

3. Markets and trade

INTRODUCTION

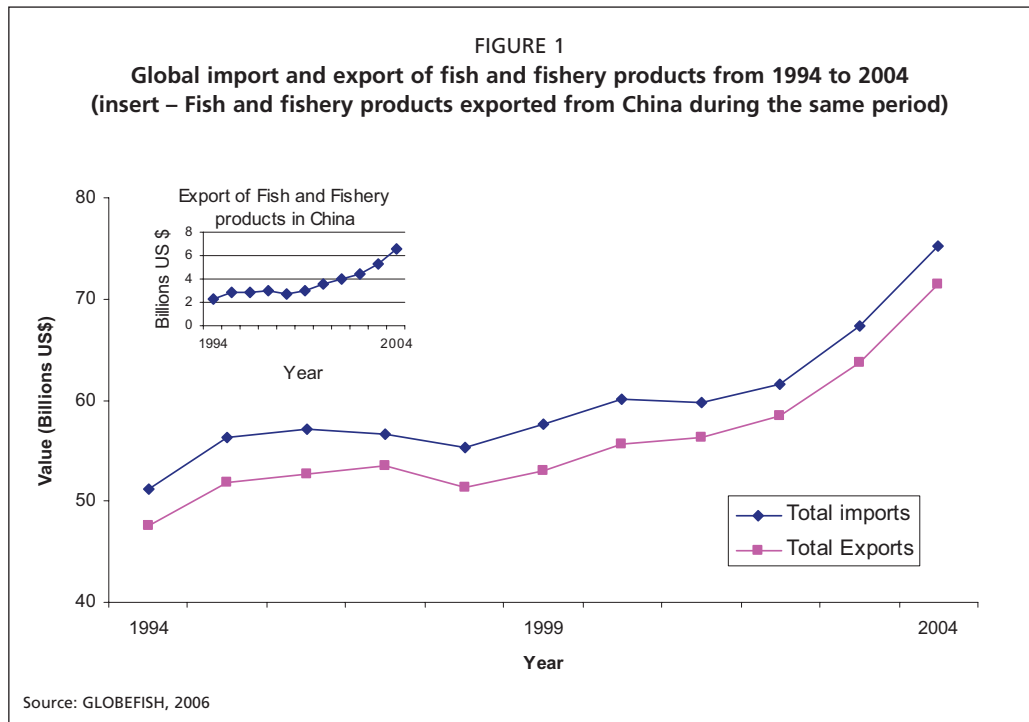
Demand, market and marketing aspects have become an important set of driving forces in shaping the aquaculture sector, globally. Demand for aquaculture produce continues to grow but future growth will be driven largely by market requirements. Consumers are becoming more quality conscious and demanding. Issues such as socially and environmentally responsible aquaculture practices, food safety, traceability, certification and ecolabelling are becoming increasingly important. During the past five years, especially, market access and trade issues have dominated events in many parts of the world. The events are categorized into low international prices, trade barriers, non-tariff barriers, traceability issues, changing tastes according to demographics and consumer purchasing power and intense global competition, particularly for internationally traded commodities.

New markets are emerging worldwide. As high value species are increasingly exported (intra- or interregionally) and low-value products are imported (this is a particular trend in Asia), there is an increasing need by aquaculture farmers to improve and facilitate access to export markets. The choice of species produced may also increasingly be directed towards higher value strains that have export potential. With the more stringent demands of export markets, small-scale operators are facing increasing difficulties in producing aquaculture products for export and may leave the sector as they become uncompetitive. For some export commodities, exporting countries are beginning to look at quota systems or mutual agreements on production limits to avoid destabilizing market prices.

The regional aquaculture trends reviews indicate various responses by governments to market issues that have a significant impact on the aquaculture sector. They are mostly geared towards the small and poor farmers while generally they are aimed at improving the country's competitiveness in foreign markets. In some countries, the latter tends to bias support to the commercial, especially export-oriented farmers, but generally resulting in more efficient and, in many cases, responsibly managed production and processing of aquaculture food products. A study of China's fundamental and broad-ranging fisheries policy changes to align with World Trade Organization (WTO) rules shows how a country's broad-ranging adjustment to the WTO framework can have positive impacts on its fish farmers (Luping and Huang, 2005).

MARKETS, TRADE AND RURAL DEVELOPMENT

The global fish trade was worth US\$63 billion in 2003 and Asia accounts for US\$20 billion of this (Figure 1). Over 40 percent of fish production is traded across borders and exports exceed that of meat, dairy, cereals, sugar and coffee. Much of the traded fish and fish products are from aquaculture, which is practised almost entirely in rural areas and concentrated in developing countries. Thus trade presents an opportunity to help rural communities. Governments, however, do not appear to exploit fully the opportunity that this scenario presents for rural development (Gupta, 2005).



Developing the local markets

The aquaculture status and trends review of sub-Saharan Africa is illustrative of some of the issues that contribute to market failure in nascent aquaculture sectors. Market failure is largely a consequence of poor governance, poverty, lack of resources and infrastructure and is one of the principal reasons for the failure of aquaculture to develop beyond the subsistence oriented scale. Bene and Heck (2005) consider market failure as the norm rather than the exception for the rural poor in Africa and efficient, redistributing trickle-down mechanisms are yet to be created in much of the sub-Saharan region. Farmers can be categorized into non-commercial¹ and commercial farmers. The market chain of commercial farmers in sub-Saharan Africa differs widely and depends entirely on the product, scale of operation and the target market. As elsewhere, the commercial aquaculture market chain is variably organized and ranges from selling fish via traders in urban markets (e.g. Ghana, Cameroon, Nigeria and Uganda) to sophisticated cold chain export of species such as live abalone. Because the non-commercial farmers internalize the bulk of their production and only sell fish to raise cash for immediate use, the market chain is correspondingly short. In most instances fish are sold at the pond or farm gate. Throughout the region there is an emerging small-scale commercial fish farming sector. It is crucial to promote the growth of this sector and to develop markets for these farmers. The most logical route, under current conditions, would be for emerging commercial farmers to link into the market chain of the established commercial fish farming sector. This underlines the key role that the larger commercial farmers can play in the overall development of the sector (Hecht, 2006).

The positive impact of market incentives on the scale and intensity of fish production is shown by a comparative analysis of two groups of fish producers

¹ The African overview referred to “non-commercial” aquaculture as small-scale subsistence, small-scale artisanal or integrated aquaculture and is normally practised by resource-poor farmers. Non-commercial producers may also purchase inputs, such as seed and feed, but rely chiefly on family labour and on-farm sale of produce. An additional feature of non-commercial aquaculture is that it is one of a variety of enterprises comprising the farming system; it is undertaken to diversify production and income, improve resource use and reduce risks of such events as crop or market failure.

differentiated by the location of their market, one in the peri-urban, the other in rural zones of southern Cameroon. In the peri-urban domain, prices were 48 percent higher, the number of buyers was three times greater and the average purchase per customer was nearly double that of the rural domain. Producers in the peri-urban domain sold 300 percent more fish per harvest, were 72 percent more productive per unit area and had 11 times the production scale of producers in the rural domain. This suggests an urgent need to connect rural producers to urban markets in order to foster the growth of aquaculture in sub-Saharan Africa. On the other hand, non-commercial fish farmers are widely distributed in most parts of the countries, where suitable conditions for aquaculture prevail. This does not provide the concentration and economies of scale for the market to become interested in the product. The Cameroon case suggests the potential advantage of zoning areas for aquaculture concentration, using bio-physical, demographic, marketing and socio-economic parameters. Such zones may provide platforms for the progressive development of aquaculture throughout the region. An example is the proposed Namaqwaland Mariculture Park in South Africa. In a related review of sub-Saharan Africa, the WorldFish Center (Bene and Heck, 2005) also recommends improving fish market chains through local small-scale entrepreneurs. The review points out that increasing demand of the urban population for higher quality fish products will drive small-scale enterprises in peri-urban areas.

A further constraint is that the infrastructure designed for agriculture, such as farm to market roads, may not be adequate to answer the needs of aquaculture. This is because aquaculture products are inherently much more perishable than for instance grains or other agricultural crops. Thus ice plants, cold storage and suitable transport facilities are even more critical in aquaculture. The provision of a cold-chain infrastructure on the other hand also raises its own problems related to cultural norms on the acceptability of frozen or even iced fish.

Another lesson relating to markets and market infrastructure and demand is the attempt of several countries (e.g. Angola, Liberia, Mozambique, Nigeria, United Republic of Tanzania, Kenya and Ghana) at shellfish culture. Such initiatives, for several economic, market and environmental related reasons, have not been successful. Mariculture is inherently more expensive than freshwater aquaculture and its success is strongly dependent on the market and the interest of the private sector and requires comprehensive business and environmental planning.

In the Near East and North Africa region, increased domestic demand has been stimulated by such factors as improved road access, improved cold chain facilities and effective marketing. Improved transportation of the aquaculture products means that inland communities that have not traditionally eaten much fish, can now include this protein in their diet.

North American producers, while they have to contend with lower-priced imports, have a decided advantage in their access to well-developed support services and close proximity to one of the world's largest seafood markets.



COURTESY OF MOHAMMAD HASAN

*A worker feeding fish in an African catfish (*Clarias gariepinus*) farm (Obasanjo Farm) in Ota, Nigeria. This livestock farm, which was established in late 70s, diversified into fish in 2004. If all 12 concrete ponds of the farm are harvested twice annually, the farm should profit over US\$50 000 a year.*

The United States of America alone imports US\$11 billion in seafood products annually. The same advantage could probably be said of European Union (EU) aquafarmers.

Aquaculture production in North America contributes significantly to local economies in regions of the United States of America and Canada characterized by low levels of economic development and high rates of unemployment. In the southeastern United States, marginally profitable agricultural land coupled with available water and soils suitable for pond construction provide the foundation for development of the channel catfish industry. The US\$480 million in farm-gate sales in 2004 generated an economic impact of billions of dollars through production, processing, feed manufacture and associated goods and services. From 1995 through 2002, the number of processors alone has ranged from 19 to 26. Localized impacts can be highly significant. For example, in 2004, catfish farming in Chicot County, Arkansas (United States) generates a total economic impact of US\$359 million, providing US\$20 million in tax revenues and 2 534 jobs, accounting for 46 percent of total employment in the county.

In Canada, Atlantic salmon aquaculture accounts for more than 90 percent of the total value of Canadian production and has developed in British Columbia and New Brunswick provinces where the resource extractive industries of timber harvesting and commercial fishing have declined significantly. In British Columbia, for example, salmon farming creates 1 800 direct year-round full-time jobs and over 2 000 indirect jobs. Ninety percent of salmon farming employment is in rural areas and the total economic activity attributed to the farmed salmon sector is worth US\$523 million. Given that more than 85 percent of aquaculture production is exported, the value of this sector in generating outside revenue is amplified.

It is difficult to overemphasize the importance of a functioning market for small-scale aquaculture. Lessons from an Asian Development Bank (2004) evaluation of small-scale aquaculture in eight rural farming areas in Bangladesh, Philippines and Thailand include the following:

- Markets provide key channels for the exchange of goods and services to generate incomes.
- For producers, capital assets and factors of production have alternative uses and markets can provide important signals for producers to respond to demand.
- Functioning markets enable the flow of goods and services from producers to consumers, providing information on: (i) products and their features; (ii) prices of goods and services; (iii) places or locations of market transactions; (iv) promotion of sales; and (v) people, including producers, intermediaries and consumers, who are involved in these markets.

In summary, the major factors that contribute to functioning markets include transportation and communications. Fish farming cannot succeed if pioneered and left to sustain itself in isolated areas where essential support services and markets are absent. Rural infrastructure makes access to and expansion of markets possible.



COURTESY OF ALISTAIR STRUTHERS

Offshore salmon cage farm in Canada. The technological advancements in systems design and construction help in mitigating environmental impacts and improving production efficiency.

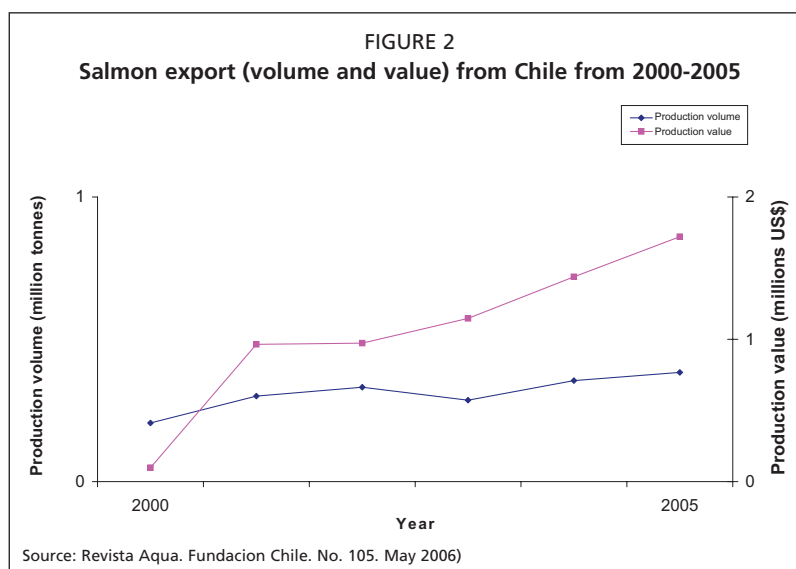
Role of the market chain

The efficiency and nature of the market chain impacts significantly on the margins of producers and the price and availability of fish to consumers. In many parts of Africa, post-harvest losses in capture fisheries exceeds 30 percent. This has a double impact on food security: it reduces income and the total supply of fish to consumers. Because of weak market infrastructures and facilities in rural areas, much of the captured fish is marketed as dried or smoked products. Local public and private investments are needed to support small-scale marketing initiatives in these areas leading to higher income and a greater supply of quality fish to consumers. This would stimulate rural development and provide economic opportunities for women traders (Bene and Heck, 2005).

As the Latin America and Caribbean review illustrates, the market chain for aquaculture products varies according to production volume and the distance between production centres and ports or export exit points. Small producers sell their products at the farm-gate or the nearest population centre. For the local market, rural sector supply chains are oriented from the producer to the selling point, while at the national level the processor and intermediaries are introduced. Larger enterprises often process their own products and transfer them to the “broker”, even in the country of destination (as in salmon). For larger outputs, products are transported to the nearest cities that have cold storage facilities and processing plants. Prices are lower due to larger volumes handled. Large farms harvest and process their own products, placing them directly in the markets for their redistribution. The marketing of aquaculture products is carried out in supply centres, chain stores and supermarkets and in some instances in selling points that belong to the producers or the processing plants.

In this regard, a regional meeting in Panama in September 2005 convened by FAO/OSPESCA (Organización del Sector Pesquero y Acuícola del Istmo Centroamericano), attended by experts mostly from governments, noted the distinction between intermediaries operating in national markets and the chain of intermediaries active in export markets. Noting the significance of the aquaculture market and trade and the fact that market liberalization has no effect on intermediation and product prices, the meeting advised producers to group into associations and to form alliances with traders. They urged government support to producer associations and formulation of policies to reduce the chain in the trade of aquaculture products (Morales and Morales, 2006). Sub-Saharan Africa exhibits the same increasing marketing complexity and sophistication for traded products. The market chain for export products such as fish, prawns and abalone is more sophisticated and the chain may have the following links: producer, company marketing section to collective marketing companies, foreign agents or buyers, exporting companies to wholesale or direct to retail market (FAO, 2006a).

Three finfish and two shellfish species groups dominate trade in farmed aquatic products in the Western Europe region. In 2003 salmon, trout, seabass and seabream accounted for 92 percent of regional export and 90 percent import trade of farmed products. For



The production has almost doubled during the five year period. Atlantic salmon contributes more than 50 percent to the over all value of export.

finfish the most dominant product form was fresh chilled whole fish on ice. In the case of salmon and trout there was a significant market for fresh fillets and smoked products. Shellfish were mostly sold live on ice. Netherlands and Ireland show a net positive trade balance. Norway had the highest trade surplus of US\$3.1 billion. Iceland and Denmark were in second and third with surpluses of US\$1.43 and 1.04 billion, respectively. In contrast to these less populated countries, Italy, Spain, France, Germany and the United Kingdom reported trading deficits of US\$3.11, 2.68, 2.46, 1.37 and 0.85 billion, respectively. The ability of aquaculture to contribute to this deficit in the Western European region will depend on farmed products being transformed from luxury products to mainstream commodities. In the case of salmon and trout this status is fast being achieved with falling prices and wider distribution through chains such as hyper- and supermarkets (Rana, 2006).

The role of super- and hypermarkets is not as pronounced in the Central and Eastern European countries as in Western Europe although their importance is gradually increasing. In some of the countries, these large outlet chains have already become important channels of distribution (e.g. in Estonia). Supply chains and distribution channels are diverse, from direct sales at the farm site to large supermarkets. In Poland, the sale of fish from aquaculture is handled directly by farms. From 90 to 95 percent of the production is sold wholesale, while 5–10 percent is sold retail through small outlets owned by the fish farms. Retail prices are approximately 20 percent higher than wholesale prices.

In Hungary and in Serbia and Montenegro, domestic production is mainly sold to the consumer in the form of live fish, through special fish shops and supermarket chains. Due to the lack of adequate numbers of such outlets, many consumers do not have access to live fish. The wholesale market for fish is very small in Romania, with the consequence that there are many short-link marketing chains, resulting in high transport and distribution costs. The markets for fish products in Russia have a three-tier system: local, regional and federal. In Moscow and Saint Petersburg regions fish farms sell 30 percent of their production themselves through their own shops and mobile aquarium booths. The rest of the production is supplied to the trading network at wholesale prices.

The processing trend is towards direct purchase from farms as well as contract farming. Fully integrated companies (as those in Western Europe, North America, Asia and Latin America), control the production process and can assure traceability of their products. More and more feed companies are also becoming fully integrated to improve customer confidence in quality products through the production process. However, despite assurances of quality, occasional rejections by importers due to safety and quality issues are being continuously reported.

EXPORTS AND THEIR IMPACT ON THE ECONOMY

Impact of exports on local fish prices

Asia and the Pacific region has countries with the highest per capita consumption of fish. One forecast (Delgado *et al.*, 2003) sees consumption trends driving an increase in the demand for fishery products for food, partly due to changing food habits and the increasing purchasing power of several developing countries. In the Asian region, it is expected that there will be a shift from the region being a net exporter of fishery products to being a net importer. Developing Asian countries are expected to remain net exporters overall, but the percentage of their production exported could decrease due to rising domestic demand.

It seems logical to assume that the cost of fishery products will increase as, in most of the projections, supply cannot keep up with demand. Projected rises in prices between 1997 and 2020 are about 15 percent. Indeed the increase in the average price of fish to over US\$2/kg in sub-Saharan Africa in the last five years has led to a resurgent interest in aquaculture throughout much of the region. On the other hand, analysis of recent

price trends seems to indicate the opposite trend, i.e. prices of fish are decreasing. This is in fact one scenario considered by Delgado *et al.* (2003); a rapid expansion of both scale and efficiency of aquaculture could lead to decreasing fish prices (this was the only scenario where fish price decreased). Herbivorous and omnivorous fishes are already being cultured very efficiently. However, current trends indicate that aquaculture is drifting towards higher value species, which present higher margins, allow investment in more intensive production systems and effluent treatments, may be easier to market and have greater export potential.

Regardless of price trend, but especially if it decreases over time, and given that the yield from capture fisheries is not expected to increase much, there would be a great emphasis on aquaculture's ability to provide increasing quantities of fish to satisfy the increasing demand in all regions.

Asia has a significant export orientation and focus on high value species, which has resulted in a shift in the balance of trade in fish commodities in favour of Asian developing countries. Despite being a significant net exporter, Asian developing countries' fish trade has been largely confined to a few developed country markets such as the EU, United States of America and Japan. In Asia, exports are relatively better documented than other aspects of aquaculture. Exports of individual countries range from a few hundred million to a few thousand million US dollars with China as the top exporter of aquaculture products (US\$2 450 million in 2003). Thailand and Indonesia are viewed as the second largest aquaculture exporters in Asia with some US\$1 600 million followed closely by Viet Nam with US\$1 555 million.

Aquaculture export is focused on high value products, notably marine shrimps, but increasingly finfish including tilapia and catfish and seaweed. Almost all the South and Southeast Asian countries are shrimp exporters. The most notable success story in terms of non-shrimp export is that of the Pangasid catfish by Viet Nam which grew rapidly to reach almost 400 000 tonnes in 2005.

The principal aquaculture export products from countries in sub-Saharan Africa are mariculture products, mainly shrimps, abalone and seaweed. Shrimps are exported frozen (Madagascar and Mozambique), seaweeds are exported dry (United Republic of Tanzania, Madagascar and Mozambique) and 80–85 percent of abalone produced in South Africa is exported live and the remainder is canned. The value of marine products exported comprises 95 percent of the total mariculture revenue of the target countries and 33 percent of the total value of aquaculture products in the region. However, Uganda exports a small quantity of cold smoked *Clarias gariepinus* to the EU, showing the potential of freshwater fish for export.

In Latin America industrial aquaculture and some medium-scale operations are geared mainly to the export market. Leading the region's exports were Atlantic and coho salmon, with an exported volume of 375 000 tonnes and a value of US\$1 500 million – normally marketed as whole fresh salmon and frozen fillets.

Next came marine shrimps with a production of 256 000 tonnes and a value of US\$1.24 million. These were exported as fresh or frozen head-on shrimp and shrimp tails, and as processed shrimp tails. Tilapia exports amounted to 86 500 tonnes and a value of approximately US\$266 million – mainly exported as whole frozen fish and fresh or frozen fillet. The main markets were North America and Asia, although Europe was becoming increasingly important. Intra-regional trade (especially to Brazil and Colombia) was low in volume and value, but was on the increase. Exports played a significant role in certain national economies. Operations with the largest economic capacity, which were usually organized into trade associations, focused their investment on industrial culture for export. Many small and medium producers organized into cooperatives or other forms of association, concentrated on forms of culture that gave them access to local markets or markets in neighbouring countries, although shrimp and tilapia also targeted the export market.

The larger enterprises in the region gear their investments to fish, shrimp and mollusc culture towards international markets, organizing themselves into associations within or among countries, e.g. the Salmon Producers Association for the Americas. In general, the participation of the more powerful economic groups is reflected in the development of intensive aquaculture with a higher degree of technology and technological investment such as those in Chile, Brazil, Ecuador and Mexico. In Central America, associations enable the small- and medium-size producers to bring their products to local markets and, in cases such as shrimp, to external markets.

Fish produced in Central and Eastern Europe (CEE) are mainly exported live, frozen, quick-frozen, canned, salted and smoked. Exported fish are traded mainly within CEE countries and only in limited amounts in other European countries. Russia, despite its huge aquaculture production, only exports sturgeon and trout roe (caviar). Bulgaria also exports substantial amounts of aquaculture products (>5 600 tonnes annually), mainly molluscs (46 percent of the total exported quantity) and frozen fish, mainly to Romania, Serbia and Montenegro, Germany, Greece, Turkey and Japan. Croatian aquaculture production is focusing on export markets, which has resulted in a foreign trade surplus for several years now. In view of its export orientation, Croatia places strong emphasis on further trade liberalization, primarily with EU countries, and on increased export quotas.

Although production in the Near East and North Africa region has focused on domestic markets (led by Egypt, the dominant producer – which sells most of its product domestically due to high local demand), 11 of the 17 countries in the region export some or all of their production. Most exports are destined for other countries within the region, although some products are exported to more distant markets such as Europe, North America and Japan. A wide range of products is exported, principally market-size finfish and shellfish, but also fingerlings and seed, supplies (particularly fish feed) and non-food aquatics. Exports from this region are expected to increase both from established and new exporter countries.

Potential negative impacts of trade

A general conclusion about trade is that income from exports is good for the economy. But in a situation where the local demand has not been satisfied, exporting fish could undermine national or even regional food security. In this context, two issues are raised. First, while the fish removed from African markets can in principle be replaced by imports and the foreign exchange earnings from exports can stimulate national economies, the benefits of international trade versus the stimulus to local economies through increased processing, and national and regional trades have not been fully analyzed or demonstrated. Second, too strong a focus on international export could divert policy-makers' attention, research and management efforts and donor support away from the small-scale fisheries which supply local, provincial or national markets (FAO, 2003).

IMPACT OF COMPETITION FOR COMMON MARKETS ON AQUACULTURE DEVELOPMENT

Is competition for common markets good for national aquaculture sectors? Would it be good for all farmers in a country? Would it lead to a better global aquaculture order? Or would it favour stronger and better positioned countries at the expense of the poorer ones?

The regional reviews provide various general indications that competition had prompted governments, farmers, processors and exporters to adopt various measures to improve competitiveness. These have included improving technical efficiencies and reliability of supplies, diversifying products to cater to a wider range of specific market demands, improving capacities to comply with food safety requirements, promoting

the quality reputation and image of products and promoting the image of a socially and environmentally responsible farming and processing.

A study on shrimp farming in Latin America and the Caribbean provides an interesting perspective. It views the market-led development process as causing initially disruptive effects on aquaculture development in exporting countries, but with longer term beneficial outcomes (Wurmann, Madrid and Brugger, 2004).

The study focuses on two sources of competition: producers in importing countries, as with the United States shrimp fishing industry, and producers in other regions, particularly Asia. The study views the antidumping case in the light of its negative impacts on national shrimp industries. It takes the position that the antidumping accusation was in effect defending the probable structural incapacity of local shrimp fishers to compete on equal terms with a growing influx of cheaper shrimp imports whose costs and prices are lower than those of United States fishers. It notes that even if unfair competition by some countries was demonstrated and the corresponding producers face new tariffs, it will still be true that other farmers will be more cost efficient and competitive than the United States shrimp fishers. It predicted that after the completion of the exercise, things will go back more or less to where they were at the outset, but not before causing disruptions in producing countries, financial collapses of traders, importers and distributors and prompting less consumer demand (in the United States) because of higher priced shrimp products.

The study points out that China and other Asian countries have been producing whiteleg shrimp, *Penaeus vannamei*, in massive quantities.

It expects the production trend in Asia to continue with initial adverse impacts on the Latin America and Caribbean shrimp industry such as players leaving the industry altogether. It also predicts, however, that the competition will prompt the Latin American and Caribbean shrimp industry to develop innovative production methods and cost savings allowing farmed shrimp to become reasonably profitable and more competitive than in the past. This process will in turn enhance demand inviting more players to join or expand current capacity. It also pointed out an important strategic concern: balancing the support to small and medium producers with that of the big enterprises. The study contends that while the small producers are important for development and employment in poor rural areas, it is the big industry that leads the way in competitive and sustainable exports and increasing consumption in important local markets.

To mitigate the ruinous effect of competition between countries for the same product(s) and for the same market(s) the review of Asia and the Pacific region raised the prospect of adopting a form of “parts and product complementation” as practised in the manufacturing industry (automotive, electronics, etc.). One approach could be “national branding” whereby the production and marketing capability of each country will be put to a severe test in the open global market arena. In a related vein is the growing trend towards labelling or certification. For certification to be recognized and accepted, it is also essential to have an accreditation system for certifiers.

In Asia, a good case of a wide ranging government support to maintain market leadership in the face of growing competition from other producers is Taiwan Province of China’s promotion of tilapia as an export product. Taiwan PC exports tilapias mostly to the United States, Saudi Arabia and Korea (Rep. of), but Viet Nam is fast catching up, with cheaper prices, while China is now the biggest producer and also exporting significant quantities to some of the same markets. The Council of Agriculture (COA) strategy to boost tilapia’s competitiveness includes upgrading its productivity, management systems and value addition. In short, they are turning tilapia aquaculture into a knowledge-based industry to stay ahead of competition.

One of the best models for an industry-initiated and industry-led marketing promotion which led to massive industry growth in aquaculture is that for the channel

COURTESY OF MATT BRIGGS



Penaeus vannamei specific pathogen free (SPF) broodstock and postlarvae production hatchery in Thailand. Ability to produce SPF shrimp opened the door for *P. vannamei* to enter into Asia. As long as they remain free of major diseases such as Taura Syndrome and White Spot Syndrome Virus, the production will continue to grow.

catfish in the United States. Farming of channel catfish was considered economically practical only in the 1950s and developed more rapidly only in the mid 1970s. Before then, catfish was still largely considered a regional food with little or no acceptance outside the southern United States. Acceleration in industry growth started during the 1980s which was attributed to the development of large feed mills and processing plants and an effective national advertising campaign launched by the combined effects of growers and feed millers. The expansion of the catfish market beyond southern United States of America made the industry grow from 15 000 ha pond area

producing 35 000 tonnes in 1980 to 80 000 ha producing over 270 000 tonnes by year 2000 (Tucker, 2003). To finance the nationwide advertising, the growers agreed to pay a levy of a few cents for every kilogram of feed they purchase. The money collected by the feed mills was used for an advertising contract that covered all media as well as test-taste sessions in supermarkets. This cooperative and voluntary approach is worth emulating not just for market promotion but for other industry problems as well such as to finance research and development. On the other hand, in order to survive, the industry subsequently had to resort to anti-dumping legislation effectively applying a non-tariff barrier to protect it from foreign competition.

The above may be put in some perspective with a snapshot of the United States' seafood export and import status. The United States of America is one of the world's largest seafood exporters and the second largest seafood importer. While it is a significant exporter of seafood from the capture fisheries sector, aquaculture exports from the United States of America are small.

Oysters valued at US\$17.2 million and clams worth US\$10.9 million were exported in 2004, primarily to Canada. Ornamental fish worth US\$8.7 million were shipped worldwide in 2004, with almost half going to Canada. During the same time the United States of America imported ornamental fish worth US\$43.8 million primarily from producers in Asia. Tilapia imports to the United States of America have surged recently with imports in 2004 of 113 000 tonnes valued at US\$297 million. Fillets comprise 50 percent of imported tilapia and 80 percent of total value. China provides more than 50 percent of the total and 77 percent of the frozen fillets. Total frozen fillet imports of 34 700 tonnes were valued at US\$114 million with a unit value of US\$3.28/kg. Honduras, Costa Rica and Ecuador provide 89 percent of the fresh fillet imports that command US\$6.05/kg.

Salmon imports into the United States of America reached 179 000 tonnes with a value of US\$871 million in 2004. Sixty-seven percent of imports are fillet products representing 70 percent of value. Average price is US\$4.86/kg while fillets sold for US\$5.06. Sixty percent of the total imports originate in Chile with the remainder coming primarily from Canada. Canada is the leading exporter of whole fresh fish to the United States of America with 78 percent of the market.

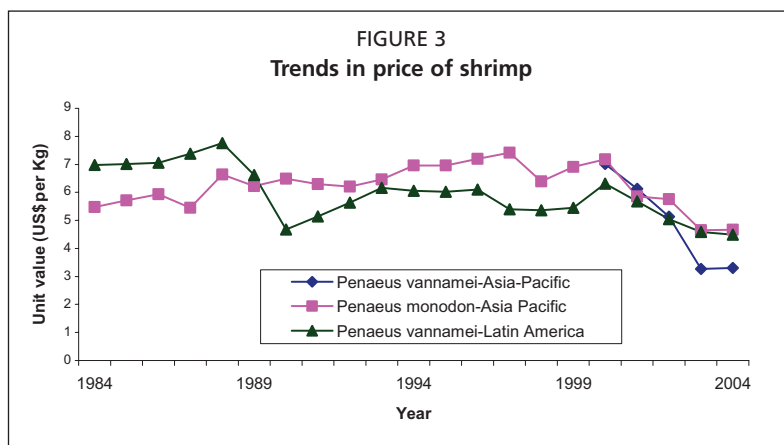
Shrimp is the most popular seafood in the United States of America with imports reaching 500 000 tonnes in 2004 with a value of US\$3.7 billion. The average price of all products was US\$7.11/kg. Thailand, China and Viet Nam are major suppliers, however imports from Bangladesh, Mexico and Indonesia have increased recently. Ironically the most significant aquaculture export of the United States of America also consist of shrimps, not the usual frozen shrimps for cooking, but live broodstock shrimps for hatcheries. The export of SPF (specific pathogen free) *Penaeus vannamei* and *P. stylirostris* broodstock may not be significant in terms of quantity or total value, but its impact is considerable both on the total quantity of shrimps produced and on global pricing. Without such exports, it is arguable if Asia's major shrimp producing countries could have recovered from disease outbreaks and severe shortage of healthy wild-caught broodstock of native penaeids, much less grown significantly to the present level of production.

The majority of Canadian salmon production is exported to the United States of America and to a lesser degree Japan, Taiwan PC and France. Canada exported US\$370 million in seafood products in 2004 with United States market accounting for almost 95 percent of the total. Canada holds 47 percent of the nearly US\$1 billion United States salmon market, competing primarily with Chile which holds a similar market share.

In some countries in the Near East and North Africa, advertising and public education campaigns have been effective in stimulating demand for aquaculture products. Two examples are Iran (Islamic Republic of) and Saudi Arabia, countries with large interiors, where the inland populations are less familiar with buying, preparing and eating fish, than are the coastal populations. The inland populations thus represent potential new consumers for aquaculture products. Advertising and education for these groups enters into affect after the industry has reached a certain critical mass, in other words, there is enough supply to attract the market and it is reliable.

FOOD SAFETY, IMPORT REQUIREMENTS AND MARKETS

Competition aside, market access requirements that include non-tariff barriers to trade, technical barriers to trade and sanitary and phytosanitary (SPS) and food safety requirements have by themselves stimulated various responses from exporting



It is clear that the price of P. vannamei in Asia is declining. This contributes to the declining global price of shrimp as P. vannamei now plays a major role in global shrimp production.



COURTESY OF ROHANA SUBASINGHE

Sturgeon hatchery in Islamic Republic of Iran. Besides aquaculture, culture based fisheries is a significant sector in Iran. Production of hatchery bred sturgeon fry for stock enhancement in the Caspian Sea is a regular activity of the Iranian Fisheries authorities.

countries. In general, the responses can be seen as beneficial in the long run to the aquaculture sector, although apprehensions have been expressed on their impacts on the small and poor farmers, who do not have the economy of scale to comply cost-effectively with the requirements. Government and private sector institutions are also not well oriented towards supporting the large numbers of small-scale producers to address the complex issues surrounding food safety and traceability.

The global trade liberalization agenda has had a marked impact on Asia's seafood trade. Resolutions and agreements on market access issues, regulatory measures on health and food safety requirements and a host of other forms of technical barriers to trade are, in the coming years, expected to affect seafood exports from developing Asian countries. With the rising population and demand (including export demand), expansion of supplies to maintain food security has emerged as a priority concern. However, looming on the horizon are threats to fish supplies and fishery livelihoods due to resource degradation, weak public support and investment and potential worsening inequities in global trade (Dey and Ahmed, 2005).

A driving force has also been the need to comply with an ever increasing number and stringency of market requirements. The flashpoint may have been the rejection of shrimp exports by the EU but a combination of Technical Barriers to Trade Agreements (TBTs,) SPS, and Non-tariffs Trade Barriers (NTB) has prompted the broadening and hastening of initiatives that were already in place, such as Association of Southeast Asian Nations' (ASEAN) focus on competitiveness in trade, and the FAO, Network of Aquaculture Centres in Asia-Pacific (NACA), Worldwide Fund for Nature (WWF) and the World bank (WB) Consortium on Shrimp Farming and the Environment's work on international principles for responsible shrimp farming aimed at developing uniform certification standards and better management practices².

In most Latin American and Caribbean countries, plant certification programmes have been put in place by their health authorities in order to export fishery and aquaculture products. Some programmes are of particular note such as the SSOP (Standard Sanitary Operation Process) and the HACCP (Hazard Analysis and Critical Control Points), the application of which is required by the United States of America in order to approve importation and internal sale and by the European Union. Other institutions now carry out or implement studies for Residue Control Programmes in aquaculture operations and in plants, whose certification guarantees the quality of products, through tracing and traceability.

While developing countries have found it initially expensive, institutions are being built to support the tightened regulatory requirements for production and assurance of quality and safe aquaculture products. These include investment in capacity for the analysis of "contaminants" or "impurities" at the level of precision required by the importing countries. Most importantly, they have installed measures to prevent the appearance of residues and use of banned drugs in their products through good management practices employing such drastic measures such as confiscating drugs suspected of being diverted for livestock and aquaculture use. At present, most countries have the capability to apply HACCP to the production process which includes traceability, although practical implementation is still not widespread. There is a growing awareness of the need to adopt a uniform standard for aquaculture products whether for export or for domestic consumption, however, to date there is limited international progress on such standards.

In 2003, Thailand launched a comprehensive food safety and quality ("Farm to Plate") programme in order to maintain its competitiveness in the export market but also to assure local consumers and stimulate additional domestic consumption of seafood. The programme included product and process certification, promotion

² www.enaca.org/modules/tinyd2/index.php?id=2

of voluntary adoption of a package of good aquaculture practices aimed at food safety and quality as well as a more comprehensive code of conduct which includes environmental friendly practices, requirement of processors to install HACCP and other quality assurance protocols and strict policing of the use of banned chemicals and drugs.

Probably the most interesting case that depicts the success of an exporting country, and future prospects, in dealing with competition and non-tariff trade barriers is that of Viet Nam by diversifying its market for the *Pangasius* catfish (Globefish, 2005).

During the first nine months of 2005, Viet Nam exported 89 300 tonnes of *Pangasius*, generating US\$212.3 million, an increase of 58 percent in volume compared to the same period during the previous year. The catfish anti-dumping case, 2003, along with related bond requirements in 2005, has prevented Viet Nam from maintaining in recent years a stable growth rate on the United States market. The United States of America is no longer the biggest customer for Vietnamese *Pangasius*. The share of exports destined for the United States of America has decreased to 11.7 percent compared with 37.3 percent for the EU. This success story, however, raises the question of whether price competitiveness can be sustained and its long-term impact on the producers. The report (Globefish, 2005) points out that the competitive advantage of Vietnamese *Pangasius* has been based on lower prices, which may not be feasible in the long term. It implies a low marginal profit level which is unlikely to encourage production expansion. In addition, anti-dumping remains a potential threat with low price levels. In this regard, Vietnamese enterprises are currently intensifying efforts to meet strict EU requirements on quality, hygiene and safety. Exporters are examining approaches to value addition through product innovation.

Product labelling is applied in Madagascar, Mozambique, South Africa and Uganda, while the United Republic of Tanzania has developed legislation for labelling. On the other hand, however, Côte d'Ivoire and Ghana have implemented a ban on imports of aquaculture products in order to protect their emerging industries.

AQUATIC ANIMAL HEALTH, TRADE AND TRANSBOUNDARY ISSUES

Globally, aquaculture is expanding into new areas, intensifying and diversifying; as is trade in aquaculture species, products and services. Only through the trade of aquaculture commodities, live animals or products, can the primary producers earn their livelihoods and improve their economic well-being. Trade is always associated with economic benefits and hence will continue legally or illegally. On the other hand, trade in aquaculture commodities carries an inherent risk of moving and spreading aquatic animal pathogens.

A recent case of disease transmission through trade is the spread of koi herpes virus (KHV). Although known in other parts of the world since 1998, it was first reported in Indonesia in 2002 (NACA/ACIAR, 2002). Since then it has spread to several countries in the region, in most cases associated with movement of live fish. KHV outbreaks in the region have significant trade implications for the high-value ornamental koi carp industry and the important food fish, the common carp. Active trade in ornamental fish poses a potential risk for the further spread of this disease in the region. Recognizing the significance and responding to confirmed outbreaks in Indonesia and Japan, "infection with koi herpes virus" was added in 2003 to the list of diseases prevalent in the region in the quarterly disease reports from Asian countries (NACA/FAO, 2004a). Since its listing, several countries in the region have increased their surveillance, testing and quarantine programmes for KHV.

Infectious disease emergencies may arise within a country in a number of ways, for example: introduction of known exotic diseases; sudden changes in the pattern of existing endemic diseases; or the appearance of previously unrecognized diseases. Contingency planning, early warning and early response are critical to



COURTESY OF STUART MILLAR

Koi Herpes Virus (KHV) infected Cyprinus carpio (koi carp) in Indonesia. This outbreak of KHV, a highly pathogenic virus, caused significant economic losses to the koi carp industry and common carp aquaculture in Indonesia. The disease is now found in several other countries and regions and is appeared to be moving through ornamental fish industry.

the effective management of such disease emergencies. Recognizing the importance of aquatic animal health emergencies in the region, FAO, in partnership with Government of Indonesia, NACA and the WorldFish Center (WFC), organized a pioneering workshop on *Emergency preparedness and response to aquatic animal diseases in Asia* in Jakarta held in September 2004. The workshop reviewed the regional experiences in responding to disease emergencies and developed a set of recommendations to prevent, prepare for and respond to aquatic animal disease emergencies in the region (Subasinghe, McGladdery and Hill, 2004; Subasinghe and Arthur (eds.), 2005).

Various global instruments, codes of practice and guidelines (voluntary or obligatory) exist which provide certain levels of protection, all

aimed at minimizing the risks due to pathogens/diseases associated with aquatic animal movement. One good example in Asia and the Pacific region is the development and adoption of regional guiding documents that take into full consideration the provisions of the WTO-SPS Agreement, the World Organisation for Animal Health (OIE) Aquatic Animal Health Standards, as well as the FAO Code of Conduct for Responsible Fisheries by 21 Asian governments. The Asia Regional Technical Guidelines provide the most comprehensive framework available for the development and implementation of national strategies to address aquatic animal health issues at national, provincial and local levels (FAO/NACA, 2000).

Risk analysis is increasingly being used as a decision making tool to determine risk associated with the movement of live aquatic animals and trade in aquatic products. International (e.g. OIE) and regional (e.g. NACA) disease reports provide regular and updated information on diseases of concern to facilitate risk analysis and minimize the introduction of pathogens as a result of trade. Towards training and capacity building, NACA in collaboration with Asia-Pacific Economic Cooperation (APEC), FAO, OIE and other partners, conducted two regional workshops on "Capacity and awareness building on import risk analysis for aquatic animals" in 2002. In addition, a risk analysis manual produced through this collaboration has provided a technical guide for implementing risk analysis (Arthur and Bondad-Reantaso, 2004; Arthur *et al.*, 2004).

From an aquatic animal health perspective, irresponsible practices (e.g. misuse of chemicals) adopted by farmers, with no access to technical knowledge, could lead to food safety problems in aquaculture products. This underlines the need to equip primary producers with necessary skills and knowledge so that the commodities they produce meet the requirements demanded by the market and consumers. As an example, a collaborative project in India between the Marine Product Expert Development Authority (MPEDA) and NACA supported by FAO has successfully brought together shrimp farmers (organized into aquaclubs) to collectively implement better management practices (BMP) to reduce disease-related losses, improve yields and produce quality and antibiotic-free shrimp. During 2005, the BMP implementation was carried out successfully at 15 villages in Andhra Pradesh and 5 villages in 4 other coastal states. In Andhra Pradesh and Gujarat, 635 and 88 farmers, respectively, participated in the demonstration programme.

The harvest results, from 930 demonstration ponds spread over 484 ha and 15 aquaclubs of Andhra Pradesh showed a two-fold increase in production, 34 percent increase in size of shrimp, 15 percent increase in crop duration, 68 percent improvement

BOX 1

Better management practices implemented by cluster shrimp farmers in Andhra Pradesh, India**Pond bottom preparation and water management**

- Sludge removal and disposal away from pond site.
- Ploughing on wet soil if the sludge has not been removed completely.
- Water filtration using twin bag filters of 300 μ mesh size.
- Water depth of at least 80 cm at shallowest part of pond.
- Water conditioning for 10-15 days before stocking.

Seed selection and stocking practice

- Uniform size and colored PLs, actively swimming against the water current.
- Nested PCR negative PLs for WSSV (using batches of 59 PLs pooled together. If test turns negative it means that the prevalence of WSSV infected PLs is less than 5% in that population at 95% confidence).
- Weak PL elimination before stocking using formalin (100 ppm) stress for 15-20 minutes in continuously aerated water.
- On-farm nursery rearing of PLs for 15-20 days.
- Stocking during 1st week of February to 2nd week of March
- Seed transportation time of less than 6 hrs from hatchery to pond site.
- Stocking into green water and avoiding transparent water during stocking

Source: NACA/MPEDA/FAO cluster management in small-scale shrimp farming in Andhra Pradesh, India. www.enaca.org/shrimp

in survival and 65 percent reduction in disease prevalence when compared with surrounding non-demonstration ponds. As a result, for every 1 000 rupees (US\$22) invested, demonstration farmers made a profit of 128 rupees (US\$2.9), while non-demonstration farmers made a profit of only 38 rupees (US\$0.86). This farmer-focused participatory project demonstrated that, through simple science-based, extension programmes, it is possible to bring about marked changes in the attitude of primary producers and equip them to pro-actively respond to market requirements (e.g. record keeping, traceability, chemical-free aquaculture) and stay in business.

In the Near East and North Africa, more than half of the 17 countries in the region report that their disease monitoring capabilities and programmes are inadequate. There is a scarcity of suitably qualified diagnostic laboratories, particularly for viral diseases, which are considered to be under-reported in the region. Hence, should an infectious disease emergency arise, the region is ill-equipped to respond. A regional alert system and a comprehensive regional centre of expertise in fish and shellfish health are urgently needed.

INTERNATIONAL TRADING AGREEMENTS, LAWS AND COMPLIANCE

Trade remains a potentially volatile area of tension between developed and developing countries and between the rich and the poor. The complexities of food safety and public health concerns in importing countries can dramatically affect access to markets particularly by small-scale farmers/traders in developing countries. Developing countries that can address the new hygiene and food-safety requirements, fair labour practices, and environmental needs will have the opportunity to capture the more lucrative export markets. An analysis of emerging trade patterns in fish products and the trade regime in which this is occurring indicate that food safety regulations, HACCP processes and technical barriers to trade have introduced high costs that tend to exclude the small producers and processors from the export supply chain (Dey *et al.*, 2005).

These authors point out that traditional market chains, usually long, may no longer be viable for the poor and in effect may make it too costly for many developing countries to compete on the world market. If the poor are to benefit from this potentially profitable trade, policymakers will need to find ways to include smaller scale operators (producers and processors) in those processes and to assist and support the adoption of improved management and technologies in order to minimize the costs of compliance. The study recommends identifying measures to reshape global trade arrangements and policies on production and post-harvest technology, marketing and resource use that are consistent with the efficiency, equity and sustainability of aquatic resources. These would aim to establish a trade environment that provides greater access to export markets and a fair share of the benefits of trade to poor people.

In Eastern Europe, major international standards (i.e. ISO 9001, HACCP) have already been established in almost all the countries of the region. Processing factories and also some fish farms apply these basic standards, however, specific labelling and certification schemes for aquaculture products are rare and existing schemes are largely undeveloped. Efforts have been made in some carp producing countries to promote their products through trademarks such as “Cesky Carp” or “Czech Carp”. Standards for the production of organic fish have not been elaborated in these countries except for Hungary, where the certifying body is Biokontrol Hungaria, a non-profit organization, belonging to the Ministry of Agriculture and Rural Development.

Labelling programmes in these countries are underdeveloped, however, some efforts in establishing traceability are noticeable in EU member countries of this region. There is a growing interest in such programmes but no serious initiative has been taken so far. Most of the fish products are sold in local markets, where a large segment of the consumers look for cheap products and are less concerned about quality and traceability. Although various quality schemes are already available in most of the Eastern European countries such as EMAS (Eco Management and Auditing Scheme), fish farmers are either not familiar with such systems or refuse to pay for the certification which may not pay off for them.

For some countries in North Africa, namely Morocco and Tunisia, compliance with strict EU regulations for finfish and shellfish is the key to their existing export market. Egypt is in the process of adopting and applying EU regulations on safety and quality

control, which will be essential for the emerging export sector. In the Near East, Saudi Arabia is also in compliance with EU standards, and can now export shrimp to this market (previously Saudi Arabia exported prime shrimp to Japan, Australia and United States).

Although the countries within the Near East and North Africa exhibit a great heterogeneity in the extent of labelling (traceability), permits and certification that apply to their aquaculture products, this does not appear to be related to volume of aquaculture production, or to duration of establishment of commercial aquaculture. Regulation, via



COURTESY OF MATTHIAS HALWART

Aquaculture products with certified organic produce displayed in a supermarket in Germany. High value products such as salmon and shrimp are increasingly being subjected to labeling and certification to ensure consumer acceptance and market access. Certification of aquaculture products for safety, quality and environmental sustainability is a challenge for Asian shrimp as they mainly come from small-scale producers.

permits and/or certification for export of market-sized fish and for export and import of fish eggs, juveniles and broodstock, is, however, in place in most of the countries in the region.

WTO/SPS AGREEMENT, RELATED ISSUES ON COMPLIANCE AND CHALLENGES FOR SMALL PRODUCERS

The more fundamental effects of WTO membership on policies are illustrated by the experience of China. In general, policy responses associated with WTO accession take one of two forms: to enable a country to keep its commitments to WTO accession and align existing domestic policies with WTO's; rules or to introduce new measures allowed under the new framework. In this regard, a study of China's policy adjustments in its fishery sector after its accession to the WTO gives a broad perspective of the effects of compliance with WTO regulations on a nation's aquaculture sector (Luping and Huang, 2005).

The government's response to WTO involved an entire shift of its policies, from directly intervening in the economy to playing an indirect, regulatory and fostering role. The specific policy and institutional adjustments have been on:

- (i) Changes in laws and regulations. Essentially, the new regulations aim to transfer government functions to the market economy and direct the government to take a more indirect role in commerce and trade activities. They try to limit government intervention and emphasize that the role of government is primarily to provide social and public services. The regulations also seek to simplify administrative processes;
- (ii) Encouragement of farmer organizations. The creation of farmer organizations used to be a politically sensitive issue. Recognizing that government investment in creating such farmer organizations as agricultural technology and marketing groups will not be counted as part of the nation's aggregate measurement of support (AMS), the government has now officially thrown its support behind self-organized farmer groups that focus on agricultural technology and marketing. Perhaps most importantly, the government is going to need these farmer organizations to lead the fight against the imposition of trade barriers on China's agricultural exports and to protect the interests of domestic agricultural exporters and producers;
- (iii) Tax reform. To make the rural economy more competitive and to remove a set of institutions that has historically caused a lot of frustration among rural residents, the government has begun to experiment with rural tax reform. The boldest experiment to date is based on a movement that seeks to "convert fees into taxes". The earliest experiments began in Anhui Province in 2000. The reform was designed to reduce the burden of various fees imposed on farmers to a maximum level of 5 percent of the farmer's income.

Challenges for small-scale producers

The above case illustrates government's response to a new world trading regime by making adjustments and market-oriented reforms in a broad national context. However, notwithstanding WTO rules and regulations that are meant to level the international trading field, it has been the non-tariff trade barriers and other market access requirements, related to food safety, environmental, animal welfare and other issues such as bio-terrorism imposed by importing blocs that have driven reforms in production sectors. The other side of the coin is the same have been seen as threats to the continuing viability of small farmers simply because they raise the cost of farming. Apprehension has been expressed (NACA/FAO, 2004), that the increasing number and stringency of market requirements could drive the poor, small farmers – unable to comply with all these requirements – out of farming. Other studies have shown that poor access to capital and the high capital requirements for certain technologies and farming systems either make it difficult for the poor to enter or stay in farming (Ahmed, Rab and Bimbao, 1994).

Consequently, the high capital needed to adopt technologies and high cost of compliance with market requirements raise the spectre in Asia (where more than 80 percent of fish farmers are small scale) of hundreds of thousands of displaced and unemployed farmers, or farmers turned labourers in what used to be their farms being consolidated by some corporate giant.

The obvious impact of the increasing number and stringency of market requirements on developing country producers and exporters, many of which are small and mostly unorganized, will be higher costs of production and compliance. Not so immediate and not so evident, but a valid apprehension nevertheless, is that the high cost of compliance could become onerous to the small aquaculture producers or even large but unorganized producers with the result that they might eventually be pushed out of business. The challenge, therefore, is to enable the small farmers to take advantage of the economies of scale and thus be able to comply with market requirements by being well organized, while using the same market requirements to encourage responsible and sustainable practices. In the face of many barriers, meeting this challenge will also require much commitment from and cooperation among stakeholders (NACA/FAO, 2004).

In Asia, transparency and cooperation in information sharing and the need to strengthen information and intelligence capacities with information technology has been continuously emphasized. The forums have raised the prospects of developing countries moving into *e-commerce* and establishing mutual arrangements that facilitate and reduce cost of information flows, speed up the processing of “documents” and improve the efficiency of handling and moving products. Among trading partners, establishing common customs procedures and operations would reduce very high compliance costs, which had been estimated to be 7–10 percent of the value of global trade (UNESCAP, 2001). Applied to global trade in aquatic products, that is a cost of around US\$4.3 to 6.0 billion.

In Latin America and the Caribbean, governments do not establish protection policies for small-scale producers. In general, only sanitary regulations are established and become obligatory for the safety of fisheries and aquaculture products for export. In certain cases aquaculture associations have undertaken efforts to establish support programmes to achieve quality, traceability, added value, biosecurity and promotion of exports (e.g. Brazil, Chile). On the other hand, countries such as Guatemala promote programmes to pledge banking warranties when producers apply for credit or loans. In Nicaragua, education is promoted among producers to fulfill national and international regulations. Guidance and direction is given in Paraguay through policies for new product incorporation to export lines. Associations for quality assurance policies and better practices are supported in Peru. In Venezuela, the exploitation of certain species is reserved solely to artisanal or subsistence fishermen or their community organizations. Costa Rica maintains a special tax policy as well as phyto- and zoo-sanitary measures for all aquatic species and products.

In sub-Saharan Africa, there is very little evidence to suggest that there are any country specific strategies to safeguard small-scale producers from impacts of compliance to international trading standards, though at this stage there is hardly a need for this. However, Mozambique, Madagascar and South Africa have implemented strategies to safeguard larger producers of export commodities.

Trade in non-food aquatic products

There is an increasing trade in ornamental fish and plants (excluding seaweeds) and other products that are raised for non-food purposes. Interest from governments in promoting the culture and trade of non-food aquatic species, particularly ornamentals, has been spurred by their growing potential for increasing rural employment and generating income among small rural and even urban families. By 2000, the global total wholesale value of live ornamental fish both freshwater and marine (live animals

for aquarium only) was estimated at US\$900 million with an estimated retail value of US\$3 billion.

Asia provided more than 50 percent of the global total ornamental fish supply (FAO, 2000). Estimates place the annual value of the marine ornamental trade at US\$200–330 million; the overall value of the marine fish trade accounts for about 10 percent of the international ornamental fish trade (marine and freshwater included)³.

Ornamental fish are also produced for regional and international markets in Cameroon, Kenya, Uganda, Malawi, South Africa and Zambia, though no accurate figures are available, except for South Africa. The most important non-food aquaculture products exported from sub-Saharan Africa are Nile crocodile skins⁴. Crocodiles are produced in several countries. The industry is growing particularly rapidly in South Africa, Zambia and Madagascar. Live bait fish are exported from Uganda and Kenya to the United Republic of Tanzania for the Nile perch long-line fishery on Lake Victoria. No figures are available for the volume of fingerlings exported. Except for the east coast seaweed industry, crocodile and ornamental fish farming, very little is known about non-food aquaculture in the region. The continent has an immense diversity of fishes and ornamental fish offer enormous potential in West and East Africa, particularly cichlids, cyprinids and catfishes. South Africa is the major producer of ornamental fish in the region and some 21 tonnes were exported in 2003. Except for Seychelles, there is no pearl farming in sub-Saharan Africa, although some experimental work has begun in Kenya.

Southeast Asia is the hub of the ornamental fish trade, supplying up to 85 percent of the aquarium trade⁵.

The production of non-food aquatic species is very limited or non-existent in CEE countries, except ornamental fish, which are produced in a few food fish production farms as secondary species. The exception is the Czech Republic where ornamental fish production is an integral part of the aquaculture production; the total value of exported aquarium and ornamental fish was estimated to be US\$120 million in 2003.

In the Near East and North Africa, the principal non-food aquatic species are also ornamental fish, which are raised in Algeria, Egypt, Iran (Islamic Republic of), Libyan Arab Jamahiriya, Morocco, Saudi Arabia and the Syrian Arab Republic. For Egypt, the export of locally bred, imported freshwater ornamentals is growing very fast.

In Latin America and the Caribbean, as well as ornamental fish which are farmed in almost half the countries, alligators are also raised and exported in a quarter of



COURTESY OF ZHOU XIAOWEI

Ornamental fish stall in Thailand. This industry and trade has become an income generator and livelihoods supporter for many people in Asia. Even agricultural farmers are diversifying their livelihoods to raise ornamental fish through satellite farming systems in several countries in Asia.

³ These trade figures were calculated by the UNEP report from export value of the top ten producers. Unofficial figures place these values much higher. There is also significant intraregional trade which also adds value. www.unep-wcmc.org/index.html?www.unep-wcmc.org/resources/publications/UNEP_WCMC_bio_series.htm-main

⁴ In terms of value, crocodile skins are the most valuable export commodity, followed by ornamental fish, seaweeds and baitfish. This summary is based on South African export figures and the value of seaweeds produced in sub-Saharan Africa.

⁵ Useful references to marine aquarium trade can be found at: Global Marine Aquarium Database: www.unep-wcmc.org/marine/GMAD/; www.marine.wri.org/

the countries. The annual contribution of ornamental fish exports to the national economies was estimated around US\$3.5-4 million. In North America, ornamental fish are a significant industry in the State of Florida (United States) where 178 producers raise 700 species that generated US\$47 million in farm-gate value in 2003. The overall value of the industry is estimated at US\$175 million.

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