PAPERS PRESENTED AT THE SYMPOSIUM

Fish in the global food chain: challenges and opportunities

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ABSTRACT

Fish plays an important role in the world's food system. In the rich world it is increasingly seen as a healthy luxury food, but in many developing countries it still constitutes an important part of the staple diet. For the developing world, fish exports have become an ever more important source of foreign exchange. This is causing strains regarding trade policies and has exacerbated the need for fisheries management capable of keeping catches within sustainable limits. Capture fisheries are now levelling off globally. In 2005 they produced 93.5 million tonne, while aquaculture production was at a record 47.5 million tonne, or 34% of total fish production. If calculated on the basis of fish for human consumption only, aquaculture production constitutes 44.6% of the total, but 22.3% if China is not included. Global consumption of fish per capita in 2005 was at a peak of 16.6 kg per capita. An FAO study projects that capture fisheries could produce some 12 million tonne more by 2015, compared with 2005 levels, and that aquaculture production could reach 66.8 million tonne by then.

Fish constitutes truly part of the modern food industry. The variety and quality of fishery products is on par with any other food production sector. Fish is classified in the world trading system with industrial products, and thus carries very low tariffs compared with agricultural goods. Some 38% (by volume) of all fishery production enters international trade, with over half of that originating in developing countries. Fish exports reached a record level in 2004 of US$71.5 billion, a growth of 51% over the preceding decade.

So the market for fish is strong, but the growth potential is limited, not the least for products from the capture sector. Capture fisheries are putting pressure on fish stocks worldwide. Currently, FAO estimates that 25% of the 600 fish stocks on which it has information are overfished, depleted or recovering from depletion, whereas 52% of the stocks are fully fished. While overfishing and its consequences are highlighted in the world's news media, the fundamental flaws of the fisheries management policies that have led to that state of affairs have received less attention. Instead, solutions are suggested as being capable of curbing overfishing in their own right, such as establishing Marine Protected Areas, a ban of trawling gear, ecolabelling and an ecosystem approach to fisheries management. As much as these approaches have their just place in managing fisheries, they do not deal with the fundamental flaw affecting most capture fisheries, namely the open, or semi-open, access to the resources, combined with a lack of fishing rights. FAO acknowledges that it is not enough to simply limit access and restrict fishing operations: one has to establish legally defendable fishing rights. That will foster conservation and a sense of stewardship of the resource among the sector's participants and communities. However, the nature of the rights must be tailored to suit the national and regional cultures and value systems.

Thus, the biggest challenge for fisheries is to make fisheries and aquaculture management work in a way that puts to rest the serious concerns of fish consumers and society at large regarding overfishing and the environment.

The opportunities for the sector lie in further product diversification and value addition, as well as better scientific awareness of the benefits and risks of fish consumption.

INTRODUCTION

Capture fisheries and aquaculture supplied the world with about 106 million tonne of food fish in 2004, providing an apparent per capita supply of 16.6 kg (live weight equivalent – LWE). Of this total, aquaculture accounted for 43%. However, because of the overwhelming importance of China in aquaculture production, this figure drops to 22% for the world without China. Figure 1 shows development of fish production.

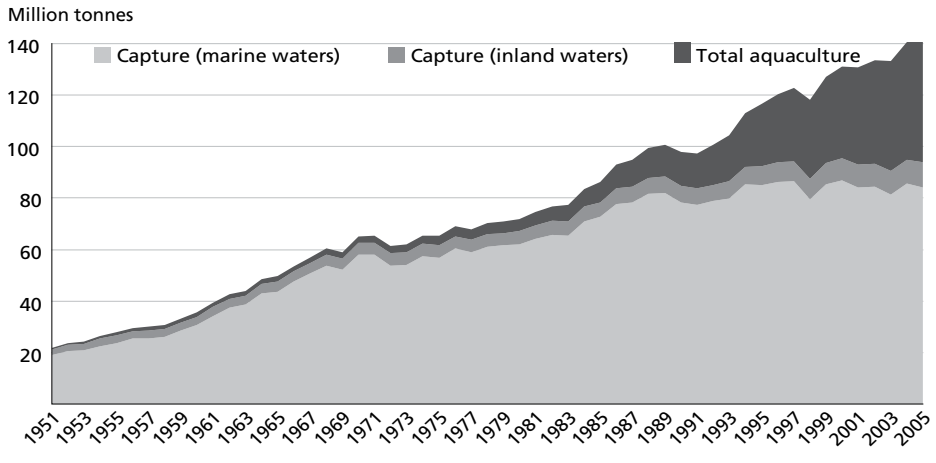
In 2004, per capita food fish supply was estimated at 13.5 kg, if data for China are excluded. Overall, fish provided more than 2.6 billion people with at least 20% of their average per capita animal protein intake. The share of fish protein in total world animal protein supplies grew from 14.9% in 1992 to a peak of 16.0% in 1996, declining to about 15.5% in 2003. Notwithstanding the relatively low fish consumption by weight in low-income food-deficit countries (LIFDCs) the contribution of fish to total animal protein intake was significant—at about 20%—and is probably higher than indicated by official statistics in view of the unrecorded contribution of subsistence fisheries (FAO, 2007). Figure 2 shows how fish supply per capita has been constantly increasing.

It is expected that fish consumption will go up in both developed and developing countries alike (FAO, 2005a). Not only has the availability of fish and fishery products been increasing, but FAO estimates that total food production in the world measured on a per capita basis has also been steadily increasing over the last 30 years, averaging an annual growth rate of 1.2% over the last decade. This growth has been much higher in developing countries than developed countries. Despite this good news, the world is faced with the sad fact that in 2000 to 2002 it was estimated that 852 million people were undernourished. Food security is a complex phenomenon that relates more to economic development and poverty than to increasing production per se (FAO, 2005b).

From 1982 to 2002, the increase in fish consumption has been much in line with that of pig meat, but albeit lower in consumption; chicken meat consumption has been growing faster; whereas consumption of bovine meat has been decreasing (FAO, 2005c). Figure 3 shows the developments in fish and meat consumption.

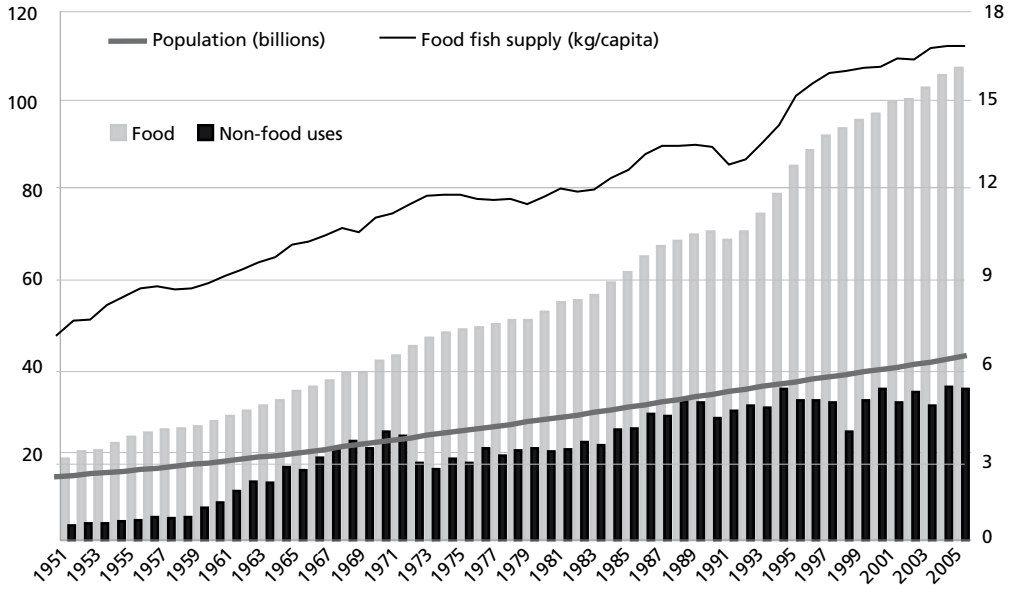
There is a renewed international commitment to fight hunger, not the least by FAO and its programme termed "The Right to Food", and FAO Council has produced

FIGURE 1
Development of fisheries production in the last half-century



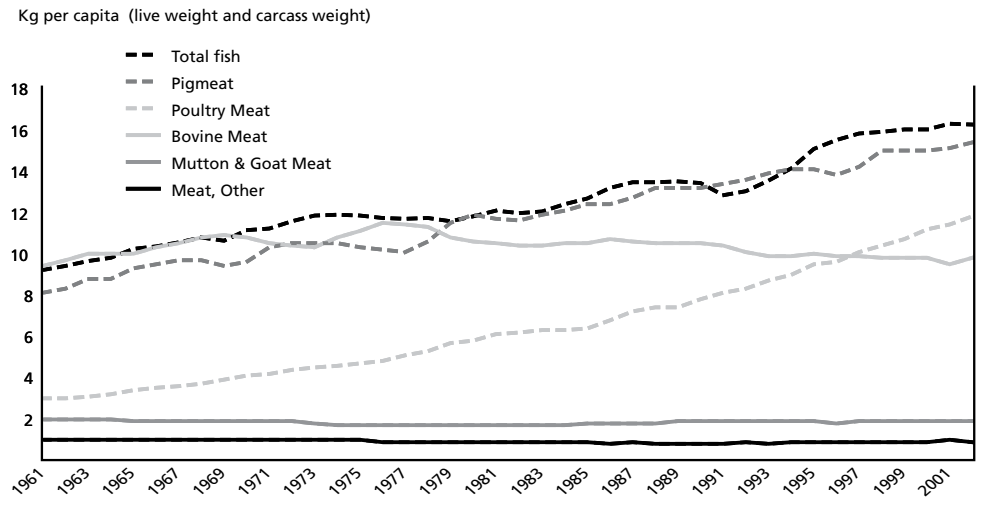
FAO FishStat, January 2008

FIGURE 2
Changes in fish supply and utilization over the last half-century



FAO FishStat, January 2008

FIGURE 3
Comparative development of fish versus meat production, 1961-2002



FAO STAT and FishStat, 2005

specific "Right to Food Guidelines". This work is based on the 1948 Universal Declaration of Human Rights. Its Article 25 states:

> *"Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control".*

Two international targets for hunger reduction have been established. The World Food Summit in 1996 set a target of halving the absolute number by 2015, but the Millennium Summit in 2000 set a somewhat less ambitious target of halving the percentage of hungry by 2015. Regrettably, it seems obvious that neither of these targets are likely to be reached.

The explosive growth in fisheries and aquaculture over past decades has been accompanied by a boom in international fish trade. In 2004, total world trade in fish and fishery products reached a record value of US$71.5 billion (export value), representing 23% growth relative to 2000 and 51% increase since 1994. Preliminary estimates for 2005 indicate a further increase in the value of fishery exports. In real terms (adjusted for inflation), exports of fish and fishery products increased by 17.3% during the period 2000–04, 18.2% during 1994–2004 and 143.9% between 1984 and 2004. Fish is traded widely, so today it can be said that fish from all corners of the world can be found on the international market. In 2004, about 38% of all fish produced (LWE) was exported as various food and feed products. Developed countries exported some 23 million tonne of fish (LWE) in 2004. Although a part of this trade may be re-exports, this amount corresponds to about 75% of their production. Exports from developing countries (30 million tonne LWE) totalled around one-quarter of their combined production, but, remarkably, the share of developing countries in total fishery exports was 48% by value and 57% by quantity (FAO, 2007).

The globalization of fisheries and the wide participation by both developed and developing countries in world fish trade is testing the current and emerging regulatory framework regarding safety and quality regimes, but today's environmental concerns are increasingly coming into play in a marketplace that is ever more competitive.

STATE OF FISH STOCKS

FAO estimates that 52% of fish stocks are fully fished to Maximum Sustainable Yield (MSY), whereas 25% of the stocks are overfished, and only 23% of the stocks could produce more (FAO, 2007). It has taken a while for the sector to come to grips with the fact that there are practically no more virgin fisheries to be developed. The widely used interpretation of MSY is now increasingly contested by fishery biologists, because it is currently widely interpreted as a goal to be reached rather that the absolute maximum, and thus outside safe limits. Therefore, the "fully utilized" fisheries are exceeding precautionary and sensible limits. Yet, this situation has been relatively stable over the past 10–15 years.

Moreover, there is general agreement that aquatic ecosystems are in decline in most parts of the world. The cause is well publicized in the news media: widespread overfishing, coastal degradation, and pollution. This is all well documented and has been a media favourite for years. The focus of the media has been very much on the outcome of failed fisheries management rather than on their causes.

The long list of problems negatively affecting fisheries include:

- overfishing, and illegal, unreported and unregulated fishing (IUU), on a significant scale;
- overcapacity and overcapitalization—which means too many vessels chasing too few fish, increasing the risk of collapse;
- by-catch and discards, and the negative impacts of these on biodiversity; and
- degradation of aquatic habitats and ecosystems: primarily coastal, adding fishing to other land-based stresses, but degradation is also apparent in high seas areas.

The increase in the number of coastal fishers and fishing vessels over the last decades is one of the major contributors to overexploitation of fisheries resources.

There is widespread agreement that capture fisheries plays an important part in these problems and fisheries as a sector is on the defence. Indirect environmental effects of fishing—such as entanglement of marine mammals in lost fishing gear—can

be another problem often highlighted in the media. Unregulated aquaculture can also degrade the coastal system.

There is an agreement among politicians, industry, NGOs and the public that sustainable and responsible fisheries must be achieved because, despite the limits on capture fisheries production, these fisheries continue to be very important for many countries, in terms of both income and nutrition. Therefore, the issue of how to restrain capture fisheries and prevent further overfishing is gaining wider attention.

WHY IS MANAGING FISHERIES SO DIFFICULT?

The main message coming from analyses around the world is this: the methods by which the world has chosen to govern fisheries are largely ineffective in restraining an ever increasing fishing effort. But perhaps more seriously, as many authors have pointed out, is that today's management objectives are often unclear or even contradictory (Cochrane, 2000; Cochrane and Doulman, 2005). In addition, when cultural values or socio-economic objectives of fisheries are also taken into account, management does indeed become complicated. This, of course, makes management of fisheries more difficult than for most other production systems, which simply concentrate on producing goods that the market wants at competitive prices.

When the need for limiting the amount of fish caught first became generally acknowledged, fisheries agencies focused on the need to ensure that enough fish remained in the water to keep reproducing. However, this biological mandate expanded as new instruments were developed. The Rio Declaration, Agenda 21 of the Summit on Sustainable Development, the Convention on Biological Diversity (CBD), and the Code of Conduct for Responsible Fisheries are all instruments that recognize the nutritional, economic, social, environmental and cultural importance of fisheries and the interests of all those concerned with the fishery sector—in addition to the need for biological considerations. In summary, contemporary thinking focuses not only on the biological sustainability of the fishery sector, but also on its contribution to the economy and society as a whole.

This author believes that the various futile attempts to manage fisheries have somewhat echoed the seductive inexhaustibility idea, i.e. some restrictions to fishing may be necessary but that it is not necessary to be too pedantic about it as "long gives the ocean". Exact landing figures are really not necessary—keep the accountants away. Ironically, the main lesson that we have learnt—or should have learnt—about fisheries over the last decades is that sooner or later the open or semi-open access fisheries will suffer from overfishing.

Whereas we have extensive literature and persistent media attention highlighting the symptoms of poor fisheries management policies, and texts describing where we want fisheries to be, there has been much less attention given to the fundamental flaws in current management policies and to what is at the heart of getting to sustainable fisheries. The fisheries management failures, largely the institutional ones, were neatly summarized by (Garcia, 2005) as:

- the free and open nature of fisheries (lack of enforceable rights);
- perspectives of short-term political or financial gain or losses;
- poor decision-making processes (in Regional Fisheries Management Organizations [RFMOs]);
- the poor participatory nature of most systems (top-down systems);
- lack of transparency and accountability;
- weak enforcement (both at national and regional levels); and
- scientific uncertainty (affecting the precision of the advice) and errors (affecting the accuracy of interpretations).

SMALL-SCALE FISHERIES VERSUS LARGE-SCALE FISHERIES

By far the highest number of fishermen operate small, non-motorized vessels. Various names are given to these fisheries, such as artisanal, small-scale or subsistence fisheries. The numbers of these fishers has been constantly rising over the last decades and were estimated to be over 41 million in 2004, including some 11 million fish farmers, but often the same individuals are engaged in both (FAO, 2007). In contrast, fishers in industrialized countries were estimated to be about 1 million. The contribution of the small-scale fleet to fish for human consumption may be as high as 50%.

The distinction between the small-scale fisheries and the large-scale (or industrialized) fisheries is not clear cut. Traditionally, the small-scale sector has been seen to be very important for local food security or subsistence, and the industrial fishing fleet for exports and thus generating financial revenues. This distinction is becoming more blurred with time as it now acknowledged that pure subsistence fisheries are indeed very rare, and that almost all fisheries involve some kind of economic activity in terms of trade or barter.

Due to technological advances, smaller vessels are getting much more effective at locating and catching fish and they are increasingly engaged in fisheries that aim for marketing the products on the international market. Due to increased pressures on inshore areas there is now mounting pressure to "professionalize" the small-scale fisheries sector so as to make fishing effort commensurate with the productive capacity of the resources. This is particularly important in the light of the economic and nutritional dependency on these fisheries by millions of coastal people. The importance of involving the stakeholders in the fisheries decision-making process is becoming increasingly recognized, as well as devolving fisheries management to the communities themselves, and establishing defined fishing rights plays a significant role in various types of co-management arrangements.

ECOSYSTEM APPROACH

The obvious failures of the methods currently employed to govern capture fisheries have spawned a swathe of suggestions as to how that situation can be improved. An obvious one is that the classical single-species focus is inadequate, as each fish stock is only one piece in the whole eco-puzzle. Taking one species out of the system has various consequences for all the other components. Thus, the ecosystem approach to fisheries management aims at looking at the bigger picture—a more holistic approach.

Collectively, the FAO Code of Conduct for Responsible Fisheries, the 2001 Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem and the 2002 Plan of Implementation of the World Summit on Sustainable Development establish an ecosystem approach to fisheries (EAF).

The interactions between fisheries and the ecosystem can include direct impacts of the fishery on target species, on by-catch species (whether retained or discarded) and on critical or important habitats. Indirect impacts of fishing are typically transmitted through the food web: for example, heavy fishing of a prey species is likely to lead to a decline in abundance and productivity of its predators, which may be target species for other fisheries, or constitute food for higher marine life.

In all cases, a pragmatic approach to EAF needs to make use of the best available information with reasonable application of the precautionary approach in a participatory manner. Good progress is being made in this way in Australia (e.g. Fletcher *et al*., 2005), the Alaska region of the United States of America (Fluharty, 2005) and by Angola, Namibia and South Africa, the countries of the Benguela Current large marine ecosystem (Cochrane *et al*., 2007).

Nevertheless, high levels of scientific uncertainty are a significant obstacle in many cases to implementation of EAF. The Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem reinforced the point that ecosystems, as such, cannot be controlled. They are simply too complicated. "As the models become more detailed

and complex, they are able to address more issues that are of concern to managers, but at the same time it becomes ever more difficult to interpret results" (Stefansson, 2003).

Thus ecosystems as such cannot be managed, but only the human activities exploiting them (FAO, 2003a). And for the human activities to be amenable to management, the incentive structures have to be right. Fishing rights and responsibilities must go hand in hand (Garcia and Boncoeur, 2004) because without rights there is little reason for fishers to engage in responsible fishing (France and Exel, 2000). Defined and secure fishing rights are the core of what is good fisheries governance (Sinclair *et al.*, 2002). Finally, the main conclusions of an FAO study on non-sustainability and overexploitation in fisheries (FAO, 2003c) were:

- Poor governance is a major cause of the inability to attain sustainable fisheries. Failure to have good governance is in itself sufficient for fisheries management to fail.
- There is a need to grant secure rights to resource users (individually or collectively) for the use of a portion of the resource, space, or other relevant aspect of the fishery.
- Inappropriate incentives and lack of good governance are often predominant issues preventing sustainability, and both link to the absence of secure rights.

Whatever way the "Ecosystem Approach to Fisheries Management" might develop, it is clear that it will require far more information to be collected about the fishing operations than hitherto, and that such information will have to be presented to the authorities, and even to society at large, in a manner that is transparent and verifiable. To prove compliance with ecosystem-related standards, fishing operations would have to address and report such things as amount of by-catch and incidental catch of seabirds, turtles and dolphins, to name only a few. Ultimately, as with other Quality Management Systems (QMSs), the fish producers will have to be able to prove that they have complied through auditing and verification by independent inspection bodies.

The industry will request that the objectives of eco-certification be set clearly, specifying what information will need to be collected and how that information will be used. That underlines the all-important issue of incentives for such an undertaking, and the cost implications (Valdimarsson and Metzner, 2005).

Since the launch of the Marine Stewardship Council in 1996, retailers have increasingly committed their companies to sell only fish that comes from sustainable fishery resources. They see this as a response to apparent consumer demands. Many leading food retailers in the developed world have now decided to sell only fishery products that are sustainably harvested, and that carry a statement to that effect. This is already putting significant pressure on both governments and the industry to set in place processes to respond to these demands. FAO has made guidelines that lay out the basic requirements for such Ecolabelling schemes (FAO, 2005d).

UTILIZATION OF FISH

In 2004, about 75% (105.6 million tonne) of estimated world fish production was used for direct human consumption, and the remaining 25% (34.8 million tonne) was processed into feeds, mostly fishmeal and oil (FAO, 2007), besides 7.3 million tonne discarded (see below).

Some 61% (86 million tonne) of the world's fish production (2004 figures) underwent some form of processing, and 59% (51 million tonne) of this processed fish was used for manufacturing products for direct human consumption in frozen, cured and canned form. The rest went for non-food uses. Unlike many other food products, processing fish does not necessarily increase the price of the final product, and fresh fish is often the most highly priced product form. Freezing is the main method of processing fish for food use, accounting for 53% of total processed fish for human consumption in 2004, followed by canning (24%) and curing (23%). In developed countries, the

proportion of fish that is frozen has been constantly increasing, and in 2004 accounted for 40% of total production. In comparison, the share of frozen products was 13% of total production in developing countries.

Utilization of fish production shows marked continental, regional and national differences. The proportion of cured fish is higher in Africa (17% in 2004) and Asia (11%) compared with other continents. In Europe and North America, more than two-thirds of fish used for human consumption was in frozen and canned forms.

Fish for non-food purposes comes mostly from natural stocks of small pelagics, and some 90% of such catches were processed into fishmeal, with the remaining 10% being utilized directly for aquafeed or as feed for fur animals.

By-catch, i.e. non- targeted species and discards, is seen as an important issue in fisheries. In 1994, FAO estimated that the global discard could be as high as 27 million tonne annually. A more recent study by FAO re-estimated this figure by analysing data over a 10-year period (1992 to 2002) and came up with a very much lower figure of 7.3 million tonne (FAO, 2005e). Most of the discards (over 50%) are associated with trawl fisheries for tropical shrimp and demersal finfish.

Lower discard figures are probably a reflection of the fact that more of the by-catch is retained for use, particularly as feed for the booming aquaculture fish industry. From a utilization perspective, good use can be made of everything that comes out of the water, which puts the "by-catch" issue into a new perspective. This development, of course, underlines the need for effective fisheries management systems that properly address the need to protect spawning fish and their offspring.

CONCLUSION

The wild capture fisheries potential worldwide is largely at its limit: it has reached a plateau. Increases in wild capture fisheries would have to come through restoring overfished populations by vastly improved management practices. All projections point to increased demand for fishery products in the future, and it is evident that aquaculture will play a crucial role in satisfying that demand. The large amount of fish entering international fish trade will continue keep fish prices relatively high, and this may compromise access of the poor to adequate fish protein.

Over recent decades, the fish processing sector of the industry has gone through a significant change in philosophy concerning how to respond to ever more demanding product safety and quality regimes. In large, the successful approach has been to move away from centralized government controls towards making the industry responsible for implementing "self control" systems that are verified and audited by governments. Such systems require clearly specified objectives and ample record keeping for industry to be able to prove due diligence. A similar approach could well apply in complying with the new environmental demands, particularly at the hands of the large retailers that are increasingly committing their companies to sustainably sourced seafood.

To balance the utilization and conservation points of view, more effective and more sophisticated managements systems are being developed. Experience shows that for such systems to evolve, secure, legally binding fishing rights are necessary. Secure fishing rights foster responsible fisheries, leading to long-term stewardship of the fishery resources and their ecosystem.

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Trends in the international trade of seafood products[1]

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The objective of this report is to present key factors and trends in international seafood trade and to make some suggestions as to where the sector is today and where it is going. Compared to other animal proteins, the seafood sector is the most complex and diverse. It is based on more species and it comprises a vast array of different technologies, which tends to complicate the analysis of emerging trends. It is clearly the most international of the food subsectors. For example, in the United States of America (USA) we import more seafood than we do all beer and wine combined. We import more seafood than we do coffee. It is also the most fragmented food subsector: you have people harvesting from canoes, and at the same time, you also have large, multi-national companies investing resources in the trade. It is an industry that basically argues with itself all the time: fishermen fight with aquaculturists; offshore fishermen fight with near-shore fishermen; those that support transferable quotas fight with those that do not. The list goes on and on. It is incredibly volatile because of its nature and because of its fragmentation. The sector is very bureaucratic, being trapped in a messy regulatory environment in most cases. It is clearly our most wasteful food sector, and it is misunderstood by both consumers and chefs. The marketing of seafood tends to lack transparency. Given all these factors, I argue that the countries and companies that can address these problems—in other words, become less fragmented, reduce volatility and become less wasteful—will be the leaders in international seafood trade. And I also argue that those countries and sectors that adopt primarily rights-based management and technologies that use aquaculture will be the subsectors that will lead. Aquaculture currently accounts for about 40% of world fish production [1]. However, if we remove the non-food fish, such as fish for animal feeds, corals, pearls, etc., aquaculture accounts for nearly 50% of the seafood consumed [2], and it represents an even larger share of international trade.

If we take a look at the world harvest of certain fish groups, such as flatfish, we observe that the global harvest is either stable or declining. The world harvest has been declining, but actual trade has been increasing somewhat, according to FAO data [3]. Actual trade figures may be higher, as one of the key world traders, China, has a strong tendency to report a large portion of their exports as "fish fillets not elsewhere indicated." Thus, we can observe a declining harvest but a gradually increasing trade. This trend is observed also with pollock and cod [4, 5]. Now, an examination of seafood consumption in the USA will illustrate two key points [6, 7, 8]. First, per capita consumption of aquaculture species has increased remarkably over the last two decades [6, 7]. Consumption of shrimp, the number one seafood, increased by 92% between 1987 and 2006. Consumption of salmon, third in the ranking, went up by nearly 360% over the same period. Consumption of catfish (sixth on the list) increased by more than

1 The numbers in the brackets refer to the slides presented at the end of this paper.
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60%, while tilapia, a species virtually unknown in 1987, is now making great strides in the top ten list. It becomes obvious that growth in seafood consumption is being fuelled by aquaculture, while consumption of certain wild-caught species, such as cod, is declining. Thus, USA seafood consumption is currently dominated by imported aquaculture products. Second, seafood consumption is becoming concentrated on fewer species, at least in the USA [7]. The top five species accounted for 72% of consumption in 2006; in comparison, they accounted for only 56% of consumption just two decades ago. The top ten species comprised 71% of consumption in 1987; they now represent 90%. At this point, some might wonder: Why are we seeing the industry getting less complicated and more concentrated, at least in the USA and probably in many developed countries?

The answer to this question lies in the fact that growing markets and growing trade will come to those who can consistently deliver a high-quality product at stable or declining costs. In the seafood sector, this is what aquaculture producers have been doing for the past few decades. It can also be argued that sector diversity in the future is going to come from the "sauce" (i.e. the value-added component of the fish) and from image issues, such as ecolabelling, rather than being created through the production of a large number of species. Thus, despite the fact that over 1 500 different species are harvested—and will continue to be harvested—around the planet; in proportional terms, more and more of the supply is going to be concentrated in fewer and fewer species. Likewise, more of the diversity is going to come from the marketers because, as you take control of and manage the fish, you can market it better and start selling additional attributes.

This report will briefly touch on four different species (salmon, catfish, shrimp and tilapia) to emphasize the points made above. In the first place, farmed salmon production already accounts for about 70% of world supply, while the wild sector has remained relatively stable [9]. Regarding USA imports of salmon, most of the growth in recent years has come in the form of boneless, skinless fillets produced primarily in nations with significant aquaculture industries [10]. A natural consequence of having an industry based on something that has control of production systems is that more value-added and more processing activities take place. In Norway, the farmed salmon industry is now even more important than the traditional cod fishery. What is remarkable in a country like the USA is that we used to be the world leaders in salmon production. The USA had a US$650-million trade surplus in 1992. By 2007, this surplus had evolved into a billion-dollar deficit, which continues to increase year after year. In conclusion, the industry is currently dominated by portion-control, value-added products. It must be mentioned that the negative media campaign associated with salmon aquaculture has had some impact on demand, while there has been some positive media reaction towards wild salmon. An analysis of these recent developments is beyond the scope of this report. For the purposes of this discussion, the point that must be emphasized is that salmon aquaculture has moved forward and gained market share, while there is still room for wild salmon in the special-premium segment.

Catfish aquaculture production in the USA has also increased significantly over the last 30 years [11]. The case of catfish is interesting because it is a fish that many people did not think could be sold. Nevertheless, because of the control associated with processing, it is being sold based primarily on the diversity of the sauces, not the fish. Catfish is also interesting because it epitomizes another key trend in at least the USA: trade barriers, mostly in the form of anti-dumping cases. The industry moved forward in the 1990s and then a surge of imports from Viet Nam in 2000–2001 drove down prices, which stimulated anti-dumping litigation. Domestic producers in the USA are particularly prone to these efforts. Increasing production volumes in the 1990s turned farmed catfish into the top fish species by value harvested in the USA, ahead of salmon and pollock. The success of catfish farming made Mississippi the second largest state

in the Union in terms of fish production. An important feature of the industry is the trade aspect. The industry developed with almost no trade, meaning that the USA did not export much and it did not import much either, and then a developing country (Viet Nam) came along exporting basa and tra, which precipitated the anti-dumping case. Trade litigation has also been stimulated by escalating shrimp and salmon imports. An important question that comes to mind is: Are these anti-dumping cases effective? Vietnamese catfish imports dropped after the Catfish Farmers of America filed the anti-dumping suit in 2002 but rebounded again in 2005, 2006 and 2007 [12, 13, 14]. The increase in imports has paralleled a decline in domestic production [11]. Despite the fact that, in general, these anti-dumping cases are ineffective, the USA domestic industries seem eager to waste millions of dollars hiring trade-litigation lawyers. Another important development is that the Vietnamese catfish is not being sold as catfish; it is being sold as tra or basa and it is also sometimes being passed as grouper and many other kinds of fish. This illustrates another international-trade issue, the problem of labelling and fraud. To summarize, the USA catfish market, even though historically it has been supplied primarily by a domestic industry, illustrates two key trends: a trend towards trade barriers (anti-dumping) and a trend to misrepresent the product in order to get higher prices.

In the case of the shrimp industry, growth has come mostly from export-oriented developing countries (China, Thailand, Viet Nam, Indonesia). World shrimp farming is increasing at an annual rate of about 16% [15]. A very high percentage of this production enters international trade. We have seen rapid growth, but market development has not kept track or pace with supply. An interesting trend, observed also with other species, is that value-added processing is taking place outside the USA and outside many developed countries. In other words, as developing countries improve their production technologies, a consistently higher proportion of their processing is occurring within their borders. China and Thailand, in particular, are doing much more processing than the USA; this trend has been reinforced by the recent anti-dumping case against shrimp producers, as anti-dumping margins were applied on uncooked shrimp. In response, China is now processing their shrimp, and, as a result, our processing industry is going out of business. Imports of breaded shrimp into the USA exploded after 2004 on the heels of the shrimp anti-dumping case [16].

Tilapia also supports strong aquaculture industries in developing countries (Egypt, Philippines, Indonesia, China) [17]. As observed previously with salmon, USA imports of tilapia are experiencing a shift from whole to processed fish [18]. Tilapia is seen as a substitute for flounder, snapper and all kinds of white fish. In addition, many environmental groups actually favour tilapia. Based on my own forecasts, I expect USA tilapia imports to potentially pass salmon imports by 2012 or so [19].

Another key point in this discussion has to do with the structure of costs. In the traditional fisheries, the primary costs are labour, fuel and maintenance of the boats. In the aquaculture sector, the primary costs are feed and fingerlings [20]. This is an important difference, as aquaculture has immense opportunities to reduce costs through genetics research and feed substitutions. In contrast, fisheries have less room for improvement unless a move is made towards more efficient management, such as rights-based fishing. The case of Norwegian Atlantic salmon is rather impressive, as production costs have decreased over 60% in the last 20 years [21]. No fishery on the planet (not even in rights-based fishing) has been able to do that. This is really a question of better management, biotechnology and related factors. The most impressive achievements have been attained in salmon aquaculture, but there is still much room for improvement with regard to production of tilapia and other new species.

It is important to examine real price trends of aquaculture species, as they indicate what might be in store for prices of wild-caught products. The real price trend for many fish species is going down because of the declining trends observed for shrimp

and salmon. Competitive pressures in the last few years have led the prices of salmon, catfish and cod to converge [22].

China is becoming a remarkable country in terms of its export and import values. It is now the number one seafood exporter and the number six seafood importer in value terms [23]. In quantity terms, it is the number one seafood exporter and the number one seafood importer [24], which illustrates the emerging trend whereby large volumes of seafood are sent to China to be processed for subsequent re-export. In the case of the USA, China has become the major source of finfish, frozen seafood and breaded shrimp imports. China is also the major supplier of tilapia, processed flatfish fillets, cod fillets and pollock fillets [25]. The emergence of China as a major force in the USA import market has occurred in just the last five years. China illustrates the case of a developing country that has basically taken control by sourcing products all over the planet and then selling them back to other nations. In terms of USA exports of seafood, China is actually number two in quantity and number three in value. China has also become the major destination of USA salmon exports, as well as exports of groundfish and flatfish [26]. This has occurred because USA processing plants are closing down, with processing taking place now in China. This trend has just started and has been in place for about the last five to seven years.

Finally, the USA, Japan and the European Union (EU) are net importers, but most other countries are net exporters. All the countries in Asia, except Japan, are net exporters. Net exporters are primarily developing countries (but not always). Comparing the list of top exporters in 1976 vs. 2004, it is evident that the countries that have recorded the most gains in export value (China, Norway, Thailand, Canada, Chile and Viet Nam) have all embraced aquaculture [27]. These are all countries that have taken control of their processing, handling and distribution systems. In terms of imports, it is interesting to see to the extent that China has risen in the ranking [28]. The main reason for this is that China has become a re-processor, but it will become a major consumer in the next few years. This is a fact we cannot afford to ignore.

CONCLUSIONS

- Growth in the seafood industry will be fuelled by aquaculture imports.
- There will be increases in per-capita seafood consumption; however, consumption will be concentrated on fewer species, with diversity coming in the "sauce" and on labelling issues, such as ecolabelling.
- The growth of aquaculture parallels a shift in the market towards value-added products. Technology, innovations, better nutrition, and disease management will continue to reduce costs in aquaculture. Lower production costs will increase supply from aquaculture and hold prices down for all fish. The trend towards value-added creation will drive processing to countries where labour costs are low (China, Viet Nam).
- Despite criticism from environmental organisations, aquaculture will not go away. The potential constraints for aquaculture development, in particular the fish meal trap, will be circumvented by new technology and substitution.
- Aquaculture will dominate the commodity market, but there will be increasing opportunities for wild market products in the upper-end segments, especially the niche market.
- Retail outlets are becoming increasingly important. Supermarkets and club warehouses, at least in the USA, are major distribution channels. Chain restaurants have also become important outlets. All these channels care about quality and portion control, a important phenomenon that extends control all the way through the system. Supply, stability and product standardization will be foremost for these companies. We are starting to see more long-term contracts, which were very uncommon in the fish industry just a decade ago.

- Anti-globalization trade barriers are likely to increase. This is unfortunate because economic growth will be undermined, not just in developing countries but also in developed countries.
- There will also be an increased use of labelling and certification programmes (Marine Stewardship Council, organic production, etc.). All these are important strategies for diversifying a product and making it seem different from others. Credibility issues might emerge as competing certification programmes will tend to conflict with each other.
- China will become an increasingly important force, both as a food processor and a significant consumer.

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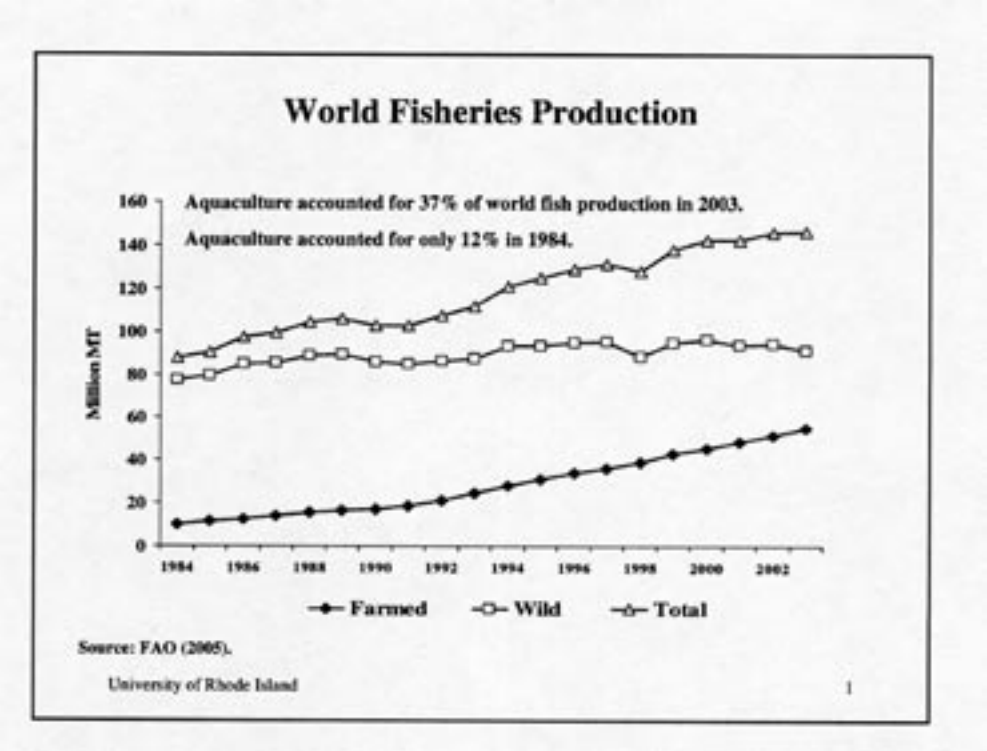
APPENDIX



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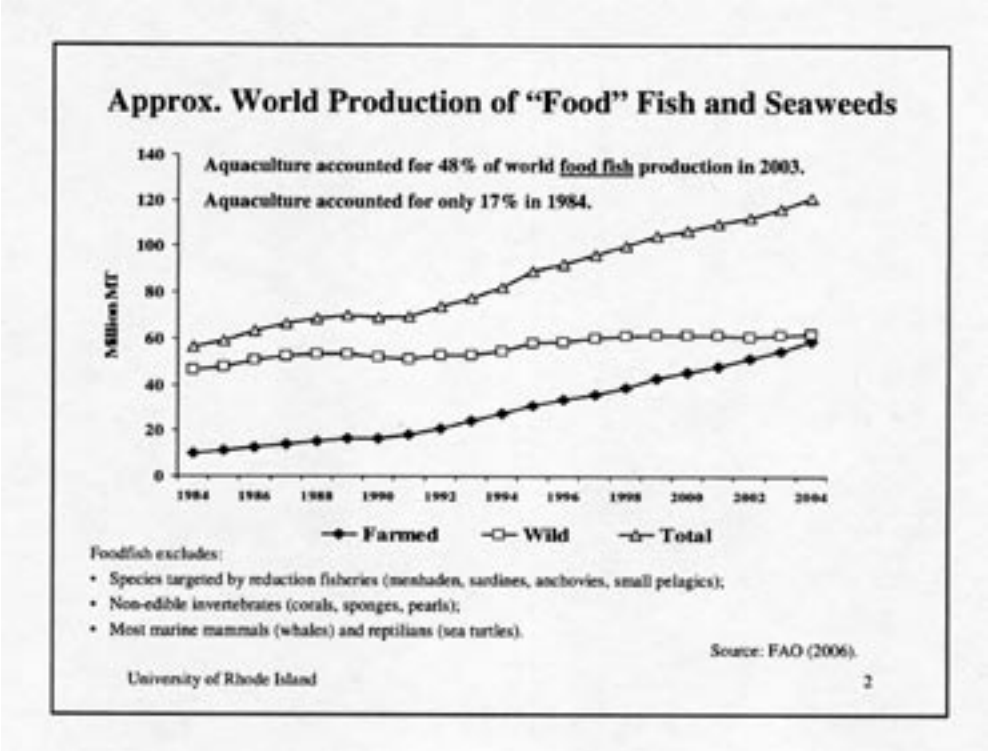

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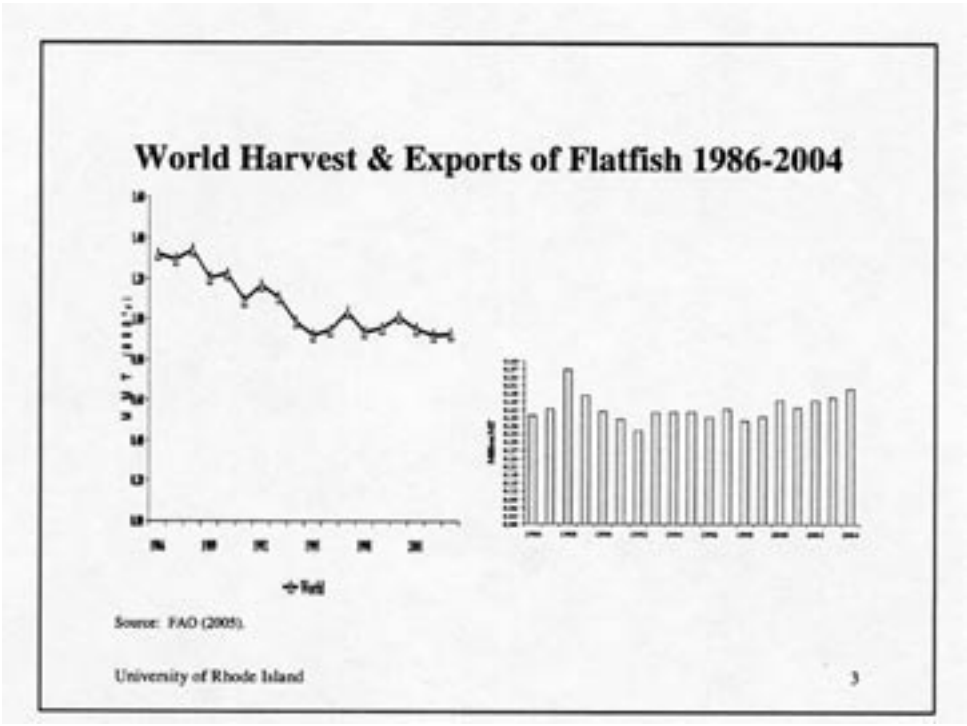

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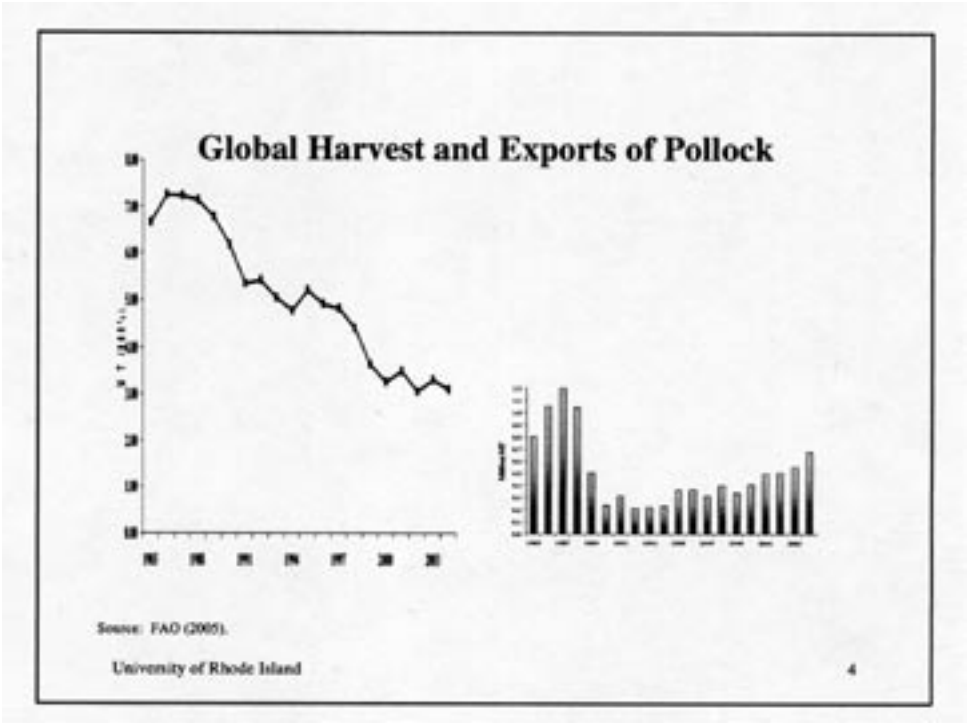

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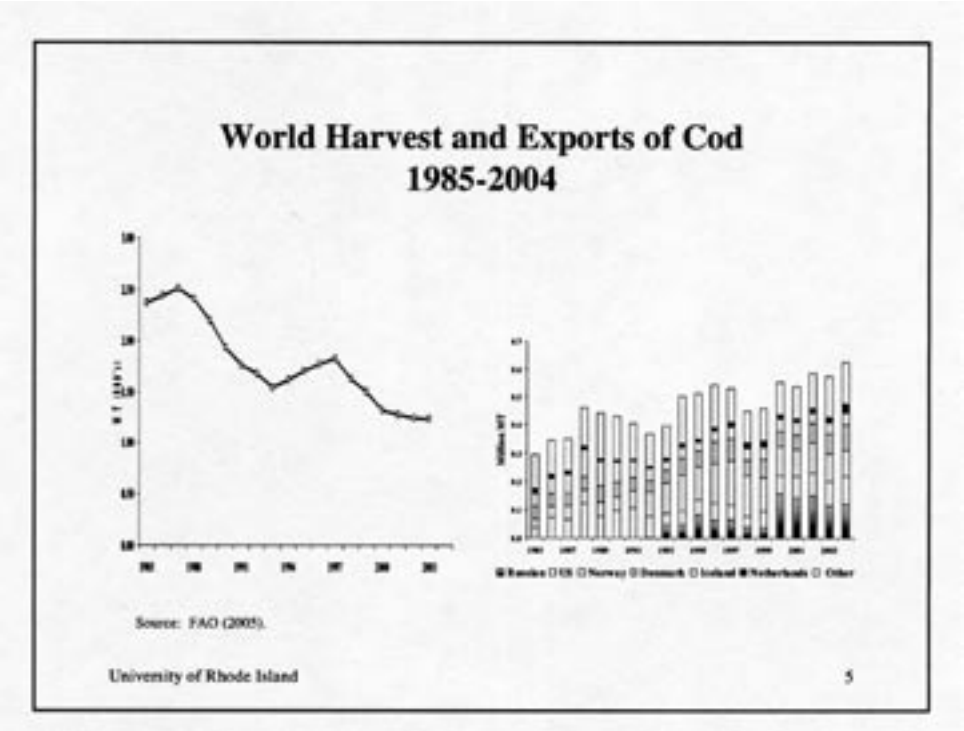

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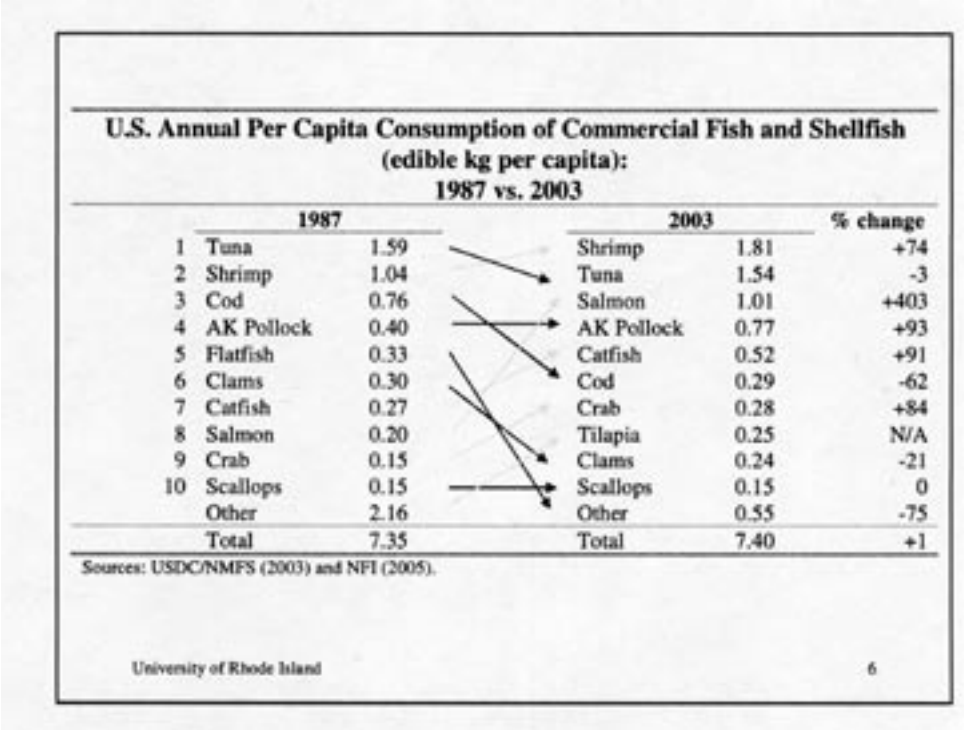

U.S. Annual Per Capita Consumption of Commercial Fish and Shellfish (edible kg per capita): 1987 vs. 2003

	1987		2003		% change
1	Tuna	1.59	Shrimp	1.81	+74
2	Shrimp	1.04	Tuna	1.54	-3
3	Cod	0.76	Salmon	1.01	+403
4	AK Pollock	0.40	AK Pollock	0.77	+93
5	Flatfish	0.33	Catfish	0.52	+91
6	Clams	0.30	Cod	0.29	-62
7	Catfish	0.27	Crab	0.28	+84
8	Salmon	0.20	Tilapia	0.25	N/A
9	Crab	0.15	Clams	0.24	-21
10	Scallops	0.15	Scallops	0.15	0
	Other	2.16	Other	0.55	-75
	Total	7.35	Total	7.40	+1

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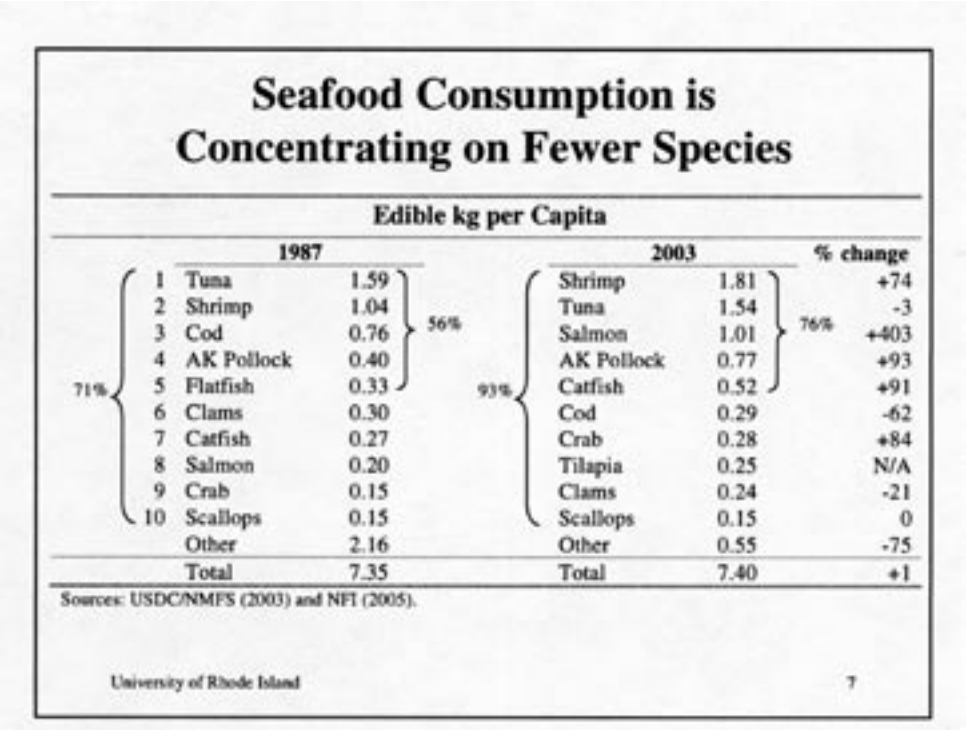

Seafood Consumption is Concentrating on Fewer Species

Edible kg per Capita

	1987			2003			% change
1	Tuna	1.59	56%	Shrimp	1.81	76%	+74
2	Shrimp	1.04		Tuna	1.54		-3
3	Cod	0.76		Salmon	1.01		+403
4	AK Pollock	0.40		AK Pollock	0.77		+93
5	Flatfish	0.33		Catfish	0.52		+91
6	Clams	0.30		Cod	0.29		-62
7	Catfish	0.27		Crab	0.28		+84
8	Salmon	0.20		Tilapia	0.25		N/A
9	Crab	0.15		Clams	0.24		-21
10	Scallops	0.15		Scallops	0.15		0
	Other	2.16		Other	0.55		-75
	Total	7.35		Total	7.40		+1

71% (1987) 93% (2003)

Sources: USDC/NMFS (2003) and NFI (2005).

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Seafood Business Survey: U.S. Retail Sales, 1994 vs. 2004

Best Sellers

	1994	2004
1	Shrimp	Shrimp
2	Salmon	Salmon
3	Pollock, Cod, Haddock	Tilapia
4	Catfish	Tuna
5	Flounder	Catfish

Fastest Growing Items

	1994	2004
1	Salmon	Salmon
2	Shrimp	Tilapia
3	Tilapia	Shrimp
4	Catfish	Tuna
5	Orange Roughy	Crab

Sources: Perkins, C. (1994) and Robinson, F. (2004)

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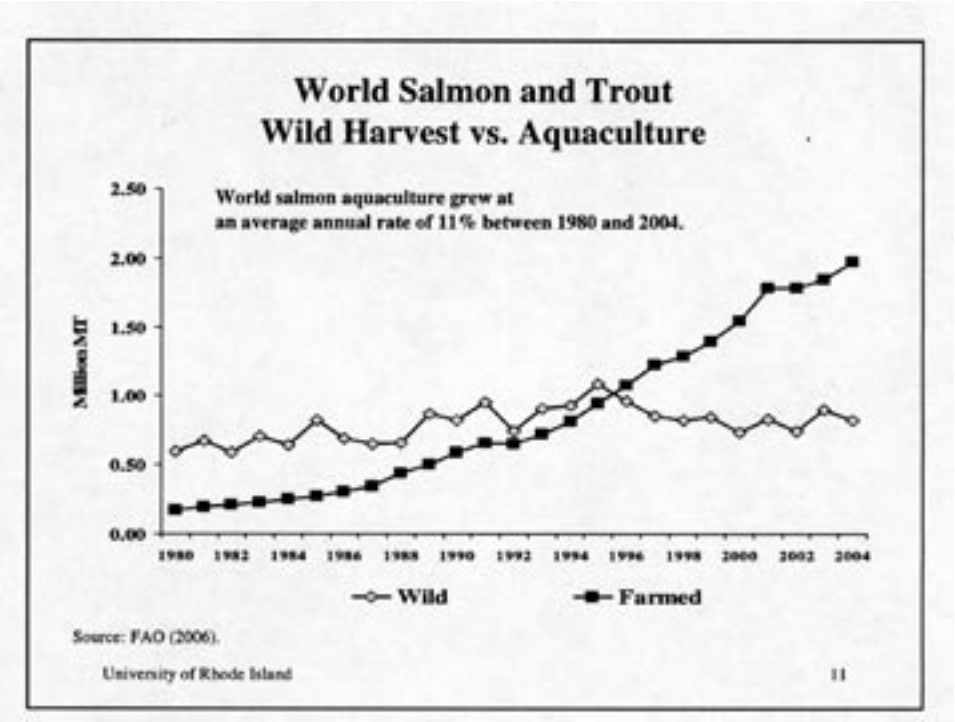

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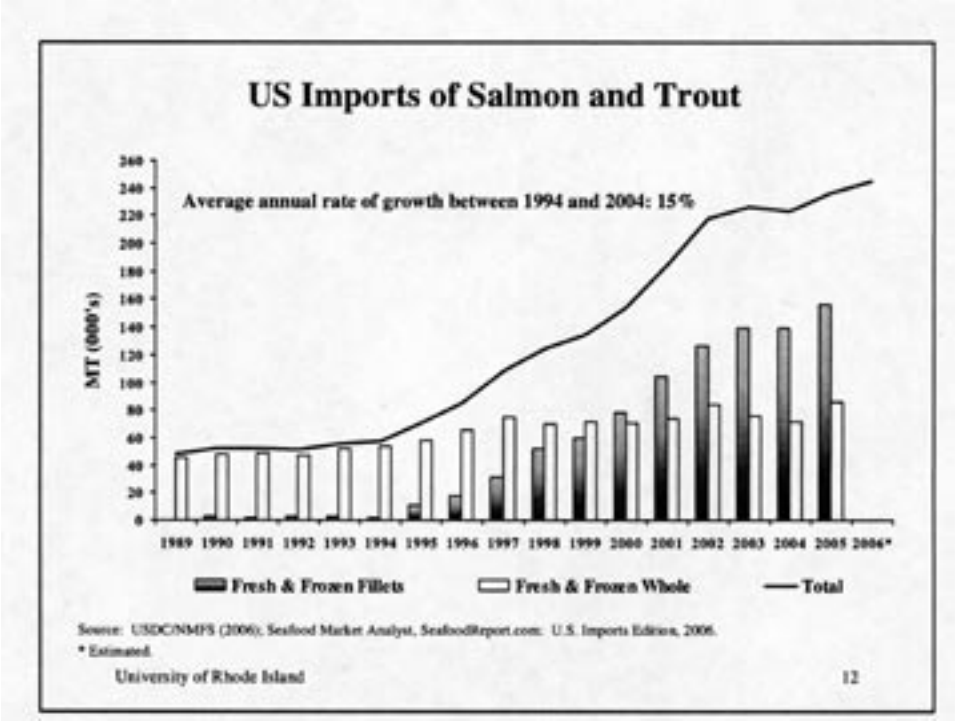

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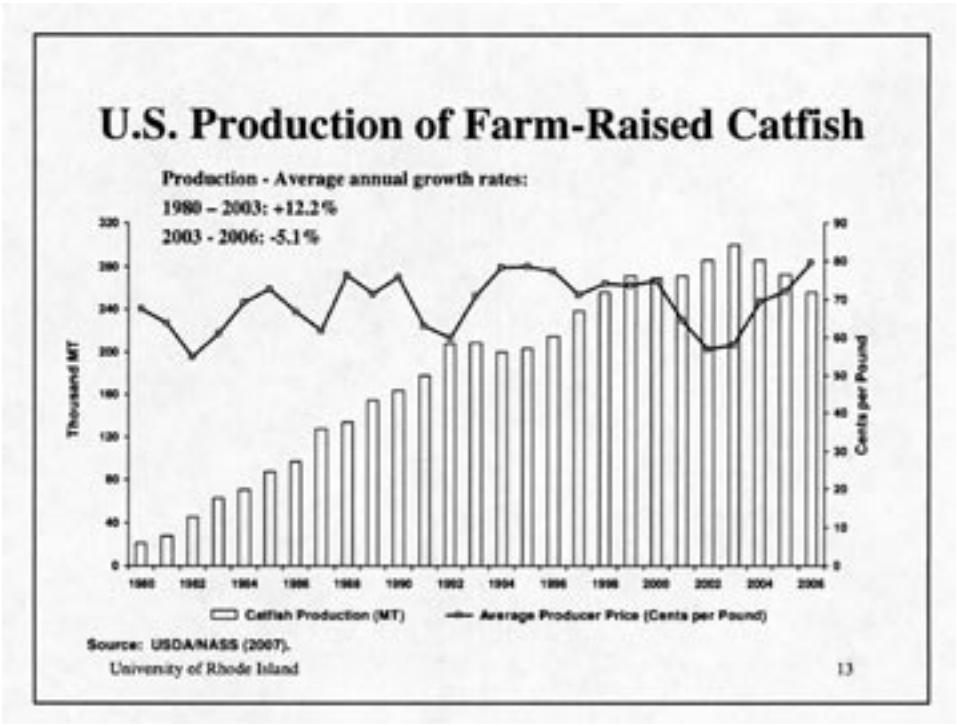

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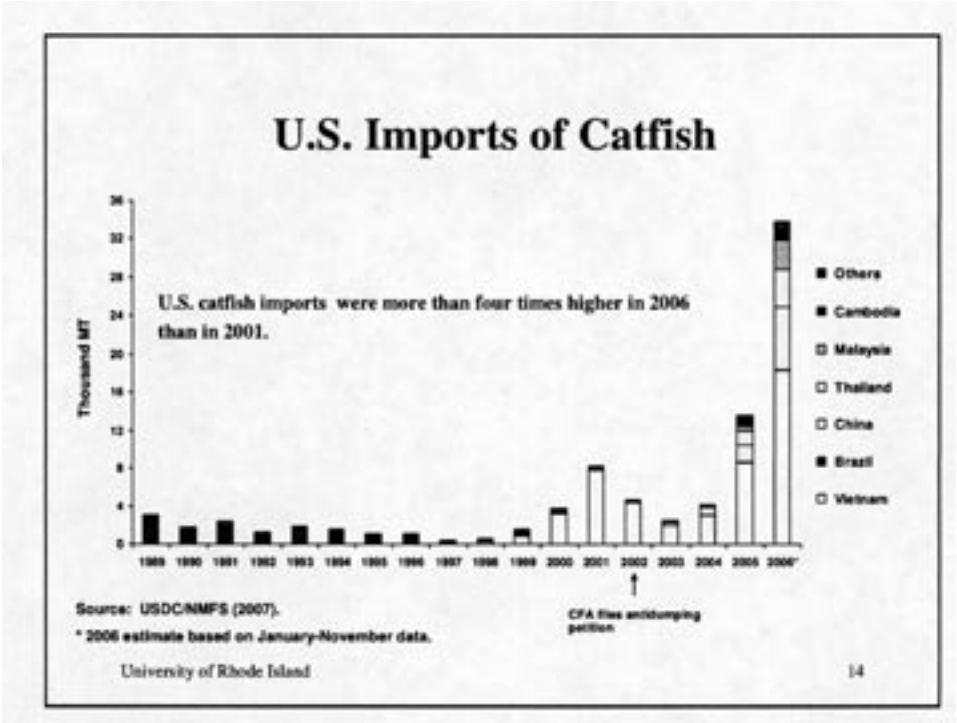

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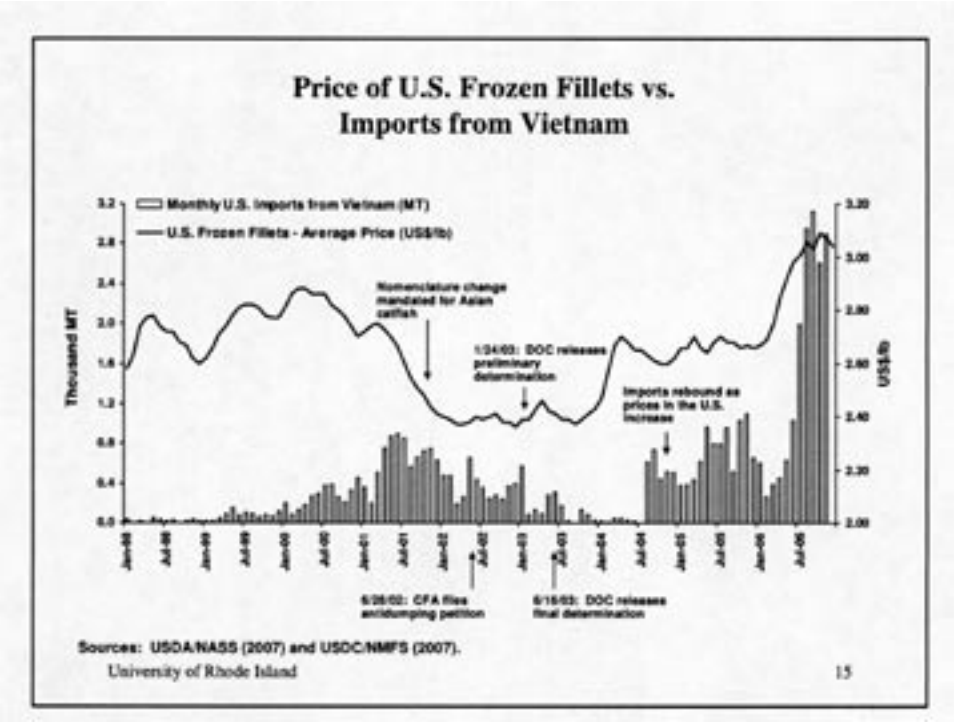

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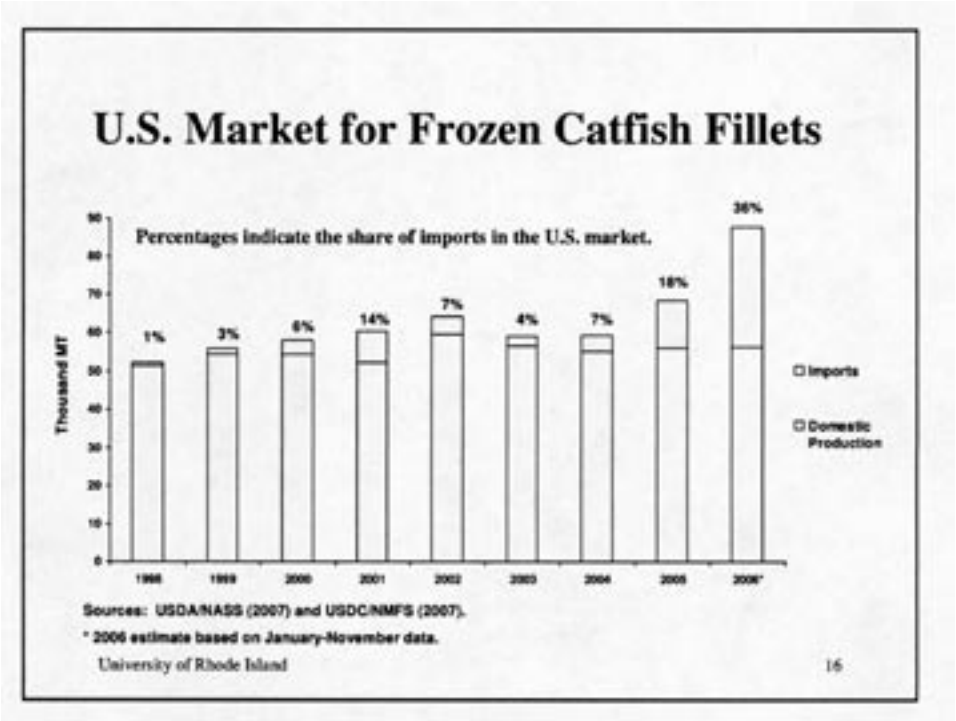

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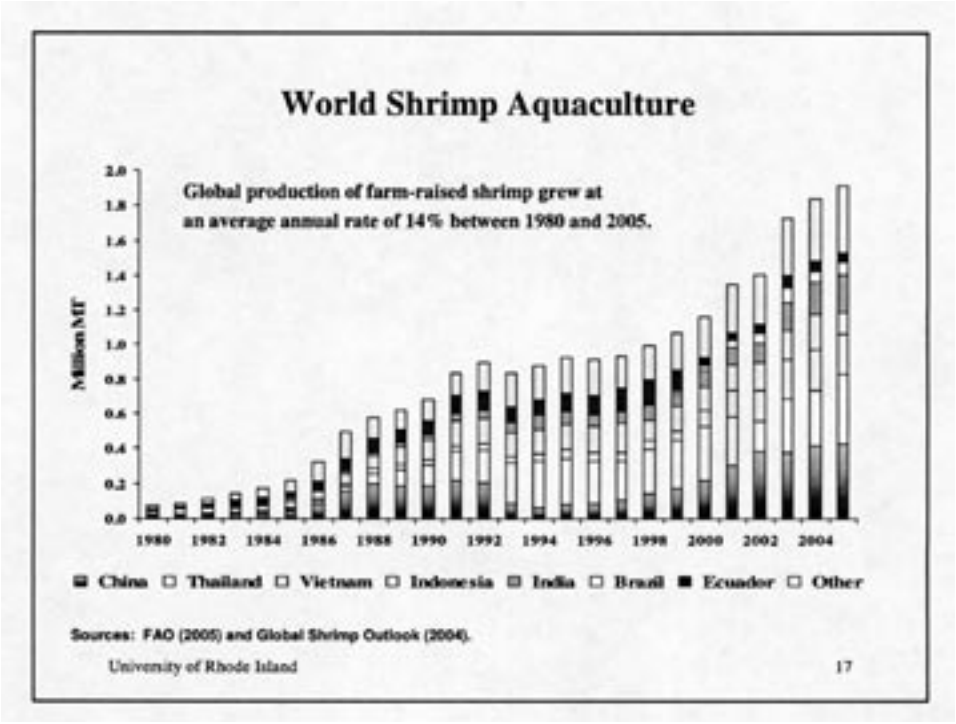

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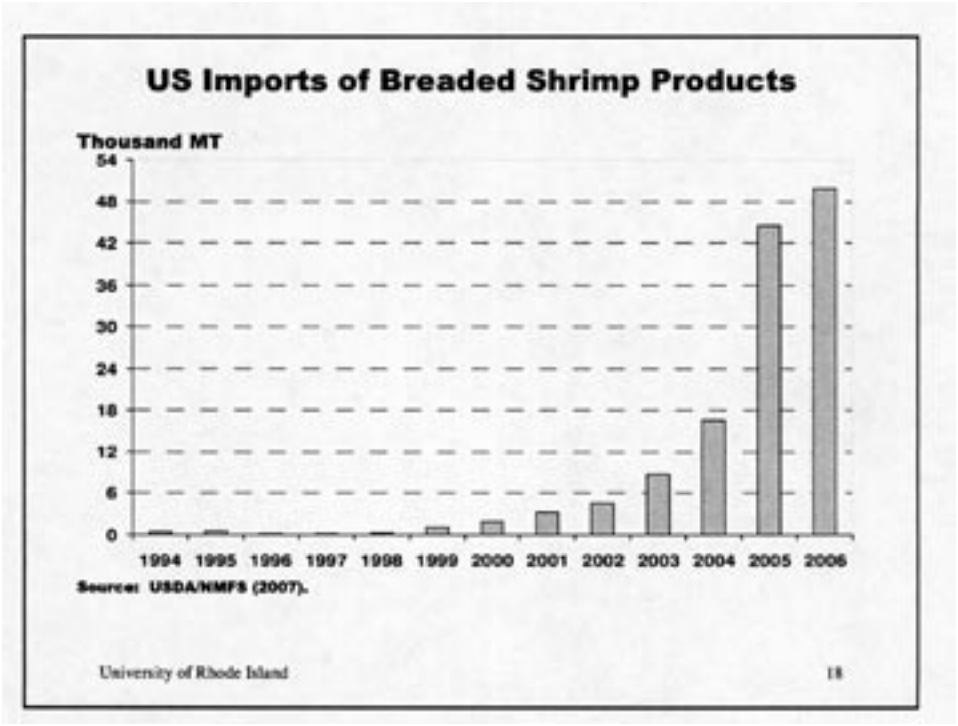

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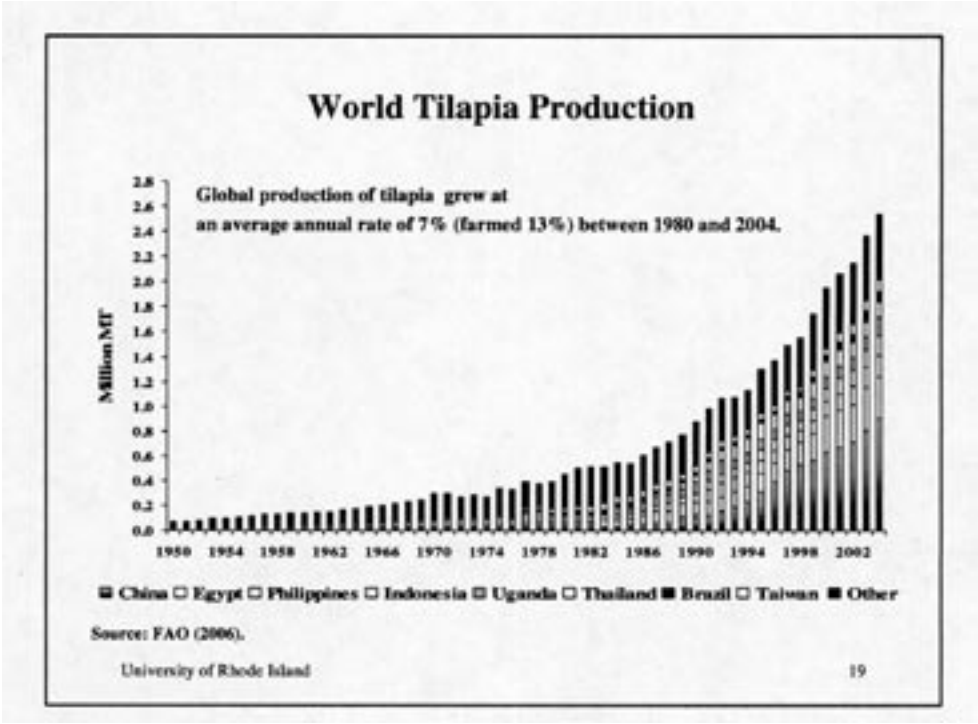

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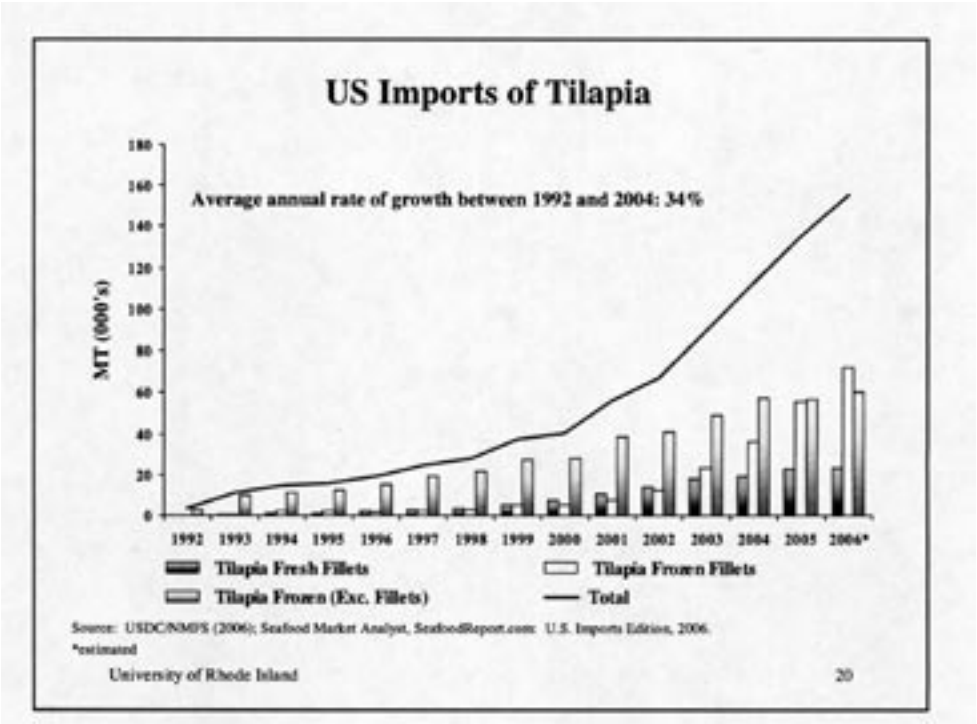

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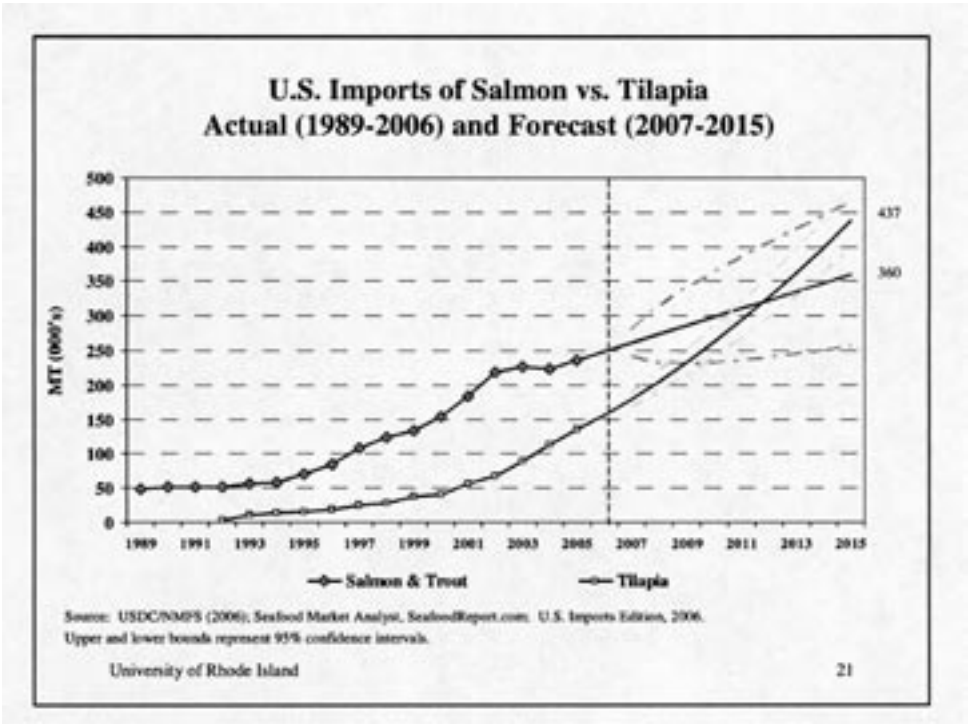

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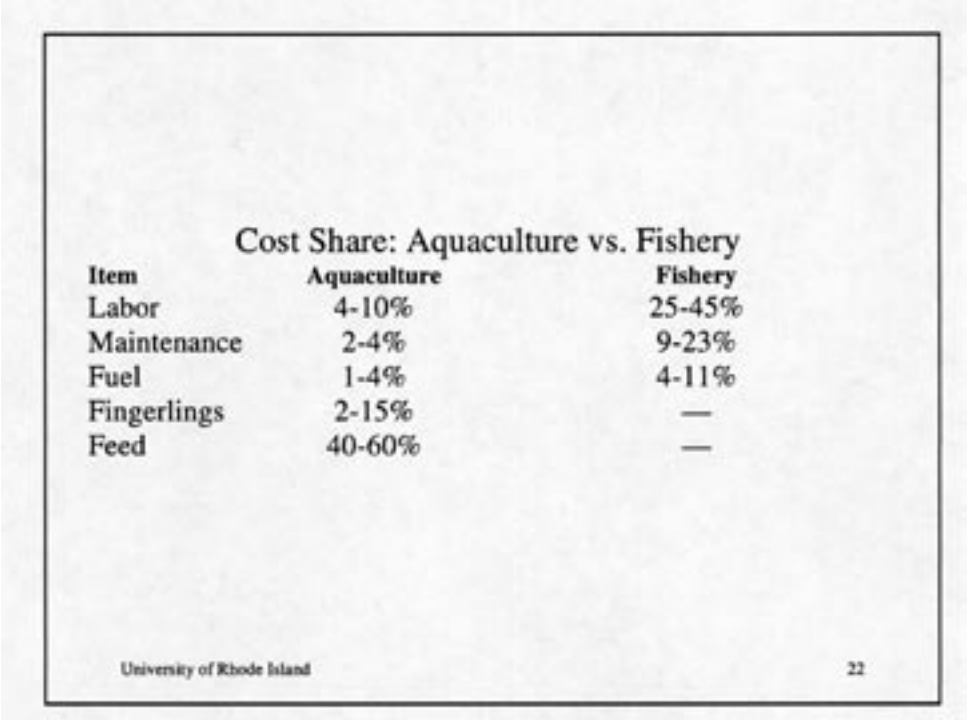

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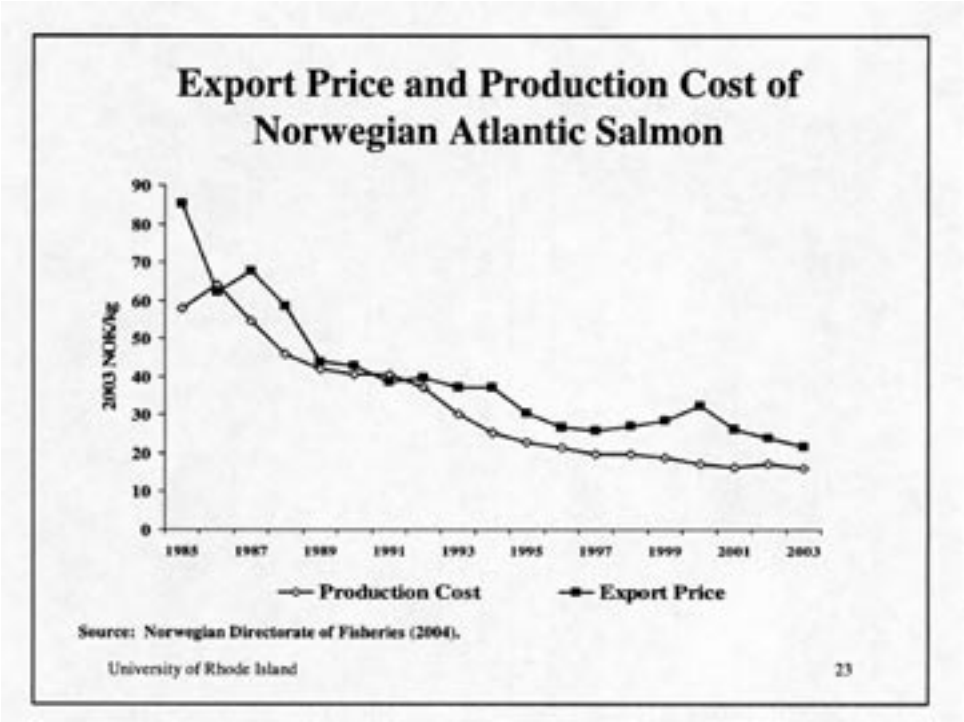

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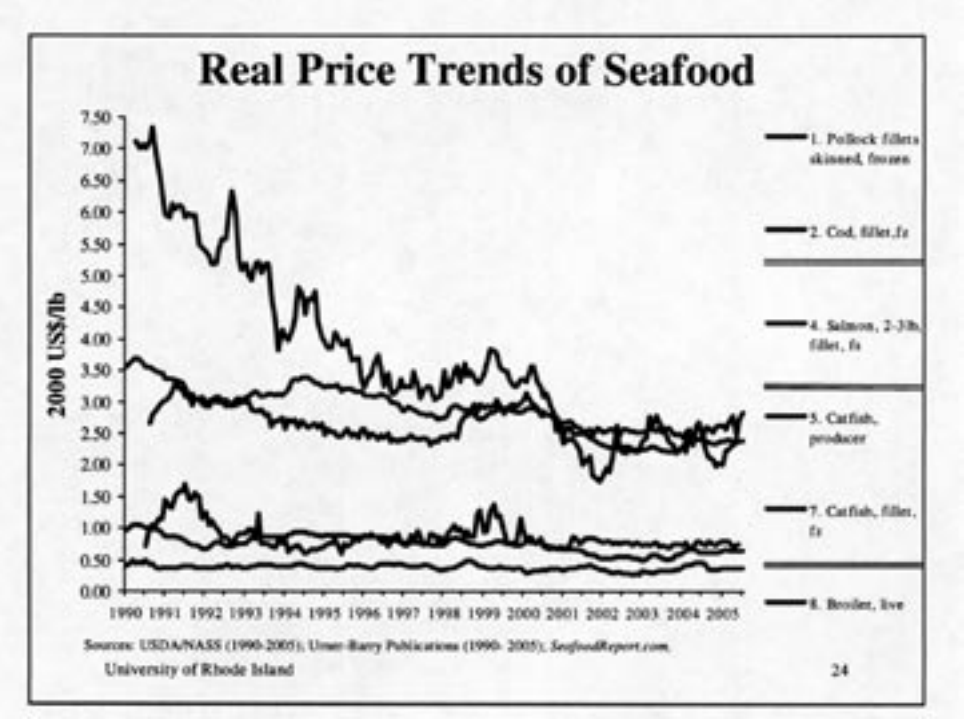

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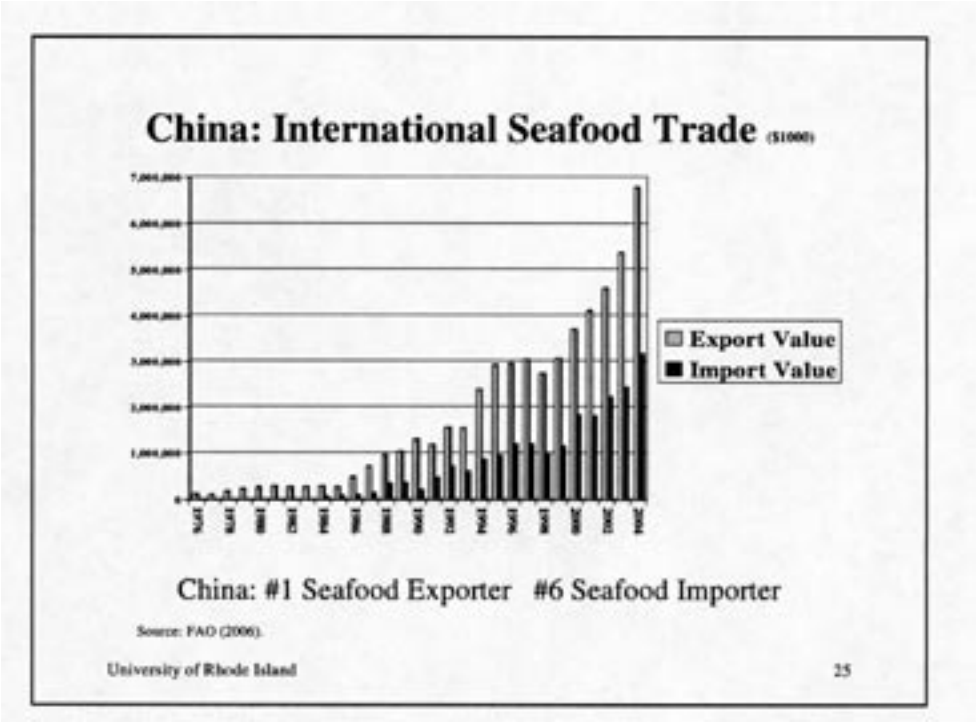

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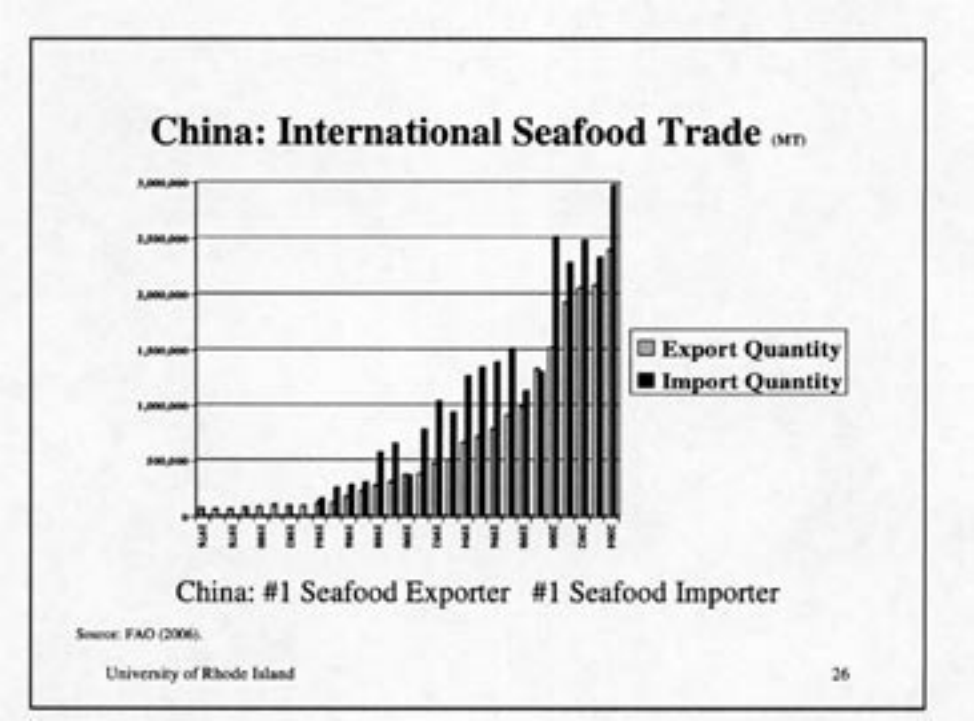

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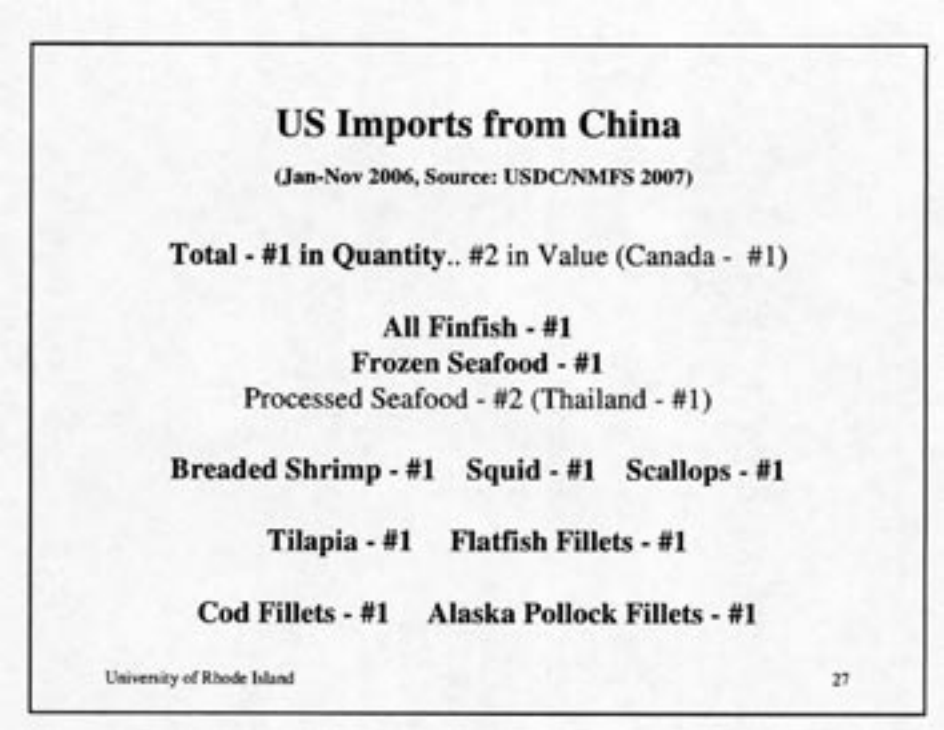

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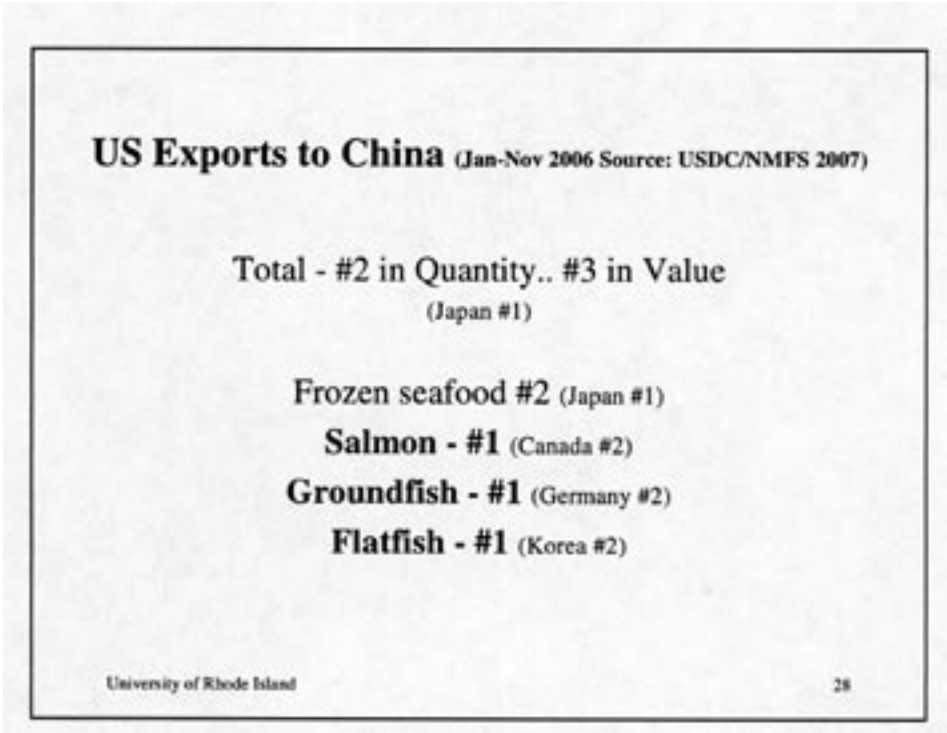

SLIDE 26

Seafood Exports (1000$)

	1976			2004	
Rank	Country	Value		Country	Value
1	Japan	662469		China	6779909
2	Norway	654703		Norway	4170996
3	Canada	604232		Thailand	4053351
4	Denmark	520935		US	3693079
5	Taiwan	431893		Denmark	3576980
6	US	371899		Canada	3506676
7	Korea Rep.	329114		Spain	2581893
8	Iceland	290338		Chile	2547235
9	Netherlands	267130		Netherlands	2468384
10	Spain	244969		Vietnam	2408502

Source: FAO (2006).

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Seafood Imports (1000$)

	1976			2004	
Rank	Country	Value		Country	Value
1	US	1890921		Japan	14830080
2	Japan	1850360		US	12078689
3	France	575159		Spain	5238660
4	Germany	540102		France	4216736
5	UK	518737		Italy	3919082
6	Italy	397425		China	3167656
7	Belgium	216298		UK	2843021
8	Netherlands	200825		Germany	2830918
9	Sweden	194589		Denmark	2368838
10	Canada	183631		Korea Rep.	2258711

Source: FAO (2006).

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From farm to fork – new European food hygiene regulations

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ABSTRACT

A major review the European food hygiene regulations was carried out following recommendation of the White Paper on Food Safety published in 2000. Together with new regulations on the organization of official food controls these came into force in 2006. The focus of the new regulations is from "farm-to-fork" and place the responsibility for marketing safe food with the producer. This paper gives an overview of the new regulations and how they apply to the production, processing and marketing of fish and fishery products.

INTRODUCTION

January 1st 2006 marked a significant milestone for food safety in the European Union (EU), when a large body of updated food and feed legislation came into force. The new EU Food Hygiene Regulations focus on the need to protect public health in a way that is effective, proportionate and based on risk. A key aspect of the new legislation is that all food and feed business operators, from farmers and processors to retailers and caterers, will have principal responsibility for ensuring that food placed on the EU market meets the required food safety standards. The new Regulations apply at every stage in the food chain, including primary production (i.e. farming, fishing and aquaculture) in line with the EU's "farm-to-fork" approach to food safety. The regulations apply to food businesses farming and handling live bivalve molluscs and catching and farming fish and crustaceans, and handling and processing fish and fishery products.

The new Regulations clearly set out the responsibilities of the food business operator. The Regulations require appropriate own-checks to be carried out and samples to be taken by the industry to ensure the marketing of safe products. The Regulations also includes provisions for guides to good practice to be developed by industry with support from other stakeholders. The legislation applies directly to food businesses and the effect the legislation will have depends on the size and nature of the business. The new food law separates aspects of food hygiene from animal health, and aims to remove any duplication and inconsistencies in approach that can cause difficulties for both businesses and regulatory authorities.

The new Food Hygiene Regulations constitutes a complementary set of rules to harmonize EU food safety measures. They are a suite of several regulations including Regulation (EC) 852/2004, which lays down the general hygiene requirements for all food business operators, and Regulation (EC) 853/2004, which lays down additional specific requirements for food businesses dealing with foods of animal origin, including live bivalve molluscs and fishery products. Regulation (EC) 854/2004 lays down the official controls for foods of animal origin. The basis for the new regulations is provided by the General Food Law Regulation (EC) 178/2002, which provided a framework to ensure a coherent approach in the development of food legislation. The General Food Law Regulation set down definitions, principles and obligations covering all stages of

food and feed production and distribution. Other related recent legislation includes the Regulation on microbiological criteria for foodstuffs, the Regulation on official feed and food controls, and the Regulation on feed hygiene.

When the new legislation was introduced on 1 January 2006, 17 separate pieces of previous legislation were revoked. This included Directives 91/492/EEC and 91/493/EEC, which related to the placing on the market of live bivalve molluscs and fish and fishery products. In order to permit a smooth transition to full implementation of the new rules, the EU has introduced provisions for transitional periods (up to 31 December 2009 in some instances), during which certain requirements can be progressively implemented. National legislation is also being introduced, and, when it is in place, it will revoke and replace most of the existing national food hygiene legislation.

EXPORTING FISH AND FISHERY PRODUCTS TO THE EUROPEAN UNION MARKET

For all food and feed, including fish and fishery products, the general principle applies that the product meets, or is equivalent to, EU standards. In addition, under current arrangements, in order to export products of animal origin to the EU, the country must be approved for the relevant commodity and the products must originate in an establishment that is approved to export to the EU. Lists are maintained at EU level of countries and establishments from which imports are permitted. Countries and establishments approved in this manner are commonly referred to as "listed". In order to be listed the third country concerned must provide guarantees that exports to the EU meet, or are equivalent to, the standards prescribed in the relevant EU legislation.

FOOD BUSINESS REGISTRATION AND APPROVAL

Under the new legislation, primary producers involved in fishing and aquaculture will have to be registered with the national competent authority as food business operators. Operators will need to register before starting at a new location and will also need to inform the competent authority of the nature of the business. Furthermore, establishments must be approved if they handle products of animal origin for which specific hygiene conditions are laid down in Community legislation. This includes those handling live bivalve molluscs and fishery products. This does not apply to establishments engaged only in primary production, transport or storage of products not requiring temperature-controlled storage conditions, or retail operations. Premises in compliance with the new regulations should be issued an approval number.

IDENTIFICATION MARKING AND LABELLING

Approved food businesses must apply an identification mark to their products during or after production. This mark must be oval in shape, legible, indelible and clearly visible for inspection. It must show the name or two-letter code of the country (IE for Ireland), the approval number of the premises, and an abbreviation for the European Community (for example 'EC').

One of the transitional arrangements established by the EU allows for stocks of food of animal origin produced before 1 January 2006, in approved premises, to continue to be placed on the market provided that they have the appropriate health marks, such as those required under Directives 91/492/EEC and 91/493/EEC. Also, if these products have a defined shelf life longer than the transitional period, then they may remain on the market until the end of their shelf life. In relation to the use of packaging bearing identification marks in compliance with the revoked hygiene legislation (e.g. Directives 91/492/EEC and 91/493/EEC), food business operators may continue until 31 December 2007 to use stocks of such purchased by them before 1 January 2006.

Specific requirements for live bivalve mollusc products are that the label must contain the following information: the species of bivalve mollusc (common name and

scientific name); and the date of packaging, comprising at least the day and month. The date information may be replaced by the phrase 'these animals must be alive when sold'. The label, including the identification mark, must be waterproof. There is also a requirement for retailers, where the live bivalve molluscs are not in individual consumer size packages, to keep the packaging label for at least 60 days after splitting up the contents.

PRIMARY PRODUCTION

The farm-to-fork approach of the legislation embraces primary production, and the general principles of food hygiene legislation now extend to all operations involved in the primary production of food.

'Primary production' is defined as the production, rearing or growing of primary products up to and including harvesting, hunting, fishing, milking and all stages of animal production prior to slaughter. Fish and shellfish farmers as primary producers and certain associated operations listed below need to follow good practice and manage their operations as set out in Annex 1 of Regulation (EC) 852/2004. Derogations may be granted for small businesses, provided that they do not compromise the achievement of the Regulation's objectives. Primary producers are not required to implement a HACCP system. (www.fsai.ie/legislation/food/eu_docs/Food_hygiene/Reg852_2004.pdf)

In practical terms, the requirements for primary producers amount, in the main, to fairly basic hygiene procedures. Primary producers must ensure that hazards are acceptably controlled and that they comply with existing legislation. Under the new rules, primary producers need to take steps, for example, to:

- prevent contamination arising from water, soil, feed, veterinary products, waste, etc;
- keep animals intended to be placed on the market for human consumption clean;
- take account of results from tests relevant to animal and human health; and
- use medicines appropriately.

The requirements for food business operators in Annex 1 of Regulation 852/2004 also apply to certain associated activities that include:

- the transport, handling and storage of primary products at the place of production, where their nature has not been substantially altered;
- the transport of live animals, where this is necessary; and
- transport, from the place of production to an establishment, of products of plant origin, fishery products and wild game, where their nature has not been substantially altered.

GENERAL REQUIREMENTS FOR FOOD BUSINESS OPERATORS

- Food business operators carrying out activities other than primary production shall comply with the general hygiene provisions of Annex II of Regulation 852/2004. This Annex sets out the details for the hygiene requirements for:
- food premises, including outside areas and sites;
- transport conditions;
- equipment;
- food waste;
- water supply;
- personal hygiene of persons in contact with food;
- food;
- wrapping and packaging;
- heat treatment, which may be used to process certain foodstuffs; and
- training of food workers.

Requirements for live bivalve molluscs and fishery products

Food business operators making or handling products of animal origin must comply with the provisions of Regulation (EC) 853/2004 and, where appropriate, certain specific rules concerning microbiological criteria for foodstuffs, temperature control and compliance with the cold chain, and sampling and analysis requirements. Foods of animal origin include live bivalve molluscs and fishery products. The provisions of Regulation (EC) 853/2004 apply to unprocessed and processed products of animal origin, but do not apply to composite foods, i.e. foods containing both products of plant origin and processed products of animal origin. (www.fsai.ie/legislation/food/eu_docs/Food_hygiene/Reg853_2004.pdf)

Regulation (EC) No 854/2004 lays down specific rules for the organization of official controls on products of animal origin intended for human consumption. The Regulation supplements Regulation (EC) 852/2004 on hygiene of foodstuffs and Regulation (EC) 853/2004 on specific hygiene rules for foodstuffs of animal origin. This official control regulation gives details of the controls to be carried out on live bivalve molluscs and fishery products. (www.fsai.ie/legislation/food/eu_docs/Food_hygiene/Reg854_2004.pdf)

Details in relation to the approval of establishments and the withdrawal of approval if serious deficiencies are identified on the part of the food business operator are also set out in Regulation (EC) No 854/2004. Food business operators must provide authorized officers with all assistance needed to carry out the controls, notably as regards access to premises and the presentation of documentation or records. The official controls include audits of good hygiene practices and HACCP principles, as well as specific controls that have requirements determined by sector (including live bivalve molluscs and fishery products).

Regulation (EC) 2074/2005 sets out implementing measures for certain provisions of the new legislation. The Regulation includes rules for fishery products encompassing detection of parasites, maximum levels for total volatile nitrogen for certain species as a determinant of "fitness", testing methods for marine biotoxins, and labelling with cooking instructions for specified fish. (www.fsai.ie/legislation/food/eu_docs/Food_hygiene/Reg2073_2005.pdf)

Live bivalve molluscs

Harvested live bivalve molluscs intended for human consumption must comply with high health standards applicable at all stages of the production chain. With the exception of the provisions on purification, the rules also apply to live echinoderms, tunicates and marine gastropods. The Regulations include provisions for cooperation by food business operator in the classification system. Approved dispatch and purification centres are now required to establish a HACCP system, as explained below.

Regulation (EC) 853/2004 specifies requirements for the following areas:

- production of live bivalve molluscs – classification of production areas (Class A, B or C);
- harvesting of molluscs and their transport to a dispatch or purification centre, relaying area or processing plant;
- relaying of molluscs in approved areas under optimal conditions of traceability and purification;
- essential equipment and hygiene conditions in dispatch and purification centres;
- health standards applicable to live bivalve molluscs: freshness and viability; microbiological criteria, evaluation of the presence of marine biotoxins and harmful substances in relation to the permissible daily intake;
- health marking, wrapping, labelling, storage and transport of live bivalve molluscs; and
- rules applicable to scallops harvested outside classified areas.

Regulation 854/2004 specifies that new production areas, after 1 January 2006, require a sanitary survey and the establishment of a representative sampling programme based on the sanitary survey data.

Fishery products

Specific requirements in the new legislation for fishery products cover the following elements:

- equipment and facilities on fishing vessels, factory vessels and freezer vessels: areas for receiving products taken on board, work and storage areas, refrigeration and freezing installations, pumping of waste, and disinfection;
- hygiene on board fishing vessels, factory vessels and freezer vessels: cleanliness, protection from any form of contamination, washing with water and cold treatment;
- conditions of hygiene during and after the landing of fishery products: protection against any form of contamination, equipment used, auction and wholesale markets;
- fresh and frozen products, mechanically separated fish flesh, endoparasites harmful to human health (visual examination), and cooked crustaceans and molluscs;
- processed fishery products;
- health standards applicable to fishery products: evaluation of the presence of substances and toxins harmful to human health; and
- wrapping, packaging, storage and transport of fishery products.

Regulation 853/2004 requires the use of potable water in relation to fish processing, but transitional arrangements in (EC) Regulation 2076/2005 allow clean water to be used up to 31 December 2009 in certain situations, including for making ice for chilling fresh fishery products, during gutting and filleting operations and for cooling after cooking crustaceans and molluscs.

Record-keeping

Under the new Regulations, food business operators will be required to keep records relevant to food safety, including:

- the nature and origin of animal and fish feed (if used);
- any veterinary products administered and their withdrawal dates (if used);
- any occurrence of disease that may affect food safety;
- the results of any analyses carried out; and
- the health status of the animals prior to slaughter.

Hazard Analysis Critical Control Point (HACCP)

The new legislation requires food business operators (except primary producers) to put in place, implement and maintain a permanent procedure, or procedures, based on the principles of HACCP. The requirements take a risk-based approach and can be applied flexibly in all food businesses regardless of the size or nature of the business. The application of procedures based on HACCP principles is a new requirement for live bivalve mollusc approved premises, although the requirement was already in place for fishery product premises.

Guides to good practice and guides to the application of HACCP

The Regulation encourages the development of national guides to good practice in food business sectors, which should include guidance on compliance with the general rules of hygiene and the HACCP principles. If a Member State or the Commission considers that there is a need for uniform Community guides, the Commission shall consider the case for such guides. Food business operators may refer to national guides or Community guides equally.

Training

Food business operators are responsible for ensuring that food handlers have received adequate instruction or training, or both, in food hygiene to enable them to handle food safely. Training should be appropriate to the tasks of staff in a particular food business and be appropriate for the work to be carried out. Training can be achieved in different ways. These include in-house training, the organization of training courses, information campaigns from professional organizations or from regulatory authorities, guides to good practice, etc. With regard to HACCP training for staff in small businesses, it must be kept in mind that such training should be proportionate to the size and the nature of the business and should relate to the way that HACCP is applied in the food business. If guides to good practice for hygiene and for the application of HACCP principles are used, training should aim to make staff familiar with the content of such guides.

Microbiological criteria of foodstuffs

The Microbiological Criteria for Foodstuffs Regulation (Regulation (EC) 2073/2005) includes limits for certain micro-organisms in specified foodstuffs and complements the new Regulations. The microbiological criteria established in previous EU legislation have been revised as part of a risk-based approach to food safety. The legislation sets limits for food safety criteria and process-hygiene criteria. The Regulation sets E. coli and Salmonella limits for placing live bivalve molluscs and live echinoderms, tunicates and gastropods on the market for human consumption. It also sets limits for fishery products for the following:

- *Listeria monocytogenes* for ready-to-eat food;
- *Salmonella* for cooked crustaceans and molluscan shellfish;
- Histamine for species associated with high amounts of histidine; and
- *E. coli* and coagulase-positive staphylococci for shelled and shucked products of cooked crustaceans and molluscan shellfish (process criteria).

Regulation EC/2073/2005 contains detailed controls encompassing sampling and analysis requirements. It is structured so it can be applied flexibly in all food businesses, regardless of their type or size. Food business operators should apply the criteria within the framework of procedures based on HACCP principles. The criteria can be used by food business operators to validate and verify their food safety management procedures and when assessing the acceptability of foodstuffs, or their manufacturing, handling and distribution processes.

Traceability and withdrawal of food products

In accordance with Regulation (EC) 178/2002, food business operators must set up traceability systems and procedures for ingredients, foodstuffs and, where appropriate, animals used for food production. Similarly, where a food business operator identifies that a foodstuff presents a serious risk to health, they shall immediately withdraw that foodstuff from the market and inform users and the relevant Competent Authority. (www.fsai.ie/legislation/food/eu_docs/Food_hygiene/Reg178_2002.pdf)

Animal health rules

Council Directive 2002/99/EC lays down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption. Aquaculture animals and controls of certain fish and bivalve diseases are covered by the legislation. The Directive harmonizes veterinary public health requirements and covers all production stages of a product of animal origin: primary production, processing, transport, storage and sale. It also applies to live animals intended for human consumption.

New official food control regulations

In addition to the new Food Hygiene Regulations that came into force on 1 January 2006, a second group of Regulations were introduced that focus on how official food controls are organized at national level across the EU. While the Food Hygiene Regulations set out the responsibilities of the food business operator, the Regulations on Official Food and Feed Controls (EC/882/2004) and the General Principles and Requirements of Food Law (EC/178/2002) specify the responsibilities of national authorities in integrating food controls at all stages of production and in all sectors, using the farm-to-fork principle. The basic principles relating to the responsibilities of EU Member State authorities are laid down in Regulation EC/178/2002, on the general principles of food law and establishing the European Food Safety Authority (EFSA). The Regulation on Official Food and Feed Controls (EC/882/2004) describes in more detail how these basic principles shall be interpreted and implemented. Specific requirements on how official controls for fish and fishery products are organized at national level are detailed in Regulation EC/254/2004 on the organization of official controls on products of animal origin intended for human consumption. (www.fsai.ie/legislation/food/eu_docs/Food_hygiene/Reg882_2004.pdf)

Exporting fish and fishery products to the EU market

For all food and feed, including fish and fishery products, the general principle applied is that the product meets or is equivalent to EU standards. In addition, under current arrangements, in order to export products of animal origin to the EU, the country must be approved for the relevant commodity and the products must originate in an establishment approved to export to the EU. Lists are maintained at EU level of countries and establishments from which imports are permitted. Countries and establishments approved in this manner are commonly referred to as "listed". In order to be listed, the third country concerned must provide guarantees that exports to the EU meet, or are equivalent to, the standards prescribed in the relevant EU legislation.

Organization of official food and feed controls at national level

The overall aim of the new regulations are to improve the efficiency of Member State control services through the introduction of performance criteria for the national authorities responsible for food safety and to harmonize the role of control services and integration of controls across the entire food and feed chain along the farm-to-fork principle. Regulation EC/882/2004 provides for:

- a harmonized EU-wide approach to the design and development of national food and feed control systems;
- support and cooperation between national authorities in the Member States where the results of official controls require action by more than one Member State;
- a common approach to imports of food and feed;
- the inclusion of general audits of national control systems against national control plans, as a means of verifying the effectiveness of national control systems;
- auditing of national food control organizations in order to verify compliance or equivalence of third country legislation and control systems with EU requirements;
- the provision of technical assistance to developing third countries, including training of control officials from these countries; and
- enforcement measures at national level or EU level to address problems of non-compliance with regulations.

There are a number of new requirements in EC/882/2004 aimed at harmonizing how official food controls are organized at national level. There is a requirement for all Member States in the EU to develop and report on multi-annual food control plans, to

ensure that official food laboratories are accredited, and to follow prescribed rules on the delegation of control tasks to non-governmental bodies.

Requirements for a national food control system

The new regulations specify a number of basic principles for the successful functioning of national food control systems across the EU. National control authorities must meet a number of operational criteria that must ensure their efficiency, effectiveness and impartiality. They must have access to a sufficient number of suitably qualified staff and implement documented control procedures. In addition to current requirements for contingency plans in the feed and veterinary sectors, contingency plans for food crises must be established and staff must be properly trained to implement these plans. Audits subject to independent scrutiny shall be carried out to ensure that the authorities achieve the objectives specified in the new regulations. It requires controls to be carried out on imported food and feed with a control frequency based on risk.

The regulation provides the possibility to delegate specific and defined tasks to non-governmental control bodies, such as the analysis of samples by private accredited laboratories. This is based on the principle that tasks can be delegated but the responsibility remains that of the national food control authority.

Organization of official controls for fish and fishery products intended for human consumption

Specific requirements for official controls for placing on the market of live bivalve molluscs (echinoderms, live truncates and marine gastropods) and fishery products are described in Annex II and Annex III of EC/254/2004. National authorities are required to put in place a comprehensive monitoring programme for live bivalve molluscs, which includes the classification of production and relaying areas according to the microbiological quality of the water. The monitoring programme also includes a requirement for monitoring for the presence of toxin-producing marine algae and the presence of a number of algal biotoxins. Production areas are closed when statutory levels of biotoxins are exceeded (EC/254/2004, Annex III, Chapter V). Requirements for official controls for placing on the market of fishery products include the inspection of hygiene conditions of landing and first sale, and hygiene on board fishing and factory vessels. Provisions also include analytical checks to be carried out by national authorities on fishery products to determine suitability for human consumption. These include sensory analysis, tests for total volatile nitrogen (a freshness indicator), histamine in scombroid species, levels of residues and contaminants, checks for parasites and microbial contamination and check for poisonous species of fish. Fish that are found to be unfit for human consumption are not allowed on the market.

Import controls

The new regulations do not make major changes to the current controls in place for the import of products of animal origin, including fish and fishery products. The Regulation provides for a more harmonized approach to controls on imports of food and feed of non-animal origin from third countries.

In order to export fish and fishery products to the EU, the third country concerned must provide guarantees that exports to the EU meet, or are at least equivalent to, the standards prescribed in the relevant EU legislation. The European Commission requests third countries intending to export fish and fishery products to the EU to provide all necessary information on the general organization and management of sanitary control systems operated by the competent authority of the third country. This information may relate to results of national controls carried out on products intended to be exported to the EU as well as written records kept of the implementation of these controls.

Guidelines have been drawn up to assist third countries in meeting these requirements, which can be found on the website of the European Commission (EC) at: europa.eu.int/comm/food/fvo/pdf/guide_thirdcountries_en.pdf.

Where developing countries experience difficulties in complying with the provisions of this new Regulation, a number of initiatives are planned by the EC to assist, including: a phased introduction of certain specific requirements; technical assistance projects; twinning projects between developing countries and Member States; the development of guidelines to assist developing countries in organizing official controls on products exported to the EU; visits by EU experts; and the participation of developing countries' control staff in the training courses organized in the EU.

Inspections and auditing to verify compliance

The Commission has three main instruments at its disposal to ensure that EU legislation is properly implemented and enforced. It verifies the transposition by Member States of EU legislation into national laws, and analyses reports received from Member States and third countries on the application of aspects of EU legislation, such as national residue programmes and animal feed controls. Additionally it carries out inspections in Member States and third countries to check the implementation and enforcement of EU legislation by national competent authorities.

The control function at EU level is mainly the responsibility of the Food and Veterinary Office (FVO), a directorate of DG Health and Consumer Protection. Its main task is to carry out on-the-spot inspections to evaluate national control systems, to report on its findings and to follow up on the action taken by national competent authorities in response to its reports. The European Commission has published guidance for the importation of fish and fishery products from third countries. ec.europa.eu/comm/food/international/trade/interpretation_imports.pdf

Border inspection posts

For introduction of import consignments of fish and fishery products into the Community, they must enter via an approved Border Inspection Post (BIP) located in a Member State. BIPs are placed under the authority of official veterinarians, who are effectively responsible for health checks on incoming consignments.

According to Community legislation, each consignment of live animals and products of animal origin, including fish and fishery products, must be subject to official veterinary checks in the border inspection. The official controls include at least a systematic documentary check, identity check and, as appropriate, a physical check. In some cases, the frequency of physical checks can be reduced and they depend on the risk profile of the product and also on the results of previous checks. There is extensive EU legislation concerning the entry of products of animal origin, including procedure. These include a pre-notification procedure to the BIP 24 hours before arrival of some consignments and the use of common veterinary entry documents (CVED) and the recently developed veterinary computer application (Trade Control and Expert System, TRACES). Consignments that are found not to be compliant with Community legislation will either be destroyed or, under certain conditions, re-dispatched within 60 days.

European food law

One of the main objectives of Regulation EC/178/2002 is to establish common definitions and guiding principles for food law, with the aim of ensuring a high level of health protection and the effective functioning of the internal market. It requires national authorities to base risk management decisions on independent scientific risk assessments. Where possible harmful effects on health are identified, but scientific uncertainty exists, provisions are included in the regulation to allow for precautionary

measures to be taken until a full risk assessment can be carried out. National authorities are also required to be open and transparent during the development of food law. Only food that is safe can be placed on the market and the labelling of foods cannot mislead the consumer.

Key sections of the regulation cover obligations of the food industry with regard to placing only safe food on the market and the requirement for national authorities to enforce regulations at all stages of the food chain. The need for full traceability is recognized in the regulation, as there are requirements for food business operators to put in place systems to trace food and feed in the event of having to withdraw products from the market. This provision covers all stages of production, processing and distribution in the EU from the importer up to the retail level. For the first time in European regulations, there are specific requirements for food businesses to have systems in place for the withdrawal, recall and notification of food that are not in compliance with regulations.

Guidance on the implementation of EC/178/2002 has been published by the European Commission and can be found on the EU Web site at: ec.europa.eu/comm/food/food/foodlaw/guidance/guidance_rev_7_en.pdf