space, and thus the use of fishmeal and fish oil in fish

feed for noncarnivorous species groups will be increased. It was recently estimated that aquaculture is using 52.6 percent of world fishmeal supplies and 86.8 percent of world fish oil supplies (Tacon, Hasan and Subasinghe 2006). If aquaculture continues to grow at current rates, it is estimated that by 2010, 56 percent of the fishmeal and 85–98 percent of the fish oil produced will be utilized by the aquaculture sector (Scottish Executive 2002).

Fish meal and aquafeeds

Other concerns related to the negative impacts of aquaculture development are related to the sector's dependence on wild-based fisheries for feed and seed, the increased use of fishmeal, increased capture-based culture fisheries, and issues associated with energy efficiency, carbon utilization, the involvement of small-scale farmers and an over capacity in some coastal areas. Fish seed for stocking in aquaculture systems is either collected from the wild or produced in hatcheries, and may involve domestic sources or importation from other countries. Dependence on wild seed for fish aquaculture declined rapidly in many aquaculture-producing countries in Asia with the success of fish seed production through artificial breeding techniques and the establishment of hatcheries. Nevertheless, in some countries fish seed of several species that is collected from the wild still constitutes a significant share of the seed supply.

The demands placed by fed aquaculture on fishmeal may constrain its future development. As most fish oil and fishmeal is made from small, bony pelagic fishes such as anchovies, pilchards, mackerel, herring and blue whiting, and the aquaculture sector may continue to depend on marine capture fisheries for sourcing key dietary nutrient inputs. In fact, when viewed in wet fish weight equivalents, although only about 20.0 million tonnes or 40.9 percent of total global aquaculture production in 2002 was in the form of aquafeed-dependent finfish and crustacean species, this production was realized through the consumption of an equivalent weight of 21–22 million tonnes of marine pelagics on a wet weight basis (Tacon, Hasan and Subasinghe 2006).

The other concern related to fish feeds is the energy conversion from feed to flesh. Pimentel and Pimentel (2003) reported the average fossil energy input for all the animal protein production systems studied as 25 kcal of fossil energy input per one kcal of protein produced and this energy input is more than 11 times greater than that for grain protein production, which is about 2.2 kcal of fossil energy input per 1 kcal of plant protein produce. According to Goodland and Pimentel (2000), aquaculture (fish farming) is more feed and energy intensive (34 kcal of fossil energy input per 1 kcal of protein produced) than is broiler chicken production (4 kcal of fossil energy input per 1 kcal of protein produced). However, this figure is not representative of aquaculture as a whole, as a significant amount of aquaculture production comes from low-value herbivorous and omnivorous species. More research is needed on these aspects of aquaculture to better understand and develop energy efficient food production systems and to reduce reliance on wild feed sources.

Even though non-fed culture-based capture fisheries may help to maintain or enhance fish population abundance, community structure and ecosystem functioning, negative environmental impacts may arise from ecological and genetic interactions between enhanced and wild stocks. Over crowding appears to be another cause of environmental problems, particularly with shrimp culture in some coastal areas. Such rapid and concentrated development has led to the exceeding of environmental capacity.

Environmental gains and positive environmental impacts

Although they may be significant, the positive impacts that aquaculture has on the environment are not often realized or documented. Technological and managerial innovations such as reduced reliance on fishmeal via use of low pollution feeds, better

feed conversion ratios, lower stocking densities, vaccines, on-farm waste treatment to achieve better effluent control and efficient water use have helped reduce demands on the environment. Increasing recognition of the ecological benefits of mangroves and the use of innovative technological interventions of mixed aquaculture mangrove systems have helped to restore previously degraded mangrove habitats. Integrated rice-fish farming has prevented the use of agricultural pesticides in some areas, with wider environmental benefits. Farmed molluscs and seaweeds act as net removers of excess nutrients and are thus beneficial to coastal water quality. Molluscs are also efficient in bioaccumulation of heavy metals and pollutants and are useful bio-indicators. Aquaculture provides biological control of vectors that have medical importance. Aquaculture of some marine groupers and other coral reef-associated species is being promoted as a means of reducing pressure on wild stocks as well as enhancing populations of endangered coral reef fishes. Moreover, aquaculture provides an alternate and more reliable source of food.

MAJOR CHALLENGES

There are several major challenges that aquaculture development has to face. The ecosystem approach is currently a highly topical issue and is being widely discussed in the context of aquaculture development. The application of an ecosystem approach to the aquaculture sector should consider integration of ecosystem services that are required for aquaculture and optimization of resource use to minimize risks to the sector from ecosystem degradation. Better siting of future aquaculture should be done on a range of scales, both with respect to the receiving ecosystem and with respect to ecosystem services to cultured species. Aquaculture, particularly coastal aquaculture, needs to be used as a tool to rehabilitate degraded coastal habitats. The use of wild fish in the form of fishmeal to feed farmed fish is a direct pressure on fisheries resources. Therefore, to sustain the growing aquaculture industry's ability to contribute to world fish supply, net energy conversion must be improved, reliance on fishmeal in aquafeeds reduced and more ecologically sound management practices adopted.

Responding to market demand and gaining access to international markets will continue to be essential for aquaculture development. New markets have to be developed and the existing markets expanded. It seems that access to some markets can be enabled through development of certification systems for food safety and quality. Increased consumer awareness, pressure from nongovernmental organizations (NGOs) to ensure better health and safety standards, and stricter regulations at both the national and trading block level are leading to new aquaculture processes, and the shrimp and salmon farming subsectors, in particular, are responding to these concerns and market opportunities.

Initiatives are developing along the whole supply chain, from producer to consumer, to promote more responsible aquaculture. There is strong interest in a certified aquaculture product from a wide range of stakeholders. Aquaculture producers throughout the world are recognizing that certification programmes will help them gain a market advantage for a variety of products. Production and marketing based on environmental criteria with relevant certification schemes and labels will play a larger part in the future. Therefore, viable aquaculture certification programmes are timely, urgent and important. However, concerns remain about whether these initiatives can benefit poor, small-scale producers, and also that the proliferation of different schemes may lead to market confusion and added costs of compliance for producers. Providing non-commercially biased information and working with farmers to develop low impact production and alternate systems, combined with market development, can promote environmentally and socially responsible aquaculture. This will continue to require re-evaluation and further development of current practices and their integration into the coastal environment.

Many governments are strengthening their legal frameworks and policies for aquaculture. Often, however, comprehensive policies and associated legal frameworks have been overlooked because development has been seen mainly in technical terms and thus support has been largely focused on improving the technical aspects of production. The recent expansion of the aquaculture industry and the associated increased competition for resources have focused attention on the need for appropriate policy measures and regulatory frameworks to address environmental issues and concerns. Many countries have inadequate capacity to administer their responsibilities in a transparent manner to ensure environmental protection, aquatic animal health, and food quality and safety. Therefore, an enabling policy and regulatory framework for a sustainable aquaculture sector that clearly conveys the rules for the industry and allows the sector to position itself accordingly must be developed. Increasingly, the topic of self-regulation and/or governance is raised, particularly where the decentralization of authority is discussed. The delegation of “power” to farmers to self regulate can only be achieved through associations that are both authoritative and representative of the industry. The development of associative structures is essential not only to promote and develop aquaculture production but also to assist in achieving environmental sustainability. Therefore, organization of the production sector into farmer associations, clusters or self-help groups and empowering them will strengthen compliance with existing and future sector regulations.

CONCLUSIONS

As the aquaculture sector continues to grow in response to the global requirements for aquatic products, this growth continues to raise concern about environmental impacts and management of the sector. Various initiatives are being taken to improve environmental management from farm to policy levels and from country to international levels. While the environmental limits to growth are not known, these efforts will need to continue to be intensified if the industry is to grow within the increasing constraints being placed on the natural resource base upon which the aquaculture sector and the growing number of people on our planet heavily rely. This is a challenge for all of us involved in the aquaculture sector!

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Meeting the feed supply challenges of aquaculture

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ABSTRACT

There is no doubt that the long growth and sustainability of externally fed aquaculture species production (includes all cultured finfish, crustaceans, amphibians, reptiles, invertebrate animals and nonfilter-feeding molluscs; total production estimated at 35 million tonnes or over 55.6 percent of total aquaculture production in 2005) is totally dependent upon the continued availability and provision of feed inputs. It follows from the above that if the current average annual growth rate of fed aquaculture species production is to be sustained at its current rate of 8.9 percent per year (the fed aquaculture sector growing over 108-fold from 322 808 tonnes in 1950 to 35 035 006 tonnes in 2005), then the supply of external feed inputs will also have to grow at similar rates so as to meet demand. Nowhere is this supply more critical than in mainland China, where externally fed aquaculture species production has been growing at an average rate of 11.1 percent per year (growing over 331-fold from 65 961 tonnes in 1950 to 21 860 613 tonnes in 2005, and representing 62.4 percent of total global farmed fed-species production). Moreover, with the noticeable shift in Chinese aquaculture production and policy from just the mass production of traditional lower value, staple filter-feeding and herbivorous finfish species (destined mainly for domestic consumption as an affordable source of high-quality animal protein and essential nutrients) toward also the production of higher-value cash crop omnivorous/carnivorous finfish, crustacean, reptilian, invertebrate and molluscan species (destined for high-end domestic urban markets and/or for export), the sector has become increasingly reliant upon imports to source key nutrient sources, including plant oilseed meals, fish meals and cereals. In particular, the paper highlights the current dependency of high-end Chinese fed aquaculture species production upon the use of trash fish for marine finfish/high-value aquaculture species and the use of imported fish meal, plant oilseed meals and corn, and the urgent need for the sector to move away from the increased use of potentially food-grade raw materials as feed inputs and to increase domestic self sufficiency in terms of nutrient supply. Particular emphasis is given to the increased use of high-quality feed-grade raw materials arising from the agriculture and seafood processing sector, including the use of rendered animal byproducts, agricultural plant byproducts, single cell proteins, marine seaweeds and cultured invertebrates.

EXTERNALLY FED AQUACULTURE SPECIES PRODUCTION

In contrast to traditional open coastal farming methods employed for the production of aquatic plants and bivalve molluscs that are based upon the natural availability and consumption/intake of planktonic food organisms and/or nutrients naturally present within the aquatic ecosystem (total production 27.9 million tonnes or 44.4 percent of total global aquaculture production in 2005; FAO 2007a), the culture of all other farmed aquatic animal species is dependent upon the external provision and supply of nutrients and/or feed inputs. Although the production of filter-feeding finfish species (includes silver carp, bighead carp, catla, rohu) amounted to 8.79 million tonnes or 29.0 percent of total finfish production in 2005 (FAO 2007a) and is still largely based upon the consumption of natural planktonic food organisms within the culture environment (the production of which is usually augmented and/or maintained through the external application of fertilizers), there is an increasing trend toward the use of externally prepared aquafeeds for these species, and as such they are also included here in the analysis as potential externally fed aquaculture species.

The main species groups in 2005 dependent upon the external provision of feed and/or nutrient (i.e. fertilizer) inputs included all farmed finfish (30 301 498 tonnes or 86.5 percent total fed species), crustaceans (3 961 200 tonnes or 11.3 percent total fed species), nonfilter-feeding mollusks (includes sea snails, abalone, conchs, octopuses; 333 963 tonnes), miscellaneous invertebrates (includes sea cucumbers, jellyfishes, sea squirts, sea urchins: 151 613 tonnes), turtles (201 853 tonnes), and frogs and other amphibians (84 879 tonnes) (FAO 2007a). For the purposes of this paper, external feed inputs include the use of industrially compounded aquafeeds, farm-made aquafeeds and natural food organisms of high-nutrient value such as forage/trash fish and natural/cultivated invertebrate food organisms.

Although no official statistical data are currently available concerning feed use by the aquaculture sector, it has been estimated that the aquaculture sector consumed about 23 127 000 tonnes of industrially compounded aquafeeds in 2005 (Tacon 2007) or about 4 percent of the total global industrial animal feed output of 635 million tonnes in 2006 (Gill 2007), over 20 million tonnes of farm-made aquafeeds (FAO 2007c), and between 5 to 7 million tonnes of low-value forage/trash fish species (FAO 2005, 2006).

It follows from the above that if the growth of the externally fed aquaculture sector is to be sustained at its current annual rate of over 8.9 percent per year (since 1950) that the supply of feed inputs (whether they be industrially compounded aquafeeds, farm-made aquafeeds, forage/trash fish or fertilizers) will also have to grow at a similar rate so as to meet demand. However, nowhere is this current dependency upon feed inputs more critical than within China (the feed-dependent sector growing over 331-fold from 65 961 tonnes in 1950 to 21 860 613 tonnes in 2005 and representing 62.4 percent of total global farmed fed-species production; FAO 2007) and in particular, concerning the increasing dependency of the aquaculture sector upon imported feed resources (FAO 2007a).

CHANGES IN AQUACULTURE POLICY AND PRODUCTION FOCUS IN CHINA

Prior to 1978, foodfish aquaculture production in China was almost entirely restricted to the polyculture of a handful of indigenous freshwater carps species (98.9 percent of a total reported finfish production of 753 285 tonnes in 1975; FAO 2007a) within semi-intensive and extensive culture systems (government/state owned or owned by collectives), with nutrient inputs being supplied entirely in the form of locally available fertilizers and supplementary/farm-made agricultural feeds and wastes (FAO 1983). However, from 1978 new government policies were introduced that encouraged a more open market and export-oriented approach to aquaculture development. In particular, these free market economic policies encouraged a more diverse type of ownership in aquaculture ventures (ranging from state and individual to foreign owned ventures),

allowed producers to make production and marketing decisions, and promoted diversification of cultured species (including the use of commercially important introduced or exotic species) and the culture of high-value (in monetary/marketing terms) commercial species for revenue generation and export (FAO 2003).

As a result of the above changes, aquaculture production within China has grown over 23-fold at an average compound rate of 11 percent per year, from 1 876 231 tonnes in 1975 to 43 269 413 tonnes in 2005, with the number of reported cultured species increasing from 16 in 1975 (9 fish, 4 mollusks, 2 plants, 1 crustacean) to over 59 in 2005 (32 fish, 12 mollusks, 9 crustaceans, 3 amphibians/reptiles, 3 miscellaneous invertebrates) valued at over US\$39.8 billion (FAO 2007a).

Of particular note is the rapid growth of higher-value fed aquaculture species in China, including (in order of production in 2005 by weight and value), Nile tilapia (978 135 tonnes, valued at US\$0.99 billion), whiteleg shrimp (808 433 tonnes, US\$2.9 billion), Chinese river crab (438 383 tonnes, US\$2.21 billion), snakehead (277 511 tonnes, US\$0.22 billion), Japanese seabass (249 170 tonnes, US\$0.27 billion), other marine fishes (240 878 tonnes, US\$0.21), oriental river prawn (205 441 tonnes, US\$0.71 billion), softshell turtle (182 610 tonnes, US\$0.68 billion), Japanese eel (179 245 tonnes, US\$0.33 billion), mandarin fish (175 687 tonnes, US\$1.19 billion), swamp eel (162 499 tonnes, US\$0.30 billion), Indo-Pacific swamp crab (111 423 tonnes, US\$0.24 billion), giant river prawn (99 111 tonnes, US\$0.28 billion), red swamp crawfish (88 249 tonnes, US\$0.30 billion), swimming crabs 85 274 tonnes, US\$0.28 billion), frogs (82 437 tonnes, US\$0.31 billion), lefteye flounder nei 76 884 tonnes, US\$0.084 billion), giant tiger prawn (75 731 tonnes, US\$0.28 billion) and large yellow croaker (69 641 tonnes, US\$0.078 billion) (FAO 2007a).

Compared with the production of freshwater carps in China, which has been growing at a brisk rate of 9.1 percent per year since 1990 (increasing from 4 096 614 to 15 111 228 tonnes from 1990 to 2005), the growth in the production of higher-value fish, crustaceans and other animal species has been more than double this at 19.1 percent per year (increasing from 298 427 to 4 114 144 tonnes from 1990 to 2005, respectively) (FAO 2007a). Moreover, total fisheries exports from China over the same period have grown from 369 965 to 2 544,577 tonnes, with export value increasing from US\$1.3 billion in 1990 to over US\$7.7 billion in 2005, the bulk of fisheries exports coming from the aquaculture sector (FAO 2007a).

MEETING CHINA'S INCREASING NEED FOR FEED AND FOOD

Despite the obvious economic benefits gained from the rapid growth of aquaculture in China, as the sector has grown and production intensified it has also become increasingly more dependent upon the use of external feed inputs and in particular, upon the use of compound aquafeeds (10.36 million tonnes in 2005) (Fang 2006), the use of lower-value forage/trash fish as a direct feed for key higher-value carnivorous aquaculture species, and the importation of key protein meals, including fishmeal and soybeans (FAO 2006). Moreover, although aquaculture products are only second to pig in terms of Chinese meat production (total farmed meat production in 2005: pig meat 51.2 million tonnes, aquatic meat 18.5 million tonnes (calculated), poultry meat 14.7 million tonnes, buffalo and beef 7.1 million tonnes, sheep and goat meat 437 million tonnes) (FAO 2007b), the aquaculture sector still currently represents less than 10 percent of the total animal feed produced in China (Fang 2006); total industrial animal feed manufacture in China reported as 77.5 million tonnes in 2006 and second only to the United States at 151.7 million tonnes (Gill 2007).

Moreover, apart from being the world's largest aquaculture producer (43.3 million tonnes in 2005 or 68.7 percent world total), China is also the world's largest producer of rice (milled: 124.9 million tonnes in 2006, 29.7 percent world total), wheat (103 million tonnes in 2006, 17.4 percent world total), meat (85.6 million tonnes in 2006,

30.1 percent world total), oils and fats (7.9 million tonnes in 2006, 14.3 percent world total), and the world's second largest producer of corn (maize: 142 million tonnes in 2006, 17.4 percent world total) and total oilcrops (58.4 million tonnes in 2006, 14.6 percent world total). It's domestic appetite for key food and feed resources is such that it has now become the world's largest importer of corn (42.5 million tonnes in 2006), oilcrops (31.3 million tonnes in 2006, including 28.3 million tonnes of soybeans), palm oil (5.14 million tonnes in 2006) and fish meal (979 150 tonnes in 2006 (FAO 2007a, 2007b; GAIN 2007a, 2007b).

For example, according to industry estimates, the aquaculture feed sector was the largest consumer of fishmeal in China in 2006, using between 50 to 60 percent of total imports and domestic supplies, followed by pigs at 20 to 28 percent, and poultry/others at 5 to 20 percent (Jin 2006). Similarly, it is estimated that the aquaculture feed sector in China consumed over 5 million tonnes of soybean meal in 2005 (from virtually nothing in 1990) (USDA 2006a); poultry being the largest consumer of soybean meal at 60 percent, followed by pigs at 22 percent and aquaculture at 18 percent¹. Moreover, it has been estimated that the growth rate of total protein meal consumption in China (includes soybean meal, rapeseed meal, cottonseed meal, sunflower seed meal, peanut meal and fishmeal) over the last four years had averaged 10.8 percent, with soybean meal consumption capturing most of the consumption growth to meet the growing needs of the livestock, poultry and aquaculture sectors (USDA 2006b). Finally, it is estimated that between 55 and 65 percent of industrial compound feeds in China are composed of corn; 72 percent of the corn in China currently being used as feed; 20 percent for industrial production of sugar, starch and biofuel; and less than 1 percent for food (GAIN 2007a).

NEED FOR INCREASED SELF SUFFICIENCY CONCERNING RESOURCE USE

In a country home to 18 percent of the world's poor in which about 150 million people still live on less than a US\$1 a day (World Bank 2007), there is an urgent need for China to become more self sufficient concerning resource use and in particular, to move away from the utilization of precious potentially food-grade agricultural and fishery resources as feed inputs. Particular effort should be given toward the recycling of byproducts and wastes arising from the agriculture and seafood processing sector as feed inputs for the rapidly emerging aquaculture sector, including the increased use of rendered animal byproducts, agricultural plant by-products, single cell proteins, marine seaweeds and cultured invertebrates.

By far the largest source of high-quality animal protein available to feed compounders is the byproducts arising from the processing of animal livestock and poultry. For example, the United States generated 9.6 million tonnes of rendered animal products in 2006, including 2 173,200 tonnes of meat and bone meal and tankage, 1 283 000 tonnes of poultry byproduct meal, 720 700 tonnes of porcine meal, 396 700 tonnes of feather meal, 717 700 tonnes of all other inedible products (includes blood meal and raw products for pet foods), 2 930 200 tonnes of inedible tallow and greases, 708 800 tonnes of edible tallow, 137 900 tonnes of lard and 518 300 tonnes of poultry fat (Swisher 2007). However, a recent wild card added to the food vs. feed debate is biofuels, and the possible negative effect that biofuel tax incentives and subsidies will have on the price and future availability and affordability of key food staples currently being targeted for biofuel production by some countries, including corn and animal fats and oils (Caparella 2007).

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An investor's view on investments and financing in aquaculture

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ABSTRACT

When an investor looks at fish farming, he has to make sure that the possible returns are high and outweigh the risks fish farming has. The investor will then look for possible species to farm, evaluating price, availability of juveniles, farming technology and markets. As production increases, will the price go down? Site selection is important, and the investor will look at factors like environmental conditions, infrastructure, legal conditions, the application process, taxes, stability and labour costs (which are not important). It is important for investors in cage farming that fallowing and site rotation is possible, as this makes the investment sustainable. The application process for sites should be simple and fast. Rights for sites should be transferable and for long periods, 15 years or more with rights of renewal. Fish farming is difficult to finance, but fish stock insurance and transferable sites make it easier to do. The Norwegian salmon farming industry was funded by 50 percent government guarantees for working capital loans, and this was the basis for fast growth of the industry in the 1970s and 1980s. For new species, investors may have to finance 100 percent of the capital requirements with equity.

INTRODUCTION

This is not a scientific paper, this is a presentation based on my personal experience and view from having worked 36 years in the fish farming industry and having seen Atlantic salmon farming grow from zero to 1.5 million tonnes annual production.

WHY INVEST IN AQUACULTURE?

Why should an investor be interested in aquaculture? The interest is triggered by the gap we all see and hear about between supply and demand for seafood, and this leads to the belief that seafood prices will go up.

WHAT DO INVESTORS DO?

First of all, we will look at how we select the species we want to farm. We will gather information on all topics (see Box 1). After gathering all the information about which species to farm, the question then is: Where do I farm this fish?

Selection of country and site may be the next step. The choice may be different if you are just looking to do something on your own property or in your own area, but many of us will do a proper survey to select the best place world-wide for farming the species we have selected. Box 2 gives the most important factors that should be considered when the country and a specific site to do the fish farming are evaluated.

BOX 1

Important criteria in selection of species to farm

- Availability of juveniles
 - wild
 - farmed
- Hatchery technology
 - broodfish
 - eggs
 - intensive production
 - extensive production
 - juvenile price
 - availability (year round or seasonal)?
 - delivery security
- Feed
 - knowledge about feed
 - wet feed
 - dry feed
 - feed availability
 - feed cost
- Farming technology
 - extensive
 - intensive (recirculation, land-based or in cages?)
- Markets
 - local
 - export
 - product form (live, fresh or frozen)
 - yield
- Price: The most important factor in the selection process.

BOX 2

Factors evaluated for country and site selection

- Environmental conditions
 - temperature and salinity
 - water quality
 - environmental data like:
 - winds, tropical storms
 - waves
 - currents
 - algal blooms
 - contaminants
 - depth
- General infrastructure (shore base)
 - roads
 - electricity
 - harbours
- Fish farming infrastructure
 - feed suppliers
 - trash fish
 - service supplier
 - fish health services
 - equipment supplier
 - R&D support from universities or research institutes

LEGAL, ENVIRONMENTAL AND LABOUR ISSUES

In the site selection process, legal conditions may turn out to be the most important issues. Some countries where aquaculture has flourished and some of the reasons why are given in Box 3.

I want to quote from a presentation I gave at the European Aquaculture Society's meeting in Trondheim in 2005:

"To develop aquaculture you need a willing and determined government. A government that believes the future is in the sea".

Too many people oppose aquaculture based on poor science and superstition. Without strong government support and an aquaculture law, which promotes investments, aquaculture will never develop. So, legal conditions are important. They are very important.

First, you want to know corporate ownership conditions. These and other important legal issues are listed in Box 4.

If an Environmental Impact Assessment is required, make sure the specific questions and surveys required are well defined and definite. Another area we have learned that is of importance is "compliance". When a permit is issued, what conditions would generally be in the permit and how realistic will they be? This is extremely important to an investor. We want security for our investment. If the conditions are very strict and maybe not even well specified, then you know your investment could be in trouble later. You know that if an authority wants to close down your operation, they can use non-compliance of environmental conditions to do it. So specific and realistic conditions are important.

BOX 3

Some places where fish farming has developed

- Greece
 - many islands, sheltered sites for cage farming, people used to boats and the sea.
 - aquaculture law
 - a very supportive government
 - world leader in seabass and seabream culture
- Chile
 - many islands in the south, long coastline, important fisheries; excellent sites for cage culture
 - aquaculture law
 - a very supportive government.
- Norway
 - many islands, sheltered sites for cage farming, people used to boats and the sea
 - the first aquaculture law in 1973
 - very supportive government

BOX 4

Some important legal questions

- Ownership
 - does the foreign investor have to have a local partner?
 - can foreign shareholder(s) own 100% of a company?
- Legal conditions, right to seawater sites for cage farming
 - size of sites (in tonnes of production or seabed area)
 - length of time: 15–20 yr minimum
 - renewal rights
 - annual payments
 - number of sites
 - fallowing
 - site rotation
 - transferability
- The application process
 - how "complicated" is the process?
 - are all stakeholders involved?
 - transparency of the process?
 - is an environmental impact assessment (EIA) required?

We realize we need environmental monitoring and that we have to meet environmentally accepted conditions to develop a sustainable activity, but these conditions have to be specific and realistic. We all know cage farming will have "footprints" on the seabed and a very low increase in nutrients in the water around the cages. This is unavoidable when feeding fish. But we have learned that "footprints" disappear quickly if fallowing and site rotation are possible to do. This is why these simple techniques are vital for sustainable fish farming. For example, fallowing and rotation should be legally mandatory for cage culture.

Remember that corporate taxes are not important. We have to pay taxes in nearly every country and the tax holidays given when you start a new business are not important. In the first years of fish farming the project will not make a profit anyway. A tax holiday from year 5 to year 10 would be a lot more attractive. Stability with regards to permits and regulations is important.

Labour costs and availability of people is an interesting area. Labour costs are not important; however, labour quality is very important. Labour needs to be trained in aquaculture, committed and have a high work ethic

All the above environmental, legal and labour issues are important to consider, to make sure you invest in a project that is sustainable from:

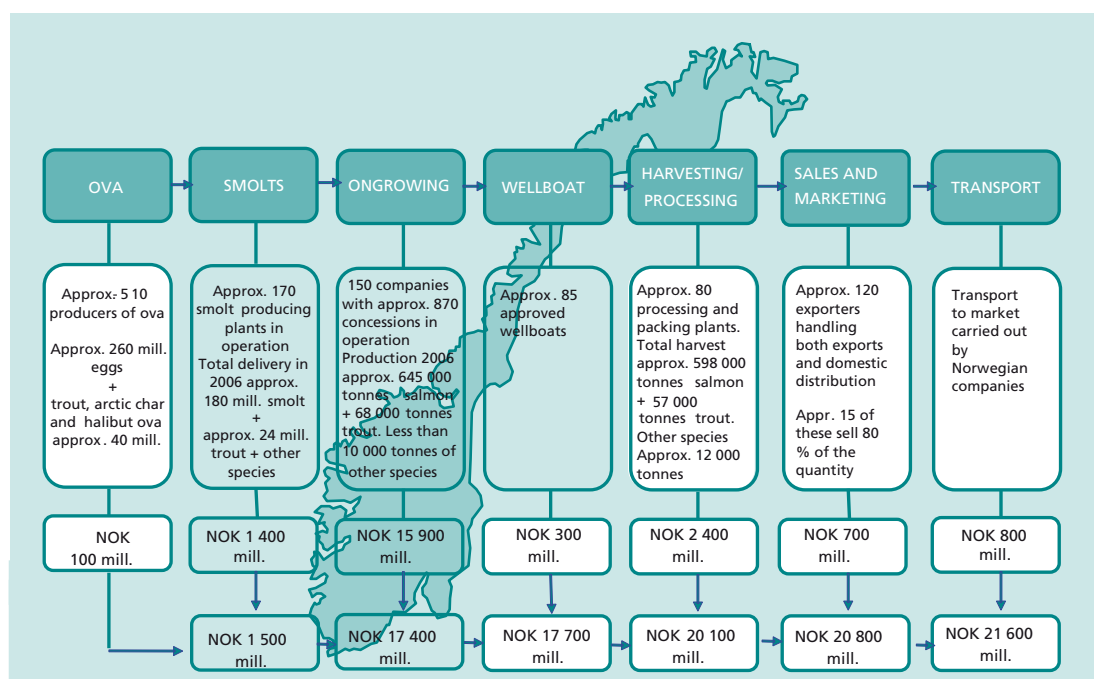
- an environmental point of view,
- a financial point of view, and
- a legal point of view.

They are all important and mandatory conditions.

OTHER INVESTMENT OPTIONS

Do I really have to invest in the actual farming process? If we look at the value chain of Norwegian salmon farming, there are many other options. You can invest in services related to the industry if you think that is less risky. Figure 1 shows the Norwegian salmon industry's value chain.

FIGURE 1
Value of the Norwegian aquaculture 2006E
Farmed salmon, trout and other species



BOX 5

Some examples of business models

- vertical integration
- outsourcing part of the value chain:
 - you supply juveniles
 - you supply feed
 - you buy back final product
 - individual farmers processing & sales
 - farmer responsible for husbandry & labour
- only have hatchery
- only do processing and sales

There are also other business models. You may want to have a vertical integrated business doing everything from broodfish to processing, or you may “outsource” part of the value chain. Some examples of the many business models are given in Box 5.

BUSINESS PLANS

When the species and site selection process is completed, you should prepare a 5 or 10 year business plan for your investment project. This is a very good exercise as it will give you the profitability and feasibility of the project and you have to think through the project from start to end. The outline of a business plan of a fish farming project could be as indicated in Box 6.

FINANCING YOUR PROJECT

With a good business plan in your hands, you are ready to start work on financing your project. Financing of fish farming is not easy. Fish farming is considered by many to be high-risk projects, and many failures in the past make investors sceptical.

You have two basic items you have to finance: equipment and biomass (working security). Equipment can be financed by loans, credit from supplier, export financing, leasing or grants. Maybe 50 percent could be financed by loans, the rest by equity from the investor. Leasing of larger pieces of equipment is possible in some countries.

Financing of working capital to pay for feed, juvenile stock and labour is often impossible via loans. In many cases, these costs have to be 100 percent financed by

equity. But it is not impossible to get bank loans; banks look for collateral. In Norway, fish in the cages can be used as collateral. The basis will be juvenile cost plus 40–50 percent of the expected cost of raising the fish to market size. In Norway, the formula is: part of smolt cost plus part of rearing cost (Nkr 4 plus Nkr 10 per kg) plus some additions. The farmer pledges the fish to the bank and reports monthly about the development of the biomass. Legislation making it possible to pledge fish as collateral is therefore important.

One of the conditions from the bank is that the fish are covered by insurance. Another important factor for a lender is the “value” of the permit. Transferability of the permit is therefore vital to be able to receive loans for working capital to fish farming. The lender then knows that it can continue the operation and sell it if the borrower fails.

Feed suppliers are sometimes willing to provide credit terms, will partly finance the working capital requirement. Venture capital is a source of funds that could be attracted to invest in fish farming. But good projects and well-prepared and realistic business plans are what the venture funds are looking for.

In Norway the salmon farming industry's working capital in the 1970s and 1980s was funded by government guarantees. To attract growth in rural areas, the Norwegian Government guaranteed 50 percent of the most exposed part of the required working capital. The capital was provided by a commercial bank on commercial terms, but with a guarantee from the government.

A future market for salmon has made it easier to predict prices and secure the income. The risk has been reduced and financing should be easier.

In Greece and Norway, there are fish farming companies listed on the stock market, and these companies can use the stock market to raise equity and loans in the form of bonds. But in general, fish farming is considered to have a high risk factor and is difficult to finance. In spite of this, I believe fish farming has a bright future and as the industry grows and matures, financing will become easier.

BOX 6

Outline of a business plan for fish farming

- Summary
- Introduction
- Species
- Sites
- Legal conditions
- Technology, products and production
- Market analysis and sales
- Organization
- Investments
- Financial projections
- Financing
- Risks
- Appendices