

RESPONSIBLE AQUACULTURE: IS THIS A SPECIAL CHALLENGE FOR DEVELOPING COUNTRIES?

Michael B. New, OBE
President, European Aquaculture Society
Past-President, World Aquaculture Society
Wroxton Lodge, 25 Institute Road, Marlow
Bucks SL7 1BJ, United Kingdom
michaelnew4awf@yahoo.co.uk

ABSTRACT

This review formed the basis for developing the keynote paper given by Michael New at **World Aquaculture 2003** on 20 May 2003 in Salvador, Brazil. After providing definitions of sustainability and responsibility, the review defines the scale of aquaculture in the developing world, particularly in low-income food-deficient countries. Brief outlines of aquaculture in developing countries and the impact of aquaculture critics, codes and trade implications follow. The review then concentrates on aquaculture development for the poor and the role of NGOs in poverty alleviation through aquaculture. Finally, the formation of a new NGO (tentatively named '**Friends of Aquaculture**') is suggested. While the primary purpose of this new NGO would be poverty alleviation through aquaculture, it would also enhance the general public perception of aquaculture as a responsible food producing sector.

INTRODUCTION

Many general definitions of the concept of sustainability exist (Cataudella 2002). Some scholars consider these definitions to be too vague to be of any practical importance; on the other hand, the term sustainability may be useful precisely because it is vague and, like moral principles and human rights, needs to be refined and interpreted on a case-by-case basis (Kaiser 2002). One of the simplest and best known definitions is:

'Sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their own needs'

Another definition, cited by Pullin *et al.* (2003) is:

'Successful management of natural resources ... to satisfy human needs while maintaining or enhancing the quality of the environment and conserving natural resources' (TAC/CGIAR, 1989).

The literal definition of the word sustainable is to 'keep going indefinitely', although in practice this has been modified to include an element of responsibility (e.g. for people, for the environment, for the equitable use of resources, etc.). The word responsibility is probably more appropriate than sustainability because it implies being morally accountable for one's actions. It has been used in relation to both capture fisheries and aquaculture by FAO since at least 1995 (FAO 1995). This was why we used this word in the theme of our joint conference

with the European Aquaculture Society (EAS), AQUA 2000 (Creswell and Flos 2002), which I chaired.

Sustainability includes economic considerations such as:

- will I make a profit?
- will I be able to bequeath my farm to my children?
- and, at a subsistence level, will I and my family be able to eat tomorrow?

We need to attend to economic and socio-economic factors, not just the environment. We talk about animal welfare, for example; we must not forget the welfare of owners and operators.

The concept of sustainable aquaculture is not as new as many people believe. Davy and MacKay (1999) charted its slow early progress as a spin-off from the much greater interest in the 1970s in sustainable agriculture. One of the pioneers who mentioned it was William McLarney, a co-author of the first 'aquaculture bible' (Bardach *et al.* 1972). Probably the first mention of what was then termed 'ecological aquaculture' in a WAS publication occurred twenty years ago (MacKay 1983). Early developments in sustainable aquaculture in the 1980s and early 1990s were driven by interest from NGOs, researchers and farmers (Davy and MacKay 1999); donors only became involved after the UNCED meeting in Rio in 1992.

The words sustainability and responsibility are generally used synonymously in aquaculture meetings and documents; this review will be no exception but I will try to use the words responsible aquaculture, since that is in the title of our meeting here in Brazil. I ask those whose papers I cite to forgive me if I occasionally substitute the word 'responsible' for what they originally wrote. My personal definition of responsible aquaculture is simple:

'Responsible aquaculture is profitable aquaculture with a conscience'.

Most concerns about responsibility involve the impact and control of aquaculture that is intensive (e.g. farming in marine cages and in tropical ponds) and/or targets high-value export and domestic markets. The species that gain most attention are salmon and shrimp. Responsible aquaculture has been the topic of numerous conferences, symposia, and workshops over the past 10-15 years (e.g. PACON 1995; Bardach 1997; Nambiar and Singh 1997; IFS/EU 1998; ADB/NACA 1998; Pullin *et al.* 1999; NACA/FAO 2001). Scientists and administrators were the main people involved in these meetings. Responsible aquaculture has been a thematic or session topic in many previous World Aquaculture Society (WAS) conferences. In these, the audience broadened to include producers. However, until the time of the WAS meeting in Seattle, shrimp farmers, processors, exporters, and distributors, together with feed manufacturers, had largely shunned the debate on responsibility and taken a very defensive posture (Hargreaves 1997). Even though few took part in the conference session on this topic in Seattle in 1997, they were busy forming the Global Aquaculture Alliance in a satellite meeting to mount a coherent response to the attacks being made on the shrimp farming industry.

Several formal public sector initiatives designed to promote responsible aquaculture have been taken in recent years, including the aquaculture related sections of the Code of Conduct for Responsible Fisheries (FAO 1995), the Bangkok Declaration and Strategy for Aquaculture Development beyond 2000 (NACA/FAO 2001) and the Holmenkollen Guidelines (NATS 1997; Sundli 1999). Though such documents are not intended to be

restricted for use by international, regional and national governmental organizations (Cataudella 2002), these seem to constitute the main audience so far achieved. Efforts have been made to increase dissemination of the content of these documents, both through regional adaptation (Pedini *et al.* 2000) and through the aquaculture media, but I believe that they have not yet reached far beyond administrators and scientists in the public sector and in the larger private sector companies. Amongst the global and regional institutional and educational leaders in promoting responsible aquaculture are FAO, NACA, ICLARM (WorldFish Center), SEAFDEC and the Asian Institute of Technology, often with specific focuses on rural aquaculture.

When considering responsibility, there is a danger that our thoughts, with some notable exceptions, may revolve around intensive aquaculture and the technologies for rearing global commodities like salmon and shrimp, or regionally high value products - such as marine carnivorous fish. These types of aquaculture attract public research funding in so-called industrialized and, increasingly now, in developing countries. Naturally these forms of aquaculture are also the most attractive to large-scale producers (and their feed and other suppliers), wherever they operate. It is also intensive aquaculture that attracts most attention from regulators, the drafters of codes of best management practice, environmental and socio-economic NGOs, and (last but not most important) the general public, including those who can afford to consume its products.

It is difficult to imagine that the idea of long-term environmental responsibility could be attractive to someone who is wondering where the next meal will come from and whether the family can be fed next week or next month, let alone next year. Thoughts of environmental and generational sustainability have to be way below the priorities of current survival. Those of us who have not yet had the privilege of working in developing countries may not understand this. Oscar Wilde noted (Rolfe 1997) that:

'there is only one class in the community that thinks more about money than the rich, and that is the poor. The poor can think of nothing else. That is the misery of being poor'.

SCALE OF AQUACULTURE IN DEVELOPING COUNTRIES

Aquaculture produced 29 per cent of total global foodfish supplies in 2001, up from 14 per cent in 1991 and 7 per cent in 1981 (Figure 1), a very healthy increase. Delgado *et al.* (2002) forecast that the proportion provided by aquaculture will rise to 41 per cent by 2020. However, such generalizations are often misleading. It is important to remember that a significant proportion of the totals of both captured and cultured foodfish arise in China. If the data for China are set aside, it can be seen that aquaculture produced only 5 per cent of the foodfish supplies in the rest of the world in 1981, and grew more modestly to 8 per cent in 1991 and 13 per cent in 2001.

Aquaculture production in industrialized countries was about 9 per cent of the global total in 2001. Even when Chinese production is excluded, the output of foodfish (fish, crustaceans and mollusks) from aquaculture in developing countries is much greater than in industrialized countries and the gap is widening (Figure 2). About 7.5 million people work in fish farms, and the numbers doubled between 1990 and 2000 (Table 1). Most are in the developing countries of Asia. While the workforce remained relatively static in the Americas, Europe and Oceania, significant increases occurred in Asia and, on a totally different scale, Africa, during this decade. The value of foodfish produced in industrialized countries seems to have leveled off but in developing countries it is still expanding (Figure 3).

In coastal areas (Figure 4), when Chinese production is excluded, production in other developing countries (20 per cent) is similar to that in industrialized countries (17 per cent). Even excluding Chinese production, freshwater aquaculture (Figure 5) in other developing countries (24 per cent) is much more productive than in industrialized countries (3 per cent).

Unsurprisingly, most shrimp production occurs in tropical developing countries (Figure 6). Most salmon production occurs in industrialized countries but a significant proportion now comes from one developing country, Chile, which produced almost as much as Norway in 2001 (FAO 2003). Since then, Chile has overtaken Norway as the largest producer of farmed salmon and trout (Anonymous 2002j).

Aquaculture is of particular importance in what are termed low-income food-deficit countries (LIFDCs), the poorest countries. Aquaculture production in the LIFDCs is 82 per cent of the global total (Figure 7). However, as in the case of so many other statistics, China's production data have a dominating influence (69 per cent of the global total). The production of foodfish in the other LIFDCs is about 13 per cent of the global total. In addition, a further 9 per cent is produced in other developing countries.

Aquaculture is responsible for more than one third of the total foodfish production in eleven of the top twenty-five aquaculture producers amongst the LIFDCs (Table 2). Aquaculture provides an extremely important source of food in several of the most populous LIFDCs (e.g. Bangladesh, China, Egypt, India, Indonesia, and the Philippines) but less so in others, such as Nigeria and Pakistan. There is considerable further potential for aquaculture, not only in these countries but also amongst those LIFDCs not in the top 25.

FAO aquaculture statistics demonstrate the importance of farmed fish to developing countries, particularly to the LIFDCs. However, these data exclude the farmed fish that are produced, consumed and sold locally by poor rural people within these countries. Aquaculture is therefore much more important to developing countries than the statistics indicate and there is considerable further potential for food production and poverty alleviation, as well as for further expansion in exports.

RESPONSIBILITY OF AQUACULTURE IN DEVELOPING COUNTRIES

Intensive coastal aquaculture

Shrimp is the most traded seafood product (FAO 2002d). 30 per cent of the supply comes from aquaculture (FAO 2003), almost all from developing countries, where this activity

(Figure 8) has been the major focus of environmental and socio-economic attention. Although there have been problems caused by irresponsible development of this form of aquaculture, great strides towards improvement have been made.

An unfair proportion of the blame for mangrove destruction is still directed at shrimp farming. Recently, the World Wildlife Fund attempted to classify the most seriously 'at-risk' of the world's ecoregions, including mangrove swamps (Water Farming Initiative 2002). This WWF inventory makes it clear that shrimp farming is only one of the causes of mangrove destruction (often minor). Although aquaculture may have been a primary cause in some areas, other human activities constitute a far greater threat. Non-aquaculture activities causing mangrove damage include:

- pollution from urban, industrial and agricultural sources;
- over-fishing;
- oil extraction and transport;
- timber cutting;
- silt formation from soil erosion;
- dam construction;
- tree cutting for charcoal production;
- general deforestation;
- dynamite and poison fishing;
- urban expansion;
- tourism;
- agricultural expansion and irrigation; and
- salt production.

Referring to the WWF mangrove study, Chamberlain (2002a; 2002b) noted that other human activities had caused twenty times as much mangrove destruction as shrimp farming. However, he said that mangroves continue to be converted into shrimp farms, especially in remote areas. Thus, balanced strategies for the integrated use of coastal areas, better enforcement of conservation policies, and improved education in the importance of conservation are still required. Other, less productive human activities than those listed above also cause mangrove destruction. For example, Martinelli (2000) noted that the use of herbicides and napalm during what the local population term the American War of 1962-1975 resulted in the destruction of nearly 40 percent of the mangrove forests in southern Vietnam. Aquaculture is clearly not the greatest culprit but has received the brunt of the blame.

Some countries, following the recommendations of various codes of conduct and practice, have tried hard to reduce the use of mangrove areas for shrimp farming. These efforts have not only included banning the development of new farms in these areas but also reforestation. An illustration of the attitude towards site choice and construction can be seen in an 180 mt/yr shrimp farm near La Foa in New Caledonia (Figure 9). This figure illustrates the site before and after construction; mangrove destruction has been carefully avoided. Furthermore, responsibility in this farm is enhanced by the application of quality standards concerning density, rearing duration, feeds, techniques, and a total ban on the use of antibiotics during the grow-out phase (Y. Harache, pers. comm. 2002).

Fast and Menasveta (2003) noted that conversion of mangroves for shrimp culture in Thailand mainly occurred during the phase (before 1987) when extensive production

technologies were used. Most farms built after that date were intensive and built above the tidal range, behind the mangroves or in non-mangrove areas, but some further conversion of mangroves did occur between 1986 and 1996. However, while Thai farmed shrimp production continued to increase after 1996, the mangrove area also increased by 46 per cent (nearly 77,000 ha) between 1996 and 2000. By 2000, the total area of mangroves in Thailand had expanded to a level a little greater than it was in 1980, before intensive shrimp production boomed. This increase in mangroves is attributed to a greater public awareness of their importance, the decline in extensive methods of farmed shrimp production, the banning of new concessions for mangrove forest exploitation, and reforestation.

Shrimp farms constructed and operated in an irresponsible manner have had an impact on crop production and the quality of water for human use. In India, Khan *et al.* (2000) showed that a 50 m wide, 4 m deep freshwater channel or a 60 m terrestrial gap as a buffer zone between shrimp farms and agricultural fields benefited water quality for crop production. On the other hand, sustainable shrimp farming technologies have been developed (Kongkeo 1997) and applied in the dry tropics (New, 1999a).

Bilio *et al.* (1999) thought that balancing economic development, the interests of the local population, and the conservation of the environment might often seem to be an impossible task. To find a lasting solution to such conflicting interests, all the stakeholders must be given the possibility to participate in the process. Following significant socio-economic and environmental problems in India (Vivekanandan 1999), major attempts have been made to ensure that shrimp farming becomes a responsible activity (e.g. AA 1999, 2001a; Yadava 2002). An impact study (AA 2001b) concluded, *inter alia*, that aquaculture was less polluting than many other coastal activities (e.g. industries) but that land-use conflicts had occurred in some places where large farms had been established. However, the majority of the farmers follow traditional, improved traditional and extensive systems of farming and most (90 per cent) are small or marginal with a farm size of less than 2.0 ha.

Shrimp aquaculture in India, despite its problems, has contributed to rural employment and the economic development of coastal villages, as well as increasing foreign exchange earnings. An impact study (AA 2001b) is currently being considered by the Supreme Court of India (Anonymous 2002e); meanwhile, no new shrimp farms can be constructed within the Coastal Regulation Zone (coastal stretches influenced by tidal actions up to 500 m from the high tide line). Although a stay on the demolition of existing ponds in this zone was granted in 1997, no new stocking in those ponds originally listed for demolition was allowed. It is interesting to note that not only hatcheries were exempted from this rule but also traditional and improved traditional types of ponds. An attempt to favor small-scale aquaculture over intensive commercial shrimp farming has therefore been made.

Martinelli (2000) noted that shrimp farming in Vietnam is currently dominated by small producers but it presents an attractive target for transnational agribusiness companies, such as Thailand's CP Group, seeking to expand sales of aquafeeds and fertilizers. Some idea of the scale of CP's activities, in this case in Indonesia, is shown in Figure 10. Martinelli (2000) claimed that, after several decades of intensive shrimp production dominated by this vertically-integrated conglomerate, which controls all stages of the input, production, processing and marketing chain, the shrimp industry in Thailand is characterized not only by massive and widespread environmental degradation, but significant social dislocation. However, Edwards (2000) reported that small-scale farmers in Thailand, most of whom were

previously rice farmers or fishers, dominate shrimp farming there. In such circumstances shrimp farming directly contributes to the welfare of the poor. Furthermore, there are indirect benefits, through the diversification of employment opportunities.

The picture is not all bad. It is incorrect to conclude that shrimp farming *per se* is detrimental (Martinelli 2000). While it can pose enormous economic and environmental risks when done badly, it can provide significant potential for responsible poverty alleviation when managed properly. Shrimp farming is often operated by quite wealthy farmers or by medium and large companies. However, with the disappearance of ‘big business houses’ in Bangladesh who had leased land from small farmers, the latter are now producing shrimp successfully, which is helping them to rise out of the poverty cycle (M.C. Nandeesh, pers. comm. 2003).

Marine shrimp culture does not only take place in coastal areas. Its expansion in inland areas in Thailand, which was fostered by the heavy competition for coastal land and the efforts of the government to conserve mangrove areas, causes some concern. Nearly 19,000 ha of low salinity shrimp ponds have been identified in the Bangpakong river basin alone; this represents a large new source of agricultural BOD, comparable to that generated by pig or chicken farming, and is having a significant impact on water quality (Szuster and Flaherty 2002). Eliminating the illegal disposal of pond bottom sediments and imposing waste treatment processes is required. However, aquaculture is not unique in causing problems; organic pollutants from agricultural, industrial and domestic activities are also at fault. Only a coordinated and enforceable water quality policy for the whole river basin could hope to solve these problems.

The potential negative impacts of aquaculture on the environment – loss of ecologically sensitive habitats, deterioration of water quality and reduction in the carrying capacity of the aquatic environment, loss of agricultural land and salinization, loss of ground water, spread of diseases, and the introduction of exotic species – are now well-recognized. Less well publicized are the benefits that aquaculture brings. While providing guidance on avoiding or limiting negative impacts, Siriwardena *et al.* (2001) also listed some of the positive impacts on the environment, which are often neither realized nor documented, for example:

- growing fish in rice fields has limited the use of pesticides;
- aquaculture provides biological control of agricultural pests and vectors of human disease;
- mixed aquaculture-mangrove systems can be used to restore previously degraded mangroves (Primavera 2001);
- farmed mollusks and seaweeds improve coastal water quality, being net removers of nutrients;
- farmed species provide biological indicators for monitoring pollution;
- aquaculture can reduce pressure on wild stocks;
- aquacultural technology can be used in restocking natural fisheries;
- use of mangroves for extensive shrimp culture has been reduced; and
- the development of low-pollution feeds, vaccines, waste treatment facilities and lower stocking densities can reduce environmental impact.

Introductions pose potential threats to biodiversity and health. *Litopenaeus vannamei* has been introduced into China and several countries of Southeast Asia because it is claimed to be faster growing and more resistant to diseases (as well as requiring a lower-protein feed) than *Penaeus monodon*. However, over-expectations, ineffective health controls on imported

stocks, poor biosecurity, and a lack of good captive breeding programs will probably result in increasing problems with *Litopenaeus vannamei* in this region (Fegan 2002). Despite bans on its import into Malaysia and India, commercial culture of this species is taking place alongside or as a replacement to *Penaeus monodon* (Merican 2003). Santiago Caro Ros (2002) noted that the Ecuadorian shrimp farming industry will face severe competition from the Asian production of the Pacific white shrimp, in addition to struggling with its own problems with disease, climatic factors and economic difficulties.

Rural aquaculture

Edwards *et al.* (1997) felt that the term ‘small-scale aquaculture’ was more appropriate than the previously used phrase ‘artisanal aquaculture’. Small-scale aquaculture describes the lower end of the spectrum of aquaculture systems, whether for subsistence, income generation, or both. Many small-scale aquaculture systems are integrated with crop and/or livestock production but some need outside inputs because of limited resources within the farm itself. The term I shall use is rural aquaculture, which can be considered as the ‘poorest of the poor aquaculture’ (very low cost, very low output) whereby most, if not all, of the output is consumed by the producer (or his/her family), or ‘less poor aquaculture’ (low/medium cost, low/medium output) whereby most of the output is sold for economic profit (Ridler and Hishamunda 2001). The term ‘rural aquaculture’ implies low-cost production with extensive and semi-intensive technologies most appropriate for the limited resource base of small-scale households (Edwards and Demaine 1997). Thus it is inclusive of both inland and coastal aquaculture at this level.

We cannot escape the fact that aquaculture, like any other human activity, changes the environment in some form or another, sometimes distinctly beneficial, in other cases harmful (Pillay 1997). However, the promotion of environmentally sound and responsible aquaculture can also contribute in many ways to social and economic development in rural areas, as well as the local food supply (Phillips and Macintosh 1997).

Although the concept of the ‘ecological footprint’, a tool for aquaculture development described by Kautsky *et al.* (1997), is unpopular with some scientists involved in aquaculture, I believe that their paper neatly demonstrated the potential environmental sustainability of rural aquaculture. These authors showed that it is necessary to expand perspectives and actions far beyond the site of the farm to put aquaculture into its ecological context. Their study compared the ‘ecological footprint’ of semi-intensive shrimp farming in a mangrove area of Colombia with intensive tilapia farming in cages and semi-intensive tilapia farming in ponds (both in the Lake Kariba area of Zimbabwe). It is interesting to note that they found that semi-intensive farming, supported on waste products from fisheries, agriculture and households, depends very little on external ecosystem areas. Wilson (1998) stated that:

‘the overriding environmental goal is to shrink the ecological footprint to a level that can be sustained by Earth’s fragile environment’.

It is difficult to argue with that plea for responsibility.

Swaminathan (2000) coined the words ‘evergreen revolution’ to express a stage further than the ‘green revolution’ that had helped to keep the rate of growth in food production above the rate of population growth. In developing this concept of agriculture, it was stressed that

future advances in production will depend on the principles of ecology, economics, social and gender equity, and employment generation to ensure sustainability. Perhaps what we need in aquaculture is an 'everblue revolution'.

In the first of a series of articles in *Aquaculture Asia*, Edwards (2001a) noted that the 'blue revolution' in aquaculture has not yet taken place outside China but rural aquaculture has vast unfulfilled potential to contribute to food security and poverty alleviation. To take advantage of this potential, an understanding of the knowledge, problems and priorities of local people is critically important – a 'farmer-first' approach. In his second article, a personal review of the 'state-of-the-art' of rural aquaculture was provided to provoke dialogue (Edwards 2001b). In it, the benefits for the poor are listed as improved food supply, employment and income. Direct benefits include the generation of highly nutritious food for family use, 'own-enterprise' employment, and income through the sale of produce. Indirect benefits include increased local availability of fish and employment in larger grow-out farms and within ancillary activities such as fry production, marketing and equipment. Further indirect benefits accrue through an increase in general farm sustainability, for example by using ponds as on-farm reservoirs and employing rice/fish culture as a component of integrated pest management.

Sorgeloos (2001) commented that although traditional aquaculture still produces the major part of global aquaculture output, it has been based on trial and error practices, evolved over a very long time, and has received minimal research inputs. Despite this it was mainly comprised of well-balanced, extensive production systems. He felt that the recent attempts to intensify this form of aquaculture implied serious threats to sustainability; however, more research on pond culture systems could improve the economics of production as well as ensure better environmental sustainability. It is important to remember that external environmental threats are often a greater danger to the development of aquaculture than the effects of aquaculture on the environment (Hecht 2001).

Governments should give increasing attention to rural aquaculture (D. Menasveta, pers. comm. 2002). However, the attractions of profiting from export oriented, foreign exchange earning aquaculture activities have often proved too seductive. Martinelli (2000) warned that there was a risk that governments may be just as susceptible to being dazzled by the promises of riches as the average small farmer. He recommended that the (Vietnamese) government should adopt a more cautious approach that seeks to balance the twin objectives of sustainable poverty alleviation and economic development. In his view, ensuring that the benefits of increased intensification of production were shared widely and contributed to national economic development would also depend on being able to resist the trans-national corporations which were dominating the aquaculture industry. In the majority of developing countries, weak economic conditions dictate that their governments concentrate on those development activities which result in quick income and foreign exchange earnings (D. Menasveta, pers. comm. 2002). Thus conservation and the responsible use of natural resources are only theories, notwithstanding UN conferences on sustainable development.

Less intensive systems of aquaculture often have low impact on the environment (P. Edwards, pers. comm. 2002). Indeed, the impacts of semi-intensive ponds (when in multiple use with vegetable and livestock enterprises) on the environment, through conservation of surrounding habitats and species, may be distinctly positive (Pullin 2001). For example, the conversion of low-lying areas to perennial ponds can benefit surrounding natural habitats and

organisms by increasing the availability of water. Extensive systems with only naturally occurring nutrients are still viable where the opportunity cost of land is low but semi-intensive systems receiving supplementary fertilizers and/or feeds produce most farmed fish and livestock in Asia (Little and Edwards 1997).

Fish culture has proved successful in improving the standard of living of rural farmers in Asia, where fish culture has a long tradition (Edwards 2000). Despite this, the promotion of aquaculture for rural development has had a poor record in many developing countries, especially in Africa. Insufficient attention has been paid to the role of aquaculture in the livelihood or farming system of the intended beneficiaries (in Africa and elsewhere); the result has often been lack of adoption by one of the intended target groups, the rural poor (FAO 2002b). Social, economic and institutional issues remain the greatest constraints to enhanced contributions towards rural development by aquaculture but a more holistic approach towards improved livelihoods and greater household food security is emerging (Halwart *et al.* 2002). Earlier failures in reaching the rural poor prompted a decline in donor support for aquaculture over the last decade (FAO 2002b). However, with adequate support, aquaculture could contribute significantly to rural development in countries where it is neither a traditional nor widespread practice (Edwards 2000). The need to document and disseminate success stories in rural aquaculture development, and to draw strategies from these experiences was mentioned by several delegates at the first COFI-AQ meeting in Beijing in 2002 (FAO 2002c).

Despite the generally poor results that have been achieved in many of the African countries where subsistence aquaculture has been supported, efforts are being made to build on some of the pioneering work which took place during pre-independence days and within UNDP/FAO projects. For example, ICLARM and IRAD¹, with financial support from DFID, are providing technical oversight in Cameroon through a team of researchers and extension agents (Pouomogne and Brummett 2002). These staff work in close collaboration with farmers. Without any subsidies, IRRs in excess of 34 per cent have been demonstrated. The number of farmers involved increased from 100 to 400 in one month in the autumn of 2002. It is hoped to expand the project through a network of local scientists, extension agents, and NGOs. An FAO consultation in 2001 concluded (*inter alia*) that both small- and large-scale commercial aquaculture contributes to food security and economic growth in sub-Saharan countries and that tilapia, catfish and shrimp should be the focus, at least for the time being (Anonymous 2001b). Some believe that the target groups chosen in early attempts to foster aquaculture development in sub-Saharan Africa were wrong. In their view, entrepreneurs and small and medium enterprises should be the targets selected, rather than the poor, and state hatcheries and farms should be privatized (T. Hecht, pers. comm. 2003). In this scenario, at least in this region, the creation of wealth through the production and sale of aquaculture products should be the objective, rather than (food security) strategies designed to improve the nutrition of the poor (Hecht 2001). More recently, a new wave of optimism for African aquaculture has been reported by Roderick (2002), with several privately funded tilapia farming projects showing promise. These include the Kafue Fish Farm in Zambia, Lake Harvest in Zimbabwe, and several farms in Ghana, Nigeria and Malawi. Promoting 'wealth creation', I suppose, could be regarded as means of 'alleviating poverty' but policies that concentrate on fostering those who have already achieved a measure of success would worry me. In fact, as in industrialized countries, there is room for both large-scale and small-scale

¹ Institut de Recherche Agricole pour le Développement de Cameroun

aquaculture in developing countries; most employment will be in the latter (Brummett 2003). I will return to the topic of ‘aquaculture for the poor’ later in this paper.

Aquaculture needs to partner its competitors for finite resources in producing food for a burgeoning population; it cannot continue to be considered as a separate entity; integration is the key word (New 1991). Integrated systems for the poor potentially have minimal additional environmental impact and may even improve the state of the environment (P. Edwards, pers. comm. 2002). Integrated farming that includes aquaculture can be broadly defined as the concurrent or sequential linkage between two or more activities, of which at least one is aquaculture (Little and Edwards 2003). Land-based systems are commonly integrated with agriculture by stocking fish in rice fields and ponds; water-based systems involve stocking fish directly in enclosures or attaching mollusks to substrates in water bodies, such as rivers, lakes, reservoirs or bays (Edwards 2000). Water-based systems may provide an entry point for landless people and poor fishers to farm fish. An excellent introductory manual for integrated agriculture-aquaculture technology in developing countries exists (IIRR and ICLARM 2001); this deals with the integration of aquaculture with plant and livestock production. It also deals with important topics such as respect for socio-cultural considerations, working with new entrants into this form of aquaculture, and that essential aspect of sustainability so often forgotten – economics.

In Pakistan, a focus on the use of water for arable crop production seems to have contributed to an imbalance in food production, resulting in a diminished supply of fish and meat products (Haylor and Bhutta 1997). This is inconsistent with food security needs and an important potential role for aquaculture in resolving this issue exists; however, a collective strategic approach by natural resource managers is required to address the inextricable linkages between the water sector, agriculture, and fisheries.

The environmental impact of uncontrolled disposal of both livestock production and processing wastes is becoming unacceptable (Little and Edwards 1999). Fish culture can be used to improve sustainability in both rural (nutrient-poor) as well as periurban (nutrient-rich) agro-ecosystems. In the former, the fishpond can be the focus for more efficient nutrient use and recycling; in the latter, aquaculture provides a means to both profitably use them and reduce their adverse environmental impact. Integration reduces the problems of modern livestock production. Fish culture should be promoted as part of a broader agricultural system; the efficiency of the whole system, rather than that of single components alone should be considered (D. Little, pers. comm. 2002). In 2002, delegates in the first COFI-AQ meeting in Beijing stressed the need for a comparative socio-economic evaluation of the use of land and water for aquaculture with respect to other forms of agriculture and also to show how aquaculture adds value to water resources in farming systems (FAO 2002c).

Though its commonalities with fisheries (e.g. species produced, processing, markets, etc.....) are obvious, the links between aquaculture and other forms of livestock production have been more tenuous. It was therefore a welcome surprise to see the challenging title of a paper by Swick and Cremer (2001) which explored the possibility that livestock production might be a model for aquaculture. Disappointingly, this paper was restricted to the potential for salmon and shrimp to be grown, like broiler chicken, in vertically integrated businesses, rather than the integration of aquaculture with other forms of agriculture.

In a review of the integration of aquaculture into the rural development of coastal and inland areas, Haylor and Bland (2001) defined a number of principles for improved planning and management. Two are particularly important, in my opinion:

- putting people in the center, so that rural development and the role for aquaculture within it are determined by an understanding of people's livelihoods; and
- the involvement of poor people in the policy-making process.

Martinelli (2000) reported that the Tra Vinh provincial authorities of Vietnam, with the support of the UNDP, are exploring the possibilities of encouraging the expansion of giant freshwater prawn production as an income diversification strategy for rice farmers in freshwater areas. Freshwater prawn production could make a substantial contribution to sustainable poverty alleviation, particularly when integrated with rice and/or pig farming, as the freshwater area in Tra Vinh is 10 times larger than the brackishwater area, and prawn farming is thought to be less risky than brackishwater shrimp production. However, when freshwater prawn farming was associated with rice-fish culture in Bangladesh, though generating a high value product for an export market, it brought significant risks associated with large loans, uncertain postlarval availability, environmental impacts and the relative inexperience of farmers (Chapman and Abedin 2002). In particular, the high value of freshwater prawns can, like marine shrimp farming, cause other traditional systems of food production - such as rice and dike crop and fish production - to be neglected. The final assessment of the CARE-GOLDA project (Finan *et al.* 2001) noted that it did not directly benefit the poorest segments of the project villages, who could not participate because of lack of land and credit. This design fault has been recognized but the abrupt withdrawal of funding and the absence of a suitable exit strategy once project staff had departed prejudices the application of the valuable lessons learnt. Despite this, CARE is seeking to improve the education of poor farmers and to reduce risk, to enable the poorest to benefit from aquaculture projects (M.C. Nandeesha, pers. comm. 2003).

Other integrated practices have some promise. For example, the use of domestic sewage-fed fish production around the huge city of Kolkata (Calcutta), though it had origins perhaps about 100 years ago, became a large-scale enterprise in the 1930s (Nandeesha 2002). Since then, land encroachment through urbanization has decreased the area available from the peak of 12,000 ha to 4,000 ha, but a substantial quantity of fish are still produced in this way. Wastewater-fed fishponds, garbage-based vegetable farms, sewage-fed brackishwater culture and, more recently, the use of pond effluents for rice paddy cultivation exists. The species grown include Indian and Chinese carps, tilapias, catfish (*Pangasius* sp.) and freshwater prawns (*Macrobrachium rosenbergii*). Fish are depurated before sale. However, a combination of social, economic, and technical factors have limited the spread of this form of aquaculture to other parts of India. Sewage-based aquaculture is also practiced in the remoter and poorer areas of China, in Vietnam, and possibly in Indonesia (P. Edwards, pers. comm. 2003).

Establishing a framework for sustainable rural aquaculture development was one of the four priority areas identified by COFI-AQ in 2002 (FAO 2002c); this is likely to influence the future program of work for the FAO Fisheries Department.

Codes, management, and cooperation

Many codes of conduct (Table 3), codes of practice (Table 4), and guidelines and strategies (Table 5) already exist. So far, salmon farming in industrialized countries (and Chile) and marine shrimp farming in the developing world are the major targets. The leader in promoting a code of conduct for fisheries, including aquaculture, is FAO (FAO 1995). Recently, the European Parliament has encouraged the use of codes of conduct by the aquaculture profession (European Parliament 2003). In the marine shrimp sector, the challenge began to be taken up by the Global Aquaculture Alliance (GAA) in 1997. Claude Boyd pioneered the development of codes and BMPs for aquaculture (Boyd 1999) and continues to advise the GAA and others on this topic to this day. Generally, practical guidelines and codes of practice are being developed by producers' organizations.

Small-scale shrimp farmers may be disadvantaged by the establishment of Good Management Practices (GMPs). During the discussions when specific GMPs were drafted in an expert consultation in Brisbane in 2000 (FAO 2001) it was noted that their adoption might affect the competitive position of small farmers and prevent them benefiting from the price premiums attained through eventual certification and labeling schemes. Many small farmers are receptive to the adoption of better practices. However, the potential price mark up would not generate the kind of financial resources needed in many countries to provide the technical and financial support for widespread adoption of GMPs by small farmers.

Hambrey (2000) pointed out that one of the weaknesses of codes is that it is easier for large producers to adhere to them and to demonstrate that they have done so. Unless they are very well organized, small-scale producers may lose out. It is therefore positive that the Federation of European Aquaculture Producers (FEAP), which generally represents small producers, has developed a code of conduct for aquaculture (FEAP 2000). FEAP has also provided assistance in transferring their experience as an association to developing countries (Hough and Bueno 2002). NGOs are also involved in a positive way in working towards enhanced responsibility. For example, the WWF is a partner with the World Bank and FAO in the Consortium on Shrimp Farming and the Environment, which is driven by NACA (Wilkinson 2001). In a welcome collaboration, this program draws on both aquacultural and environmental communities to identify Best Management Practices (BMPs).

Certification systems (either general or specifically designed for certain types of aquaculture) are emerging (Table 6). The growth of fisheries ecolabelling schemes and of product certification in industrialized countries poses problems for developing countries (Wessells *et al.* 2001). Not all countries that export aquaculture products will be able to meet the environmental standards that other countries set for products, or afford the costs of certification. They may also find it more difficult to comply with all the traceability requirements of these schemes. Each scheme has specific requirements that may not apply equally well to all exporting nations. Such schemes, when applied to aquaculture products in industrialized nations, may be seen as discriminatory in developing countries. The elaboration of transparent and non-discriminatory certification procedures was identified as a priority by COFI-AQ (FAO 2002c).

Krone (1998) and New (1999b) warned against the proliferation of ecolabelling schemes several years ago. In my summary of the thematic session of AQUA 2000 (New 2002), I stressed again that we may confuse our multifarious audiences with the plethora of uncoordinated codes, declarations, guidelines, guarantees and ecolabels with which we are attempting to surround ourselves. Ecolabel proliferation will increase the cost burden of

producers in educating consumers about their meaning and credibility and to differentiate one ecolabel from another (Wessells *et al.* 2001). Not only will developing countries find it costly and burdensome to comply with such schemes but consumers may become confused with multiple ecolabels and decide that none have any real credibility. In an attempt to cope with proliferation, COFI-AQ suggested that a data bank of national codes was now desirable (FAO 2002c). Another problem is that ecolabels tend to be promoted by producers and retailers, who have axes to grind. To be effective, certification needs to be neutral, credible and conducted by unbiased certification agencies at national, regional or (preferably) international level (Krone 1999). Ecolabels need to be fully understandable by both consumers and the industry.

Producer organizations, mainly in the Americas and Europe, and global aquaculture conglomerates have led the way towards self-regulation. However, codes are often very general in nature and either international or national. According to Hambrey (2000), locally adapted codes of conduct and Best Management Practices (BMPs) should ideally be promulgated as part of district or regional sector environmental assessment. Ackefors and White (2002) concluded that codes of practice should be designed around the interests of the specific farm animals as well as the interests of local people and consumers, and suggested an individual code of practice for each sub-industry.

Frankly, I think that codes and BMPs for aquaculture, while useful in mitigating its impact, may be too 'isolationist'. What value do they have if the other common resource users do not operate by codes? What chaos would result if there are some resource users, for example, operating under a code of conduct for forestry, while others are operating under separate codes for agriculture, fisheries, or aquaculture, for example? Surely what is really needed is a general code of conduct for each district that takes into account international and national codes and policies, covers all local resource users and environmental and socio-economic activities, and has specific, but inter-related BMPs for each activity category.

One of the common problems of codes, guidelines and certification processes is that they are generally constructed for aquaculture by aquaculture scientists and producers. In the discussions that followed the thematic session of our EAS-WAS meeting on responsible aquaculture in Nice in 2000, Roger Pullin stressed the need for natural integrated resource management (New 2002). Noting that the aquaculture sector was far too inward looking but that others that rely on the same resources (e.g. agriculture, terrestrial livestock production, forestry) were probably the same, he thought that we would experience far more problems in future than we already have. We need to recognize that some activities are not fundamentally compatible. A system of prioritization within an overall plan, such as an ICZM or a rural development plan is essential. For example, a code of conduct for sustainable fisheries in India was adopted during a workshop organized in conjunction with BOBP and others by the MS Swaminathan Foundation (Govind (1999). This called for the mutually beneficial development of agriculture, agro-forestry, animal husbandry, aquaculture, coastal tourism and other compatible activities.

Organic production

Organic aquaculture has grown up alongside the development of codes of practice and certification. The international market for many types of organic food is booming (Stern 2002); global sales were more than US\$ 20 billion in 2000, with the USA (50 per cent) and

Europe (45 per cent) purchasing the largest shares. However, this was still less than 0.5 per cent of total food sales. According to the German certification body Natureland, global organic fish production is said to be about 18,000 mt per year and mainly consists of organic salmon and marine shrimp (Bousquet 2002). Several European organizations, including Natureland, the Soil Association, and the International Federation of Organic Agriculture Movements (IFOAM), have pioneered labeling for 'certified organic farmed fish' (Stern 2002). These have involved carp, salmon and trout. However, Bousquet (2002) reported that IFOAM was continuing to struggle with the issues surrounding aquaculture. One of its problems is that certification tends to concentrate on a single species, which seems at odds with IFOAM's insistence on biodiversity.

It is believed that the existing market for organic fish and other seafood will expand. In Europe, organic salmon achieves a premium price of 15-40 per cent above conventionally farmed salmon (Subasinghe 2002). Up to now, the concept of organic aquaculture has had less relevance and interest in the domestic markets of developing countries. However, there are opportunities for developing countries to produce organic products for export by exploiting their tropical temperatures, lower labor costs, and less stringent planning regulations (J. McInerney, pers. comm. 2002). This opportunity is now being realized, particularly in South-East Asia; in June 2003 a conference in Vietnam will specifically address this topic (INFOFISH 2003). Even freshwater prawns are being considered for an organic farming label (Anonymous 2002f); this may partly be because *Macrobrachium* culture is considered more environmentally and socially acceptable than marine shrimp farming (New *et al.* 2000).

However, the future for organic aquaculture remains uncertain. Some limitations to the acceptance of its products may occur. Many consumers are skeptical about the motives of producers and retailers of organic products generally. As organic labels proliferate, very few know what they really mean. Do they truly represent an effort to promote the consumption of healthy and nutritious food that has been produced by ecologically, socio-economically acceptable methods which include concerns for animal welfare? Or are they just a crafty means for retailers to obtain higher profits? In many supermarkets it is quite difficult to find certain types of food that are not organic. The perception of what 'organic' means is 'in the eye of the beholder'. In a survey conducted in Spain, Denmark and Germany by the Aarhus School of Business, all the respondents had difficulties in conceptualizing 'ecological fish' (Montfort 1998). For a Spaniard, a 'green fish' needs to be wild caught. For a Dane it needs to have come from a farm with a fully controlled production process. When all food is 'organic', what then? A desirable situation, you might say, if you can afford the increased costs.

CRITICS OF AQUACULTURE AND TRADE IMPLICATIONS

The scene and potential for responsible aquaculture in developing countries has been set. However, before examining aquaculture development for the poor, I want to step back for a moment to look at the critics of aquaculture and the potential impact of regulations and public attitudes. The critics and regulations of industrialized countries have an impact on imports from other areas.

Opposition, especially to intensive aquaculture, is strong and originates not only from well-funded NGOs but also from the scientific community. Criticism of aquaculture in developing countries, especially shrimp farming, has been very potent. However, Pillay (1996) noted that:

'it is not uncommon for conflicts to arise between multiple users of natural resources, but it is striking that aquaculture is invariably assumed to be responsible for any environmental degradation that has occurred in the area, even though there is no quantified information to support such a conclusion. Some interested parties have found it fairly easy to whip up political opposition, on the pretext of social equity and environmental protection.'

Criticism from our peers

Criticism of intensive aquaculture practices has not only come from outside the industry (e.g. Shiva 1995, 1999) but also from within. In 1994, for example, two well-known aquaculturists noted that 'a laissez-faire, economically driven industry (had) already shown itself to be unsustainable' (Roberts and Muir 1995). In 1997, one of our WAS Honorary Life Members said that there was 'general agreement that some of the adverse environmental impacts observed have been caused by the blind pursuit of increased production and higher profits' (Pillay, 1999). Since then, many improvements have been made in our levels of responsibility; it is rather a pity that these were not self-generated but were forced upon our industry as a response to criticism.

Some feel that we should be more concerned about criticism from our peers than from environmental and welfare organizations (Kaiser 2002). Certainly the papers by Naylor *et al.* (1998, 2000) caused uproar in the aquaculture industry and drew several complete or partial rebuttals (e.g. Chamberlain 1999; Tidwell and Allan 2001). Kaiser and Stead (2001) commented that the worst thing that one can do is to reject such challenges out of hand, to ignore them, or to downplay their importance. Another rebuttal was drafted and publicized during a meeting of the ICES Working Group on Environmental Interactions of Mariculture (Roth *et al.* 2002) but this multi-authored document failed to gain publication in a major journal. Despite these efforts to present a more balanced viewpoint, it has been the original criticisms that caught the eyes of the media and have remained in the minds of the public.

Criticism of aquaculture from the scientific community continues. Pauly *et al.* (2002) refer to the 'slash and burn' tactics of some shrimp farming operations, but the papers that they cite to back up this contention were written a decade ago (Pullin *et al.* 1993) or refer to the position in China at that time (Feigon 2000). There is no mention of the strenuous efforts by governments such as Thailand (Tookwinas *et al.* 2000) and the global shrimp farming industry to curb those activities which are environmentally or socio-economically unsustainable. Pauly *et al.* (2002) make no reference to the fact that the area of mangroves in Thailand is actually increasing, despite continuing expansion of shrimp farming (Fast and Menasveta 2003). Similarly, there is no reference to the codes of conduct and practice, or certification systems that are being introduced into aquaculture. No wonder that our current WAS President complains of the unfair portrayal of aquaculture in the public and scientific press and notes that the lack of balanced reviews on critical issues such as these hamper our ability to counter 'examples of weak science, overt exaggerations, and broad generalizations' (Browdy 2002) !

The use of diets rich in fish meal and fish oil in the farming of salmonids, seabass and other finfish species in the developed world are also targeted by Pauly *et al.* (2002) as a 'source of pressure on wild fish populations', citing Naylor *et al.* (2000). Diets rich in fish meal are also used, mainly for marine shrimp and finfish, in the aquaculture of developing countries. On current trends, aquaculture has the potential to utilize 70 per cent of the total supply of conventionally produced fish meal by 2015 and 100 per cent of fish oil by 2010 (New and Wijkstrom 2002). However, criticisms of the intensive culture of carnivorous species because of their use of marine resources ignore several pertinent factors:

- no evidence that aquaculture has increased the exploitation of fish for fish meal manufacture was found by New and Wijkstrom (2002); it has simply diverted existing and annually relatively static supplies of this commodity from feeds for other livestock, a phenomenon that is expected to continue (Pike and Barlow 2003).
- using fish meal for aquaculture may actually be an environmentally friendly use of the resource since farmed fish are already more efficient converters than other livestock (Tidwell and Allan 2001), and further improvements in efficiency are expected.
- Asgard *et al.* (1999) showed that while 6 million mt of forage fish (the annual consumption of fish by the standing biomass of wild Northeast Arctic cod (*Gadus morhua*) in the Barents Sea would be enough to produce 0.25 million mt of fillets from sustainably harvested wild cod, the same amount would produce 1.3 million mt of farmed salmon fillets; it can therefore be argued that it is much more efficient to catch forage fish, process them and feed them to farmed fish than to leave them as part of the natural marine food chain (Forster 1999).
- positive results from research into the partial or complete replacement of fish meal and fish oil by alternative plant and animal sources (Kaushik 2002) is gradually resulting in reduced use of these resources in the formulations of the aquafeed industry. Reducing the inclusion rates of marine ingredients in their feeds is one of the qualifications for designating aquaculture products as organic; however this poses nutritional problems, since the limits for total fish meal and oil inclusion are low, and different in the USA and Europe, for example (Hardy 2002). Recently, it has been reported that farmed fish can be 'persuaded' to accept a greater share of vegetarian feed by the inclusion of synthetic pheromones in their feed (Anonymous 2002b). The potential of such developments in reducing the utilization of marine ingredient resources is being balanced by the continuing expansion in the volume of production of farmed carnivorous aquatic species, however. Thus the constraint of 'fish meal and fish oil traps' may only be delayed, unless the fishing and processing of alternative sources of marine protein and oil, such as mesopelagic fish, and possibly also krill, becomes economic (New and Wijkstrom 2002).
- this year, the European Parliament has called on the EC to encourage a reduction in the use of fish meal and fish oil in aquaculture but without abandoning high quality feed standards (European Parliament 2003). This wording recognizes that there are limits to substitution.
- there are also other difficulties. Care has to be taken to ensure that the substitution of marine by plant ingredients does not reduce the nutritional or sensory quality of the farmed product. Animal welfare may also be a potential issue: is it right to make carnivores into herbivores ?

No wonder the need for informed, balanced reviews has been stressed by Browdy (2002). While criticisms of certain forms and practitioners of aquaculture from environmental and

socio-economic viewpoints may have been justified in the past, it is unfair to ignore the strenuous efforts being made by the aquaculture industry to be responsible and to promote sustainable aquaculture now. It is particularly unfortunate, and rather inappropriate, that criticisms from our peers come so heavily from (capture) fisheries scientists, when the fisheries industry itself is not perfect. Mace (1997) concluded many capture fisheries would not be commercially viable without significant government subsidies. Pauly *et al.* (2002) themselves state that '(capture) fisheries have rarely been sustainable' and that 'the concept of sustainability upon which most quantitative fisheries management is based (is) flawed'. It puzzles me why aquaculture continues to receive so much criticism from capture fisheries scientists. One is tempted to say 'healer, first heal thyself'.

It is encouraging that biological, ecological and inter-sectoral indicators are now being explored (Pullin *et al.* 2003) to examine whether aquaculture can increase and sustain its contributions to the world fish supply without unacceptable environmental impacts. These authors suggest that aquaculture needs a fundamental transition from a concentration on maximizing output from the target species to integrated management of natural resources and ecosystems. This applies not only at the farm level but also to watersheds, coastal areas, and open waters. While such ideas, like the concept of 'ecological footprints', may be anathema to some aquaculturists, I believe that they represent a framework within which we will be forced to operate, like it or not. The days of operating aquafarms in isolation are well past.

It is unfortunate that a gulf has existed between aquaculturists and environmentalists, which some seek to exploit. Surely it would be more professional and productive for both 'sides' to recognize that neither sector is perfect and to work together for improvement, instead of providing more and more fuel for the fires of public opinion. Current disputes do neither the capture or cultured fisheries industries (or the environment) any favors. I have often stressed that dialogue, not confrontation, is essential. I therefore welcome the positive approach of Sandra Shumway: as Program Chair for the triennial meeting of WAS, NSA and the Fish Culture Section of the AFS next March in Honolulu, she is trying to bring the two 'sides' together for constructive discussions. One of the co-authors of the 'Naylor papers' (Naylor *et al.* 1998; 2000), Jane Lubchenco, has been invited to participate in this dialogue.

Costa-Pierce (2002) suggests that global aquaculture expansion should be accomplished through promoting an alternative aquaculture development model – an 'ecological aquaculture' model – which not only brings the technical aspects of ecosystems design and ecological principles to aquaculture, but also incorporates comprehensive planning for the wider social, economic and environmental aspects of aquaculture. Furthermore, in expanding, aquaculture needs to adopt this model to become part of the 'culture' of a place and region. He believes that the public worldwide will not accept any new forms of food production that exploit people, cause environmental harm, or produce new sources of aquatic pollution. He also feels that environmental groups have done a service to both society and global aquaculture by pointing out its ecological and social effects. Aquaculture does have an impact on the environment, just as agriculture does. However, as pointed out by McIntosh (2002), using Mexico as an example, the contribution to coastal pollution (phosphorus and nitrogen) by aquaculture is but a small fraction of that contributed by municipal sources (which in turn is less than that from agriculture).

Ethics must now play a significant role in the development of both industrial and small-scale aquaculture for poverty alleviation. Attention has been drawn to this by Shiva (1995),

Hallerman (1997), and (more recently) in meetings of the World and European Aquaculture Societies (e.g. Kaiser 2002; Kaiser and Stead 2001). In arguing for greater public participation, Kaiser (2002) noted that providing balanced information was clearly presented, it was not necessary to be an 'expert' to make good ethical decisions. However, convincing scientists, who Hallerman (1997) describes as professional skeptics, about the importance for our industry and for society generally of straightforward discussion of ethical issues is not easy. I myself have heard 'mutterings in the corridors' about the relevance of such topics in our conferences. I do not think such blinkered views are in the majority but those that remain skeptical had better adapt their thinking; it should be obvious to all that we can no longer operate within ivory towers. Hallerman (1997) quoted Leopold (1987) as follows:

'no important change on ethics was ever accomplished without an internal change in our own intellectual emphasis, loyalties, affections, and convictions'.

Even scientists writing for the general public doubt the sustainability of aquaculture, perhaps because they have been 'infected' by the skepticism engendered by environmentalist lobbies. Edward Wilson, heralded as 'one of the twentieth century's greatest thinkers', devoted ten lines in one his best-known books (Wilson 1998) to aquaculture. Noting that aquaculture had made up part of the slack between the demand for fish and the supply from capture fisheries, he said that the 'fin-and-shell revolution' had its limits because 'marine farms pre-empt the mangrove swamps and other coastal wetland habitats'. Furthermore, 'freshwater farms must compete for the shrinking supplies of runoff and aquifer-borne water'. Both statements have their truth, except that Edward Wilson seems to be unaware of cage farming, either in marine or freshwaters. Unfortunately, he does not seem to recognize the real potential of aquaculture if it is practiced responsibly in synergistic collaboration with other resource users.

Criticism from the community

Besides criticism from scientific peers, global aquaculture faces a barrage of protest from certain NGOs and the media. However, such attacks need not be entirely written off as extreme. I am indebted to Peter Edwards for alerting me to another quotation from Wilson (2002):

'the protest groups are the early warning system for the natural economy. They are the living world's immunological response. They ask us to listen'.

Robert Winston, a pioneer of IVF treatment (test tube babies), has said that (Parry 2002):

'we (scientists) still tend to present ourselves as being very certain, whereas science is about uncertainty. We still are not prepared to really understand why members of the public have difficulty with issues such as the perception of risk. I think there's more to be done with the science environment than with the public environment. We still talk about the public understanding of science when it really should be the scientists' understanding of the public that's the real issue'

I think that Professor Winston's remarks could be applied to the 'public image of aquaculture'. Perhaps our 'image of the public' is wrong ?

The consumer is certainly influenced by the opinions of NGOs. In a presentation at the 2001 EAS conference in Trieste, the Corporate Director for Food Safety of Nutreco, Reid Hole, commented that a product image takes years to build and minutes to destroy. This company, one of the largest in global aquaculture, feels that it is important to place any new information that it disseminates in its proper context and to communicate it clearly, because areas of doubt can be exploited (Hole 2002). Doubt can be used to generate concern, to raise the profile of unscrupulous NGOs and solicit income, and to generate fear in consumers by unscrupulous journalists.

According to Reid Hole (pers. comm. 2002), criticism is often based on outdated information. We live in a modern world where everything goes faster, but publishing scientific findings still takes years. The aquaculture industry very often implements new findings prior to their publication in journals. Perhaps journal editors could discuss relaxing the rules about prior release of information, which might help us avoid such situations.

WAS has rightly been concerned with the issue of sustainability for many years. WAS noted this topic during its meetings in San Diego in 1995 and in Bangkok in 1996. In 1997 WAS held a special two-day session on this topic at the Seattle conference. An illuminating description of the conflicts that took place between pro- and anti-aquaculture participants during this session, and the litany of real or perceived problems caused by salmon and shrimp farming, was provided by its moderator (Hargreaves 1997). Lassen (1997), complaining about the behavior of some of the representatives of NGOs present at this session, asked 'if they are watchdogs and bark at everything, who will continue to listen to their warnings?' That was an exciting year to be, as I was, the WAS President! Those of you who were in Seattle will remember demonstrations outside the conference hall and the large poster opposite which proclaimed 'salmon don't do drugs'. WAS continues to provide a forum for discussion rather than a vehicle for lobbying for the aquaculture industry. Its joint meeting on responsible aquaculture with the European Aquaculture Society in 2000 in Nice (AQUA 2000) and this year's meeting here in Salvador, Brazil demonstrate this commitment. However, despite all our efforts at dialogue, some NGOs continue to make capital out of attacks on aquaculture and, contrary to the expectations of Lassen (1997), the media and the consuming public still listen to them!

One of the panel conclusions from AQUA 2000 was that we must realize the necessity to work with NGOs in a constructive manner, rather than simply defending ourselves against negative criticism (New 2002). Hans van Bieman, the CEO of Nutreco, says that 'as an industry, we have nothing to hide and therefore nothing to fear from cooperating freely with public authorities, relevant NGOs and reputable, independent scientists' (Anonymous 2002a). Uniquely, for a company that is vertically integrated in three food chains, Nutreco includes social and environmental reports in its literature. While this is a positive development, the company has found that the information provided can be used against it by unscrupulous NGOs. However, it feels that the risk is less than it would be if it did not have any communication with them (R. Hole, pers. comm. 2002). Such openness is certainly not always rewarded. Having seen material released by the company, Friends of the Earth (FoE) made an unsubstantiated attack on Nutreco at the 2002 Earth Summit in Johannesburg (Dallimore 2002). FoE subsequently apologized but the damage had been done: the media picked up their original comments. Despite this, Nutreco is developing closer working relationships with NGOs, involving joint research and monitoring across a broad spectrum of issues (Anonymous 2002a). Nutreco feels that it can learn from NGOs and positively

encourages dialogue with them, which enables both parties to climb on a learning curve (R. Hole, pers. comm. 2002).

Even banana giants have found collaboration with an environmental NGO productive (Silver 2002). Chiquita (the successor to the United Fruit Company and a company that has made great efforts to improve its performance from an environmental and social point of view) has acknowledged a debt of gratitude to the Rainforest Alliance for collaboration, not confrontation. However, trying to be a responsible producer does not necessarily bring commercial gains. For example, although the largest US retailer, Wal-Mart, appointed Chiquita as its 'Global Environmental Supplier of 2000', it noted that 'such awards do not affect purchasing decisions' (Silver 2002).

Far from being responsible, some NGOs show extreme irresponsibility. Destructive criticism is easy. What has the pro-active environmentalist to fear if his campaigns cause a farmer, or a whole industry, to crash? Where the enterprise is small, will he provide other employment or alternative supplies of aquaculture products for local people? Hepburn (1997) noted that the environmental activist does not have to stake his career, his family, his ties with the local community, or his self esteem. There are huge numbers of international, national and local NGOs who oppose aquaculture development, such as (to name but a few) the FoE - Friends of the Earth (www.foe.org), PETA - People for the Ethical Treatment of Animals (www.peta.org), EDF - Environmental Defense Fund (www.environmentaldefense.org), and CIWF - Compassion in World Farming Trust (www.ciwf.co.uk). Some NGOs that oppose bio-engineering have even recruited high profile restaurant chefs in their campaign (Anonymous 2002c).

However, all is not negative. In February 2002, a science and policy conference called 'Water Farming, the World's Future' was organized by the Oldways Preservation and Exchange Trust of Boston (a non-profit organization advocating healthy eating patterns and sustainable food choices). Bringing together experts from industry, science, government and environmental lobby groups from around North America, this conference came to a consensus that the expansion of sustainable water farming was desirable (D. Good, pers. comm. 2002). This shows that dialogue, not confrontation, can be productive. Meanwhile industry organizations such as the Global Aquaculture Alliance (www.gaalliance.org) and the Canadian Aquaculture Industry Alliance (www.aquaculture.ca) continue to fight rearguard actions against the actions of irresponsible NGOs.

According to Mishra and Rath (1999), two groups - the Campaign Against the Shrimp Industry (CASI) and the People's Alliance Against the Shrimp Industry (PASI) - joined forces to form a National Committee against Coastal Aquaculture (NCCA) in India. However, even though some sporadic cases of impacts of aquaculture on non-aquaculture activities existed, the allegations that aquaculture had caused general damage to the environment and other human activities could not be substantiated (Kutty 1998). On the other hand, evidence of negative impacts on aquaculture caused by other sectors such as agriculture, housing and tourism was noted. Shrimp culture in Bangladesh has created substantial employment on farms and in ancillary activities, and has created export gains, but this has been achieved at considerable cost (Alauddin and Tiswell 1998). This included loss of green vegetation, loss of genetic diversity (loss or extinction of indigenous fish species), pollution of surrounding ecosystems through the dumping of pond effluents and the use of chemicals, conversion of mangroves, and declining rice yields. However, 60 per cent of the

landless had experienced an improvement in their incomes and economic conditions since the introduction of shrimp farming in their area.

Many adverse impacts of other activities on shrimp farming itself in India have been observed. These include agricultural runoffs including pesticides, poisons used in fishing, mangrove deforestation (by others), discharges of oil and lubricants, reduction in the water table due to overexploitation of ground water, and the exploitation of rocky river beds for metal chips (Mishra and Rath 1999). Runoffs from nearby agricultural operations and other facilities, especially in developing countries, can include animal and human waste. Surveying commercial seafood for the presence of *Salmonella*, the US FDA found that the highest frequency of occurrence was in aquaculture products and identified the need for developing guidance for aquaculture operators to prevent pathogen contamination of aquaculture sites (Flick 2001). Are aquaculture producers expected to do this on their own? Will any aquaculture code of conduct prevent such contamination? Doesn't this neatly demonstrate the necessity for codes of conduct to be much broader than aquaculture alone?

There is no doubt that intensive aquaculture, both in industrialized and developing countries, has been under sustained attack by eco-terrorists for nearly a decade. Media moguls go into a feeding frenzy with such ammunition. In the West, some commentators regard modern farming methods in general as unacceptable (Humphrys 2001a). Intensive salmon farming in particular has been described as a 'scandal' (Humphrys 2001b) and an activity that is carried out in a 'bathful of chemically tainted, lice infested and occasionally toxic seawater' (Girling 2001). Any suggestion that genetically-modified fish might be used in fish culture in Europe leads to front page newspaper headlines accusing our industry of developing 'Frankenfish'. A major protagonist from the developing world regards global business in general as the ogre which 'starves the poor' (Shiva 2000) and shrimp farming in particular as a 'highly wasteful and inefficient technology that puts the luxury consumption of shrimp by rich northern consumers, and the profits of corporations, above the need for drinking water, food, and the livelihoods of local fishing and farming communities' (Shiva 1995).

However, others see environmentalism as a specter which haunts future expansion. For example, Philip Stott, an Emeritus Professor of Biogeography at the University of London, believes that the concept of sustainability is unrealistic and potentially dangerous, a means (like biodiversity) used by an elite few to block development and growth for the masses in an attempt to create Utopia (Stott 2002a):

'Today, sustainable development is a ubiquitous, politically compliant phrase, a pleasant-sounding palliative to inexorable and inevitable change, (which is) dished up as a placebo to eco-chondriacs the world over.'

Philip Stott was not referring specifically to aquaculture. It is clear, however, that misinformation from the West (or the North, depending on your perspective) does endanger the development of aquaculture in developing countries too. A Past-President of WAS (J. Tidwell, pers. comm. 2002) describes meeting a senior Minister in Port Harcourt, Nigeria who, when the potential for aquaculture was being discussed, said 'yes, but isn't aquaculture a dirty industry?' This seemed a strange question to pose in an area surrounded by oil rigs, mangrove devastation, and a crush of humanity living in the tidal zone, but the Minister's impression had been hatched by being told about the 'Naylor articles' (Naylor *et al.* 1998, 2000).

I wonder why aquaculture is such a target when it is a minor polluter compared to energy (e.g. oil, nuclear), industry (e.g. chemical, pharmaceuticals), mining (e.g. copper, iron, etc.) and processing; animal and crop production; forestry (Brazil, Norway); fisheries and processing; domestic sewage; production of munitions (war); corruption; and tourism (visual pollution) ? Is it just that we are the latest and most obvious activity seen by the populace ? Or just a 'soft' target ? What is the hang-up about the word 'farmed' when it is applied to aquaculture products ? We don't talk about farmed beef, farmed pigs, farmed chickens, do we ?

We tend to condemn all NGOs because we see them as 'anti-aquaculture'. However, this is loose thinking and far from the truth; I will develop this theme later.

Trade implications

Recently, an INFOFISH editorial, noted that the plethora of legislation affecting the trade in aquaculture products - including the 'unreasonable use' of sanitary and phytosanitary provisions, issues related to antibiotics, and elaborate documentation and certification requirements - causes sleepless nights for most exporters (Anonymous 2002i). Added to this the new 'bio-terrorism legislation' that is currently being enacted by the USA brings yet more worries to traders and aquaculture producers (Woodhouse 2003). Recently, the President of the Shrimp Hatchery Association of Bangladesh commented that many international producers were worried that certification systems may become 'an instrument of denial to market access'; he hopes that the 'emphasis on quality does not denigrate itself into an instrument to create non-tariff trade barriers' (Anonymous 2003a). Increasingly, seafood products have to be labeled as 'farmed' or 'wild', and with their country of origin. This rule has already come into force in the EU and is expected to be applied in the USA shortly. At first glance, such rules seem reasonable and may even satisfy the 'anti-aquaculture lobby'. However, they may also have an impact on the exports of farmed fish and shrimp from developing countries because consumers are rather fickle and may ostracize the products of those countries that are not currently in favor for political reasons. Certainly, developing countries will find it hard to comply with increasingly strict regulations, and the need for accreditation and labeling imposed by industrialized countries. Compliance costs cash. While fish farmers in industrialized countries may see such developments as beneficial, since they tend to level the playing field, those in the developing countries may see their imposition as a form of trade barrier.

Article 11 of the CCRF (FAO 1995) specifically says (*inter alia*) that States 'should not directly or indirectly create unnecessary or hidden barriers to trade which limit the consumer's freedom of choice of supplier or that restrict market access'. According to Ahmed and Delgado (2000), there are justifiable fears that trade liberalization will divert fish products and their inputs to markets with higher purchasing power. Free trade will direct resources to their most productive use, which will affect opportunities worldwide. Liberal trade regimes and concentrated income growth raise concern about worsening imbalances in consumption and income between industrialized and developing countries and among economic classes. However, WTO², FAO³, OIE⁴, WHO⁵ and the World Bank have expressed

² World Trade Organization

³ Food and Agriculture Organization of the United Nations

⁴ Office International des Epizooties (International Animal Health Organization)

a commitment to help developing countries solve their difficulties in implementing current WTO agreements (WTO 2001). These organizations will help them to participate more fully in setting international norms for sanitary and phytosanitary (SPS) measures – food safety and animal and plant health – and to take full advantage of trade opportunities.

Despite this, vested interests still seek, on the one side to exploit export opportunities and on the other to impose trade barriers to protect local producers. Tariff privileges exist but not everything is one-sided in the trade barrier story. Producers sometimes evade the EU General System of Preferences by exporting through an intermediate country (Fegan 1999). Despite the ongoing dispute between Vietnam and the US over catfish dumping (Anonymous 2003b), local farmers are planning to double the amount of catfish ('tra' and 'basa') produced in some provinces in the Mekong Delta (Conley 2003a). These species are exported to 27 countries, but the US is the major market. Total catfish exports by Vietnam were valued at US\$ 2 billion in 2002. Some tariff reductions have been granted on Vietnamese catfish (Conley 2003b) but tariffs may still drive up prices and impact on the whole US catfish market (Conley 2003c). The catfish industry in the southern Mekong Delta region is said to employ 300-400,000 people (Conley 2003b). In an effort to overcome the problems with exporting Asian catfish from Southeast Asia to the USA, the Thai government is now promoting the farming of *Ictalurus punctatus*, which is described as the 'authentic U.S. catfish' (Buranakanonda 2002).

Some developing countries and their aquaculture producers will undoubtedly perceive ecolabels as additional trade barriers (Krone 1999). Often, ecolabelling schemes use phrases such as 'environmentally friendly' that have no clear meaning for consumers (Wessells *et al.* 2001).

The European Food Safety Authority (EFSA) has recently been created (Byrne 2002), which will (*inter alia*) assess risks to the food chain, including matters relating to animal health and welfare, and give independent scientific advice on GMOs. Its main 'customer' will be the European Commission. Its work will cover all stages of food production and supply, from primary production to the safety of animal feed, right through to the supply of food to consumers. While the independence of the risk assessment of EFSA is stressed, risk management remains the province of the European Commission, Parliament and Council. Two major functions of the EFSA will be to develop credibility and consistency in the messages on food safety (something that has been clearly missing !) that are provided to the European public, and rebuilding the confidence of consumers in its food supply.

Animal welfare concerns are likely to have an increasing impact on aquaculture development. This was recognized in a session on this topic at the 2002 EAS conference in Trieste (Anonymous 2002h) and by the welfare partners in a European project on sustainable breeding and reproduction in farm animals, including fish (Komen *et al.* 2002; www.sefabar.org). The recent resolution on aquaculture by the European Parliament (European Parliament 2003) contains references to animal welfare in several of its clauses. The European Parliament has also expressed the view that the introduction of genetically modified fish into the EC should be prevented until it can be shown to present no dangers. The members of FEAP have also rejected their production. In addition, the European Parliament has urged the EC to impose the same health, food safety and animal welfare

⁵ World Health Organization

standards on products from non-member countries, so as to avoid unfair competition (European Parliament 2003).

All these concerns and measures will certainly affect those seeking to export aquaculture products into the EC (and other industrialized areas) and may be perceived as additional trade barriers. However, protecting consumers does not constitute a trade barrier and can therefore be defended; protecting products can not (J. McInerney, pers. comm. 2002). Poor fish-exporting countries are concerned that technical standards, such as sanitary and phytosanitary (SPS) measures, hazard analysis and critical control point (HACCP) standards and ecolabelling, may act as trade barriers (WorldFish Center 2002). Short- or long-term bans by industrialized countries on certain aquaculture products grown in developing countries have certainly been viewed as trade barriers. The question of chloramphenicol residues is a case in point and was a subject of dispute between Thailand, for example, and the EC. The ban was said to have caused the largest Asian feed company (CP) to have reduced feed output by 25 per cent, a measure of the ban's economic impact on shrimp farmers (P. Sorgeloos, pers. comm. 2002). Some additives for shrimp farming are said to be marketed as vitamins but really contain antibiotics; thus some farmers may not even realize that their products may breach any regulations. There are also indications that the use of chloramphenicol in hatcheries may carry through to the final marketed product. Recently, the EU has been providing support for equipment and calibration to Thailand to help in the assessment of chloramphenicol residues and that country no longer sees this particular control as a campaign against products from developing countries (P. Sorgeloos, pers. comm. 2002).

In another case that affected Thailand, the EU increased testing frequency from 10 per cent to 100 per cent of imports from this country in 2002, following the detection of nitrofurans residues in random checks on seafood and poultry (Anonymous 2003c). Following stringent efforts by Thai veterinary authorities to avoid this contamination, this strict testing regime has recently been eased and the problem is regarded as mainly solved. The EC Delegation in Bangkok stressed that this had never been the trade issue that it had been reported to be; the EU's actions were taken purely on public health grounds. This tightening of regulations reduced Thai farmed shrimp exports to the EU by about two-thirds in 2002, thus emphasizing the huge impact of regulations. Whether regulations are real or only perceived trade barriers, their impact on exporters and aquaculture exporters is massive.

AQUACULTURE DEVELOPMENT FOR THE POOR

As sampled above, countless millions of words have been written and spoken about the negative socio-economic and environmental impacts of aquaculture in developing countries. Less publicized are the positive benefits. The revenue-earning and employment opportunities provided by intensive aquaculture whose products are destined for export and/or consumption by the wealthy are well known. However, with the exception of a few internationally traded commodities, such as shrimp and tilapia, the bulk of aquaculture output in developing countries is domestically consumed. In addition, much does not find its way into official statistics because it is consumed at, or very near, the point of production. Aquaculture products are thus important, in many cases essential, components of food for subsistence - not just luxury items.

In a keynote paper two years ago, Pillay (2001) noted that aquaculture around the world is still mainly a small-scale enterprise. However, he believed that the compulsions of ensuring food security for the increasing world population and the need to utilize the opportunity for international trade and investment will more likely make large commercial farms become more common, which may involve greater use of intensive farming methods. One problem with this scenario is that larger farms may bring the specter of globalization, which has its positive and negative sides. Speaking on globalization during an EU symposium in Beijing last year, Eva Roth said that incorporation into the world economy effectively diminishes the capacity of local producers to exercise control over their choice of production system and the way resources are to be managed (Roth 2002). On the other hand, globalization can provide environmental impact mitigation opportunities, enabling the use of less sensitive habitats and ecosystems for extractive and productive purposes. So centralization of global aquaculture production within a few, responsible hands might be considered a desirable goal. However, some wonder if the aquaculture industry can be considered globally sustainable if it caters primarily for the needs of richer people (Kaiser and Stead 2001).

In my opinion, more importance needs to be given to the direct food requirements of the poor. Those who were involved in the work of the UNDP and FAO in aquaculture development 30 or so years ago will remember that this was an issue of paramount importance. Much debate occurred about whether FAO should concentrate its efforts on promoting aquaculture for food production or for income generation. The attractiveness of income and foreign exchange earnings led to a greater emphasis on high-value species with a global export market, or targeted at rich consumers within the country of production. More recently, there are indications that FAO is paying more attention to the poor again (Jia *et al.* 2001). During the first session of the FAO Sub-Committee on Aquaculture (COFI-AQ) in Beijing in 2002 it was noted that while export-oriented, industrial and commercial aquaculture practices bring much needed exchange, revenue and employment to a country, more extensive and integrated aquaculture not only make a significant, grass-roots, contribution to improving livelihoods among the poorer sectors of society but also promote the efficient use of resources and environmental conservation (FAO 2002a).

ICLARM (now re-named the WorldFish Center) recognizes that the current debate on the environmental sustainability of aquaculture is focusing on the negative consequences of the high-feed, input-intensive coastal aquaculture of shrimp, salmonids and other high-value carnivorous species (Kapadia 2000). It believes that a more balanced approach would be to look at the costs and benefits of aquaculture in the context of all other human activities. Aquaculture can make a positive contribution to improving the sustainability of the natural environment while providing food and jobs for poor people around the world.

Haylor and Bland (2001) said that we should 'put people first – but poor people first of all'. Billions of people have no access to electricity or clean drinking water. Estimates for 1998-2000 indicate that almost 800 million people in developing countries are chronically undernourished (FAO 2002c). This is a decrease of 20 million since 1990-1992, but progress in a few heavily populated countries, notably China, masks a deterioration in others. In 47 countries where progress stalled, there was an increase in the undernourished of 96 million. In the countries with the highest level of undernourishment (≥ 35 per cent), nearly 40 per cent of the population is existing on less than one US dollar per day. Six million children under the age of five die from hunger every year; most are not the victims of the well-publicized 'famines' that are reported in the international media. Nearly all of those who die from

hunger die unnoticed. Stott (2002b) coined the phrase the ‘unknown citizen’ for these unfortunates. I wonder whether it is entirely relevant for us to talk about sustainability and responsibility in aquaculture when there are much more pressing issues? Is it surprising if the less developed parts of the world demand a greater share of global resources and claim the right to be able to pollute the earth if it is a precondition to end hunger and despair? This is a matter of distributional equity (E. Fontela, pers. comm. 2002).

A very interesting model constructed as part of a collaborative study involving the International Food Policy Research Institute, the WorldFish Center, and the FAO shows that aquaculture supplies a large share of the low-value foodfish consumed by the poor. Furthermore, the model shows that investment in improving the productivity and sustainability of low-value foodfish aquaculture is a good way of making it more obtainable by the poor (Delgado *et al.* 2002). In addition, there were indications that concentrating on those sectors of aquaculture in developing countries that produce low-value foodfish could have a significant impact on poverty alleviation. However, these authors also noted that what they predict will be a ‘rosy future’ for high-value aquaculture items such as crustaceans and mollusks in the urban markets of developing countries makes it important that ways be found to keep poor fishers (and fish farmers) involved in these key sectors also.

This brings me towards considering the positive impacts of NGOs on aquaculture in developing countries but, first, some ‘scene-setting’ on poverty alleviation is necessary.

Poverty alleviation

A lively session on aquaculture for poverty alleviation and food security was held at the 2002 WAS meeting in Beijing (Edwards 2002); during this session Simon Funge-Smith, Regional Officer for Aquaculture at the FAO office in Bangkok, said that the emphasis now was on aquaculture for development, not aquaculture development *per se*. Innovative institutional arrangements between governments, NGOs, civil society groups, donors and poor people will be required. Traditionally, fisheries institutions are oriented towards solving technical issues; this alone will not solve the problems of the poor. M.C. Nandeesh (pers. comm. 2002) spoke of the need to focus more on people than technologies and noted that, contrary to popular belief, small-scale farmers (<2 ha) are responsible for 90 per cent of the marine shrimp production of India.

Not everybody agrees that small-scale aquaculture is a proper route towards poverty alleviation. In the same session in Beijing, Thomas Hecht argued that there should be a paradigm shift in philosophy away from focusing on food for the poor (which he believes addresses the symptoms of poverty but not its causes) towards the creation of wealth (Edwards 2002). This implies, in his view, moving from low-yield small-scale fish ponds to larger-scale, higher-yielding units. From a macro-economic point of view it is indeed more attractive to aim at richer rather than poor pond owners (de Graaf and Latif 2002). While some see aquaculture as a means of alleviating poverty in developing countries, others naturally find the profit motive more attractive. The conglomerate Charoen Phokphand group, in expanding its aquafeed production activities in China, is targeting the production of turbot and grouper (Anonymous 2002g). The market for these species, which achieve US\$ 44/kg and US\$ 88/kg respectively, is the 130 million individuals in China that are classified as rich.

In contrast, Marttin and de Graaf (2001) noted that the poorest of the poor find themselves in a vicious circle. Their poverty means that they cannot acquire resources to generate an income; thus they remain poor. The micro-credit schemes operated by some NGOs help to give people the chance to break this circle. Some poor people, though they have no land tenure, have access to the land on which their humble home is built and to water and what limited resources the area around it can provide. Making fish fry at reduced prices available, providing training in simple methods of raising fish in small 'holes' dug in the ground adjacent to their homes, and utilizing local feed ingredients (snails, rice, wheat bran, rice bran, bivalves and many others), are additional methods of breaking the circle. Using species which are tolerant of poor water quality (Figure 11), with relatively high disease resistance, is essential.

There are certainly many constraints to promoting aquaculture for poverty alleviation. Those highlighted by Edwards (2000) included:

- inappropriate technology;
- locally limited supplies of 'seed' fish;
- the failure of scaled-down integration of feedlot livestock with fish following the withdrawal of external support;
- insecure access to water and water bodies;
- lack of government commitment and, where commitment exists, policy implementation failures;
- lack of training and microcredit;
- lack of participatory decision-making;
- mass poaching, where insufficient members of the community are involved in something new; and
- lack of awareness amongst development professionals and policy makers about the large potential contribution of aquaculture (e.g. agricultural diversification through the construction of ponds as on-farm reservoirs, which can also be stocked with fish).

Edwards (2000) also noted that researcher-derived, on-station technologies have seldom fitted the diverse and resource-limited contexts of most poor farming households. He noted that the majority of providers of services to aquaculture, and most aquaculture professionals, focus on maximizing yield rather than meeting local objectives, on high-value species rather than low-cost foodfish, and on commodities rather than communities.

A combination of climatic, technical, political, cultural and economic factors were said to have caused the failure of many of the subsistence fish culture projects supported through two USAID programs in Guatemala and Panama in the 1980s (Lovshin 1999). Despite this gloomy conclusion, what interested me was that 52 per cent of the projects in Panama and 64 per cent of those in Guatemala were still culturing fish in at least one pond when they were revisited in 1998. Two projects (out of an original 21) in Panama and five (out of an original 39) in Guatemala were considered well-managed. Contrary to the author's conclusion, I regard this as quite a good success rate. However, I can see the attraction for funding agencies and host governments to divert attention towards the high (and less so, the middle) income farmers that can grow crops of marine shrimp, tilapia, mollusks and (in the case of Chile) salmon, mainly for export. In contrast, the WorldFish Center considers that the target beneficiaries should be small and subsistence farmers and other rural people, especially women, who do not have the resources for intensive, high-value, commercial activities (Kapadia 2000).

Economic benefits may be easier to document in large enterprises geared to production for export, or for sale to upscale domestic supermarkets, but this is not a valid reason for funding agencies and host governments to abandon the introduction of fish culture in subsistence farms. Lovshin (1999) referred to the introduction of fish culture as a much easier chore when directed to financially secure high- and middle-income farmers rather than impoverished subsistence farmers. It is interesting that development work can be regarded as a chore. It is easy to fund and supply technical assistance to those who are already successful. Supporting those whose needs are greatest may seem less visibly rewarding but this is no excuse for avoiding it. Different indicators of success are required if aquaculture is to be used in poverty alleviation. We tend to measure aquaculture in terms of total increases in production and value. For poverty alleviation, more appropriate parameters, such as the growth in the availability of protein and income per head of rural poor, need to be used (de Graaf and Latif 2002).

In reviewing the need to improve food security and alleviate poverty through aquaculture, Tacon (2001) listed several requirements to achieve this goal:

- improving the documentation of potential and actual contribution;
- increasing the funds available for aquaculture for the poor;
- not creating harmful impacts on food supplies;
- improving farmer participation in extension and research approaches;
- investing in knowledge building for management;
- acting within a framework of integrated natural resource management;
- focusing on low-cost products favored by the poor;
- emphasizing species which feed low in the food chain;
- emphasizing local consumers and markets;
- encouraging community-based production (not individuals or corporations);
- promoting aquaculture products from a nutritional point of view;
- monitoring the food security aspects of aquaculture projects.

Many of these recommendations echoed those of Kent (1995) who additionally drew attention to the danger that species (such as tilapia) whose culture was originally intended to strengthen food security for the poor may not remain cheaply accessible to them. For example, channel catfish in the USA ‘made the leap from poor folks and went upscale’ long ago (Rice 1988). In addition, there is concern that the poor, especially women and children, may suffer if lower value local strains are replaced with higher value, more marketable strains that grow faster (Edwards 2000).

For those poorer farmers who are involved in fish culture, even the limited production that they achieve has a significant impact (de Graaf and Latif 2002). Summarizing the results of a trial scheme using the exotic African catfish *Clarias gariepinus*, Marttin and de Graaf (2001) reported that 201 participating households in Bangladesh were able to produce an average of 5 kg of fish in four months, with a daily labor input of one hour per day. This production is equivalent to two months’ food for a family or a 5-10 per cent increase in family income (de Graaf and Latif 2002); the products could be sold to provide income for other purchases of food. Being able to sell US\$ 8 worth of fish after four months may seem almost derisory to many of us but it can mean the difference between being able to eat or not for others (Marttin and de Graaf 2001).

The potential for aquaculture in the alleviation of poverty is clearly recognized in research circles. For example, in a mission statement, the WorldFish Center noted the positive role

that aquatic farming can play in diversifying and expanding the economic base of local communities (Kapadia 2000). In the view of this organization it is imperative that those who have the knowledge and the means to develop this potential source of food do so for the millions of people that are still hungry and undernourished.

Begum and D'Costa (2002) made the following recommendations for poverty alleviation through aquaculture:

- beneficiaries and their problems need assessment through a participatory approach;
- access to water resources, grants and inputs are essential;
- the involvement of women needs to be addressed;
- alternative income-generating activities are needed;
- special attention should be given to fishers and underprivileged communities, including tribal and aboriginal;
- systems for marketing and the equitable distribution of benefits are required;
- legal support should be provided;
- activities should be environmentally friendly (technologies, feeds, fertilizers);
- methods of measuring the project dimensions require research;
- there should be global sharing in planning and modeling *vis-à-vis* poverty alleviation;
- an institutional framework is necessary for sustainability;
- all stakeholders must be involved in the project area for mutual understanding;
- there should be a curriculum towards spiritual and humanitarian development; and
- provision for risk coverage (insurance) is required.

The role of NGOs in poverty alleviation through aquaculture

Most of us are already familiar with the role of international, regional and national governmental organizations in stimulating and supporting aquaculture in the developing countries. In the remainder of this paper, I would like to focus on the role of non-governmental organizations (NGOs) whose contribution has already been significant and whose potential, I believe, is even greater. Edwards (2000) made a plea for partnerships between the poor and development professionals to carry out action-based programs in a shared learning process, in particular where non-governmental and governmental organizations play complementary roles.

Although perceptions in industrialized countries of the activities of NGOs in relation to aquaculture are generally negative, credit should be given where credit is due. Six years ago, as a result of the WAS session in Seattle that I mentioned earlier, Jason Clay from the WWF wrote in our magazine that 'to date, the environment, governments, and Third World communities have subsidized shrimp aquaculture' (Clay 1997). He also noted that 'best practices ... cannot and should not be defined by the industry alone. Many others, from countries to communities to consumers, have a stake in (their) definition'. As noted earlier in this paper, remarkable efforts have been made by the shrimp industry to improve since that time and it is good now to see Jason and the WWF working with aquaculturists in FAO and NACA in a consortium aimed at improving the management of shrimp aquaculture.

Gender issues have entered into the rhetoric of both governmental and non-governmental organizations, and into legislation in Asia, but they are still a poorly appreciated. This is also true in Africa. Browne (2002) reported that although women sometimes spend 8-10 hours per day in Sierra Leone in fishing related activities, they receive little or no assistance from

NGOs (or other organizations). In general, women are much more active in fish farming than in capture fisheries (WorldFish Center 2002). Special attention needs to be given to the role of women in responsible aquaculture and NGOs can have a great influence in this respect. In Bangladesh, for example, NGO strategies towards the development of women in fisheries have been more successful than those of the government (Siason *et al.* 2002).

There are many reports on the positive activities of NGOs in the developing world, where they are important but often overlooked components of the institutional structures supporting aquacultural development. Some of these NGOs have religious origins but their work is neither confined to their co-religionists nor to recruiting proselytes. They serve the needy in general (M.C. Nandeesh, pers. comm. 2003). Other NGOs appeal to the more general public for their funds. Some examples of their work in aquaculture development in Latin America and Asia are provided here.

Molnar (2001) commented that NGOs had a longer and more lasting reach to rural communities than PD/A CRSP researchers and their staffs could ever have. NGOs are expanding their interest and awareness of fish culture as an alternative farm enterprise in Honduras, for example. In Peru, Molnar *et al.* (2001) surveyed 146 practicing fish farmers in the river systems around Iquitos, where the consumption and marketing of fish is well established. In this area, CARE/Peru and a broad array of other NGOs including Caritas were providing technical assistance. There was a high level of receptivity to technical assistance in aquaculture. These authors concluded that the PD/A CRSP must work with NGOs if its research findings and insights into production practices are to provide widespread benefits to rural producers.

Oxfam America does not really support aquaculture (community-based or not), according to a spokesperson who said that she was not sure that they had a very positive attitude towards it (K. Brooks, pers. comm. 2002). She said that this NGO prefers to support projects that it feels are more sustainable; these are small- or medium-scale community capture fisheries. However, Oxfam Great Britain has a program in the coastal district of Duyen Hai in Tra Vinh province, Vietnam (Martinelli 2000). This assists poor (particularly Khmer) farmers to implement mangrove-marine shrimp production systems. However, while such systems offer significant opportunities for sustainable poverty alleviation, this author noted that the biggest risk to their widespread successful implementation is that farmers become 'dazzled' by the potential riches offered by shrimp farming. The big challenge lies in convincing farmers to be satisfied with a good profit from a single successful crop a year, rather than to risk everything in the pursuit of even greater profits. OXFAM groups, which are not averse to aquaculture as long as it is environmentally friendly, have also supported aquaculture projects in Cambodia (M.C. Nandeesh, pers. comm. 2003). Other NGOs, such as PADEK (Figure 13) and CONCERN have demonstrated the potential of aquaculture in increasing income and food supply in Cambodia (M.C. Nandeesh, pers. comm. 2003). Almost all their work is carried out either directly with farmers or in partnership with local government departments. Building the capacity of government staff and using them to carry out the work has been the main focus of the NGOs.

The role of NGOs in aquaculture in India is of recent origin, although many fisher-based NGOs have been successful in protecting the rights of traditional fishers and demarcating areas for traditional fishing crafts and gears (M.C. Nandeesh, pers. comm. 2003). The large Indian NGO Gramin Vikas Trust (GVT) has been working for many years with poor

marginalized people, mainly from tribal groups, to introduce seasonal (rain-fed) aquaculture as part of an integrated project that includes soil and water conservation, small-scale livestock production, and forestry (Haylor *et al.* 2002). More than 4,500 farmers who were unable to produce sufficient food throughout the year have benefited from the aquaculture component.

Bangladesh has been a focus for many NGOs with a positive attitude towards aquaculture, no doubt because of its extreme levels of poverty. Over 60 per cent of the people are below the poverty level, mostly living in rural areas (Begum and D'Costa 2002). According to Shelley and D'Costa (2002) there were over 18,000 beneficiaries of the aquaculture program of Caritas Bangladesh between 1998 and 2000, of which 47 per cent were women. Capacity building support, followed by some special provisions to overcome socio-cultural taboos have been successful in getting women involved in aquaculture. Caritas provides grants for individuals and groups to re-excavate ponds, as well as providing credit support for leasing or purchasing connected with village-based hatcheries, nurseries, small-scale pond culture, integrated fish farming, and paddy-cum-fish culture (Begum and D'Costa 2002). In more than 45 projects, which followed a participatory approach, Caritas has achieved the following successes:

- fish production and consumption, opportunities for employment, and family income have increased;
- remarkable levels of women participation have been achieved;
- skills in resource management were developed;
- even illiterate people were able to practice aquaculture, including operating hatcheries;
- the number of ponds increased;
- awareness on environmental and health matters was promoted;
- living standards were gradually changing; and
- social dignity was enhanced.

Alam (2001) reported that more than 500 NGOs were involved in aquaculture and fisheries in Bangladesh. Several international and local NGOs have direct-support programs targeting over 250,000 households. Most commercial and development banks, financial institutions and NGOs in Bangladesh have rural credit programs for aquafarmers. However, while most NGO programs focus on aquaculture demonstration and training for the poorest segments of rural society, small-scale farmers find difficulty in obtaining credit facilities. Nandeesh and Reshad Alam (2001) reported that about 800 CARE staff members were involved in scaling up aquaculture activities in Bangladesh but their activities are part of a wider involvement in integrated agricultural development. About 20-30 per cent of the average 40,000 families reached are involved in aquaculture, mostly rice-fish culture. Six projects funded through the DFID and EU provide support. Partnerships have been established with more than 150 local NGOs and CBOs (community-based organizations), thus reaching larger areas and more people.

One of the three 'good practice examples' of sustainable culture fisheries quoted in a recent EC publication (EC 2002a) was the Integrated Food Assisted Development Project (1995-1999) in Bangladesh, which included cost-effective re-excavation of borrow-pits and dead rivers. 836 water bodies were developed for sustainable fish culture and 864 small homestead ponds, often intensively managed by women, were developed. These created new ways of

increasing productivity, including fruit and vegetable production on pond dykes. The project was implemented through local NGOs.

One of my friends (M.C. Nandeesh, pers. comm. 2003) has reported that the most striking personal experience he had was to observe that freshwater prawn cultivation had lifted innumerable people out of poverty in the GOLDA project in Bangladesh that was mentioned earlier. More than 100,000 families were involved and many were able to improve their income and food security. Unfortunately, even though there was conclusive proof that freshwater prawn farming was one of the most powerful tools for lifting people out of the poverty cycle (Figure 12), the project was discontinued under what he regarded was the pretext that those involved were not really the poorest.

An Asia-Pacific program of communications and learning called 'STREAM', which promotes participation, communication, and policies that support the livelihoods of poor aquatic resource users has been established (Haylor 2002). This involves NACA, FAO, DFID and an international NGO, Voluntary Service Overseas (VSO). At this point it is relevant to note that staffing NGOs in the shadow of global terrorist crises is not easy. The VSO, which normally has up to 2,000 volunteers in the field, has recently had to start a recruitment drive in the UK, having found that the level of volunteers had fallen by about 40 per cent because of fears about safety.

In most Pacific island nations, progress in developing aquaculture has been disappointingly slow (Pickering and Forbes in press), except in the French overseas territories of New Caledonia and French Polynesia, and in Fiji. Outside Hawaii, Oceania has no tradition of aquaculture but, amongst others, the University of the South Pacific is actively promoting it, with assistance from Canada and the Pacific Forum (A. Forbes, pers. comm. 2002). Their work contributes to the development of a diversified, economically-viable and sustainable aquaculture industry (both commercial and non-commercial/subsistence) in Pacific Island countries. The aim is to improve capacities in government departments, NGOs and the private sector to implement successful aquaculture development projects.

Problems in NGO implementation

Both international and local NGOs have played a very useful part in the sustainable development of aquaculture and its contribution to food security in many countries in Southeast Asia and there are many other success stories. However, some local NGOs have limited access to up-to-date information and lack well-trained staff (Menasveta 2001). As in any other human activity, progress is not always smooth. Some of the problems in the work of Caritas in Bangladesh were identified by Begum and D'Costa (2002) as follows:

- due to illiteracy, beneficiaries find it difficult to understand the technical suggestions given to them;
- beneficiaries are unable to utilize their skills when the leasing period is over;
- natural, biological and environmental hazards often retard fish production;
- big problems in resource ownership, multi-ownership, marketing, leasing and superstition occur; and
- donor funds and services dry up, often when the program is just beginning to show its value.

Introducing small-scale sustainable aquaculture is not easy; some of the difficulties experienced in a socially unstable country and on a site without reliable electricity in Nigeria were also described by Doimi *et al.* (2002).

Obviously, NGOs themselves are not all perfect and many opportunities for improvement need addressing. Nandeesh and Reshad Alam (2001) noted that careful selection of local NGOs is essential, and capacity building is a priority. These authors also commented that NGOs were not always accepted as equal partners by government agencies. Alam (2001) reported that duplication and overlapping of activities between various government organizations and NGOs have been a constraint in Bangladesh. In Cambodia, the Department of Fisheries is initiating steps to increase the accountability of NGOs involved with fisheries and aquaculture (M.C. Nandeesh, pers. comm. 2003). The presentation of annual progress and work plans by the NGOs involved has been helping to coordinate activities in the sector. With the increasing funding support coming to Cambodia, there is an urgent necessity to learn from the experiences of other countries and avoid similar mistakes.

Participatory rapid rural appraisal (RRA) has been a useful tool for the NGO CARE-Bangladesh in studying the complex interactions between fish cage operators and other community members and resources (Brugere *et al.* 2000). Other uses of water include boating and river traffic, ferry operation, washing and cleaning of utensils, bathing, cattle drinking and bathing, fishing, duck farming, jute retting, irrigation, and bamboo transport. In most cases, cage farming did not have any negative impact on these other activities; on the other hand community members saw a wide range of benefits, including the generation of alternative sources of income, food and employment, as well as strengthening the unity of the community. However, some potential problems for the future were identified by this study (Brugere *et al.* 2000); for example competition for water between cage culture, rice cultivation, and the production of vegetable cash crops.

A number of problems in the use of NGOs to promote aquaculture for poverty alleviation have been provided by M.C. Nandeesh (pers. comm. 2003):

- In Bangladesh, some NGOs have been formed mainly to take advantage of the financial benefits provided by various international agencies. The necessity of reaching targets and utilizing money while it is available have led some agencies to select new NGOs that have not yet proved their credibility in the field.
- Similar problems have occurred in India, although many NGOs, especially those employing a systems approach, have demonstrated their ability to reach people at the grass roots level with aquaculture projects. Other, less efficient local NGOs have been proliferating, however, and the Indian government intends to introduce grading schemes for them. This should improve quality, since the granting of funds will depend on their grade.
- Many NGOs think aquaculture is an easy option and try to carry out the activity without proper expertise. They also look at it too narrowly instead of taking a systems approach. This often contributes to poor success with aquaculture projects.
- Some local NGOs have been exploiting farmers. With no experience in aquaculture, projects sometimes have negative results, which create a poor impression about the potential of aquaculture. Even with the screening processes used in selecting NGOs, many local NGO partnerships have proved to be unproductive, generally due to poor planning and accountability issues. Accountability is an important problem but the situation is changing and there is optimism for improvement.

- A modification of the funding policy of major international donor that allows them to favor local NGOs will cause an expansion in the number of small NGOs, with the intention of increasing the number of beneficiaries. In the past, the international and larger national NGOs were given funding to implement projects; now the trend is to use a partnership approach with local small NGOs, such as youth organizations. This is expected to increase the sustainability of the programs. However, experience so far has been mixed. Despite this, increasing transparency and auditing systems are helping to overcome problems. The CAGES project operated by the NGO CARE and funded by DFID was totally implemented through the local NGO partnership program; this has been a great learning experience.

These various areas for concern obviously need addressing. It is clear that NGOs are already playing a very significant role in aquaculture development for poverty alleviation but they need help. How can this be provided ?

ONE WAY FORWARD: A NEW NGO FOR RESPONSIBLE AQUACULTURE IN DEVELOPING COUNTRIES ?

Many different types and levels of NGOs involved in aquaculture have been mentioned above. I have discussed those that are negative and provocative (we are all too familiar with them !) but also dwelt on those that do immense good (often little recognized in our press). The NGOs that are involved in aquaculture development for the poor are sometimes religious, sometimes lay; sometimes branches of international organizations, often national or local. However, it is clear that they need help to utilize the potential of aquaculture efficiently and, as individuals, I feel that we should be ready to assist.

Groups such as WAS are often regarded as ‘professional societies’ but, unless they are qualification-granting bodies, they are not. It would be more accurate to describe them as ‘societies of professionals’; they simply provide a forum for discussing aquaculture issues and a means of disseminating information about aquaculture. In truth they are a form of NGO. GAA and FEAP may also be regarded as NGOs and, in the sense that they are producer associations with a mandate for lobbying, this is rather more obviously so. Both types of NGO originate with those who work in aquaculture: producers, scientists, educators, students, suppliers, administrators, etc.

However, the aquaculture sector does not have any NGO that appeals directly to the public (our consumers), nor do we raise any funds for aquaculture development from the public. We may sometimes wonder where are our ‘Friends of Aquaculture’, our ‘BluePeace’, our ‘World Aquaculture Fund’, our ‘Aquaculture Defense Fund’ ? I think it is most unlikely that we could persuade the public to support a lobbying organization for aquaculture, especially as we have suffered so much criticism (fair and unfair) from existing NGOs with environmental, socio-economic, ethical and animal welfare themes. Any proposition to form a ‘pro-aquaculture’ movement would be perceived simply as a defensive negative reaction to criticism. However, I believe that there is a niche for an aquaculture NGO, as I will outline in a moment.

International NGOs which address specific issues certainly appeal to the public, whether they are positive or negative towards aquaculture, and generate huge sums of money. Why are these types of NGOs so successful in raising funds? In my view, the answers are manifold:

- in general, I believe that they get support because they are believed to be for a cause. In other words it is a positive, not a negative public reaction that initiates support;
- NGOs give the man or women in the street some sense they are doing something positive;
- they do not seem to be warped by political or commercial interests;
- in general, despite some of the problems already described, they are not perceived as being corrupt;
- they appeal to people's instincts to care for people and animals, for the environment, and to be ethical, and so on;
- they are seen as a means of reaching the grass roots level more rapidly and efficiently than governmental organizations;
- in general, they are seen as better value for money than expenditure supported by the taxes imposed by governments; and
- they provide ordinary people with a sense of philanthropy, a sense that 'doing good' need not be confined to those rich enough to set up charitable foundations.

An idea of the scale of funding which could be accessed if the right topic is chosen can be provided reading a report by the Water Farming Initiative (2002). This shows the funding given to marine fisheries programs during a three-year period by just one American organization, the David and Lucille Packard Foundation (<http://www.packfound.org>). This philanthropic foundation aims to channel the personal commitment of millions of individuals who participate as volunteers and donors to 'conserve and enhance resources and improve the quality of life in our community, the nation, and the world'. The names of some of the recipient organizations will be familiar to environmentalists and aquaculturists alike (e.g. the Environmental Defense Fund, Greenpeace, the Marine Stewardship Council, the National Audubon Society, and the WWF). In total, the Packard Foundation granted nearly US\$ 32.6 million for marine fisheries programs alone between 1999 and 2001. I believe that such sources are virtually untapped by the aquaculture community.

I am totally skeptical about the possibility for forming a pro-aquaculture movement that seeks solely to promote what many regard as 'our industry'. However, I think that there may be potential for establishing an NGO that is clearly independent of commercial interests and has an obvious goal: the alleviation of poverty through aquaculture development. This would have to be initiated by people in their private capacity and would need to generate its primary funding by public appeal. It would need to appeal to people's attitudes towards NGOs, which I have attempted to outline above. While the use of aquaculture for poverty alleviation would be the sole aim of such an NGO, the positive image that it would generate would be beneficial to all forms of responsible aquaculture.

NGOs have energy, enthusiasm and funds, which are generated initially through appeals to individuals but then also supported through private foundations and public (governmental) funding for project work. In next year's WAS conference in Hawaii, Dr. M.C. Nandeesh and I hope to be able to organize a special session on the contribution of existing NGOs to aquaculture development. Responsible forms of aquaculture at the grass-roots level in developing countries can be significantly promoted through existing NGOs. However, their

scope is often so broad, it is sometimes difficult to persuade them to divert much of their resources to aquaculture development; many also lack the technical background to do so.

I would like to suggest, and here I address you personally, not as businessmen, researchers, educators and students, but as individuals, that a new NGO should be formed specifically to promote responsible aquaculture in developing countries and to assist particularly in the alleviation of poverty. It would not specifically promote large-scale aquaculture; I believe that investors and market forces can mainly look after this part of our sector. Since this is only a concept, it may seem premature to name this NGO yet (!) but, nevertheless, I would like to borrow something from a famous international medical organization working in developing countries, Médecins sans Frontières, which was founded by a group of French doctors. I will thus use the title **‘Aquaculture without Frontiers’** in the rest of my paper.

‘Aquaculture without Frontiers’ would aim to:

- promote and introduce practical techniques for responsible aquaculture;
- pay special attention to forms of aquaculture that have the potential for alleviating poverty;
- provide the wide technical and managerial experience of the existing aquaculture community for these purposes, utilizing every age strata, from students to retirees;
- demonstrate simple techniques for facility construction, responsible resource use, farm operation and management, and product consumption and/or sale;
- train others to carry on this work locally;
- pay special attention to the role of women in responsible aquaculture development;
- cooperate with existing NGOs, where appropriate;
- concentrate mainly on working at the grass-roots level;
- seek the integration of responsible aquaculture with other income and food generating activities using common natural resources;
- seek to carry out long-term projects, which are properly designed, operated, monitored, and assessed for efficacy; and
- be transparent and accountable in its work.

Where could the funding come from to support **‘Aquaculture without Frontiers’** ? I think this could follow the lines of existing NGOs. First find beneficent individual, corporate and foundation donors to provide start-up funds for a promotional and educational campaign. Then seek funds from the general public, especially in the industrialized countries. Then enhance this through appeals for major funding from private foundations and the public sector (governments and aid banks) for individual field project work. Don’t think that funds are not available. It is a matter of accessing them with suitably useful, philanthropic ideas, topics, and projects.

Every government needs a unified, general national policy for sustainable aquaculture development (New 1999b), within which an NGO such as **‘Aquaculture without Frontiers’** could operate. Those who lobby for the conservation of our environment, for social equity, for food safety, and for animal welfare, as well as the producers themselves (whether industrial- or small-scale) must be involved in developing these policies. Jia *et al.* (2001) noted the need to assist in social development, poverty alleviation and improving the livelihoods of people. In doing so, these authors felt that there was a need to increase emphasis on aquaculture and aqua-farmers in national, social and economic development plans. The importance of stakeholder participation was also stressed.

How could the concept of **'Aquaculture without Frontiers'** be materialized ? Not through the public sector: the 'man or woman in the street' is unlikely to support it if it is initiated by any government - people worldwide have an inherent mistrust of political motives. Not through the existing aquaculture industry: people would, even if it were not true, suspect commercial motives if this NGO had its origins in large-scale commercial aquaculture. I believe **'Aquaculture without Frontiers'** could only be initiated successfully by a group of people who are demonstrably independent.

Here therefore is my challenge to each one of you. Although many of us work in the aquaculture production industry, we also have our identity as individuals. We all have, or I hope that we have, the wish to promote responsible aquaculture and the human instinct to try to alleviate poverty wherever we see it. We have the potential to use our knowledge of aquaculture to help us to do both. As such, I think we could be regarded by the general public as sufficiently independent to form **'Aquaculture without Frontiers'**.

However, some dedicated people are needed to take the initial steps. Perhaps some of the individual members of WAS, or of other groups with which we are associated, such as the European Aquaculture Society or the Asian Fisheries Society, could be the pioneers of **'Aquaculture without Frontiers'** ? However, which of us has the time to take on more work, especially if it is unpaid ? This is where a story from Taiwan comes in.

In 2001 I was invited by our good friend and Honorary WAS Life Member, I-Chiu Liao, to organize and co-chair a session at the 6th Asian Fisheries Forum in Kaohsiung. This session, which took place shortly before I-Chiu himself retired, was entitled 'post-retirement careers in aquaculture and fisheries'. Many 'retirees' continue to work in their own fields - some for profit; some in voluntary work; most in a combination of both. Six fisheries and aquaculture retirees were selected to give papers during that symposium (New and Liao 2002). The criteria for participation were that they were either Asian or had contributed to the development of Asian fisheries and aquaculture. The number of people suggested as potential speakers made it clear to me that there are many aquaculture retirees who have the energy, knowledge, enthusiasm and time to continue contributing to aquaculture (and fisheries) development for many years after retirement. Perhaps the founders of **'Aquaculture without Frontiers'**, those responsible for its initial stages, could be partly drawn from the ranks of this strata of our societies. Retirees could also provide continuing guidance and technical expertise.

Who would be mainly involved in the field work of **'Aquaculture without Frontiers'** ? Like most NGOs, its staff could be a mixture of paid individuals and volunteers. Many NGOs use volunteers in their project work, for example the Peace Corps and the VSO. Numerous people – doctors, nurses, and many other professionals – devote at least part of their life to voluntary work at home or abroad. Why not aquaculturists too ? Educators and students might choose to utilize their sabbaticals and their gap years between school and university, and university and full-time employment, in such a cause.

There would be obvious opportunities for **'Aquaculture without Frontiers'** to work with existing NGOs, who have a wealth of experience in developing countries. However, such cooperation need not necessarily be confined to NGOs who have already included aquaculture in their portfolio of project work. The general hostility to aquaculture amongst

many environmental, socio-economic, and animal welfare NGOs has been infectious. Such attitudes did not originally appear without cause; few people complain without any justification. Some objections to aquaculture were primarily generated because of the environmental excesses of intensive aquaculture. Others were caused by fears of competition for markets and finite resources. However, the public sector (through environmental and food safety regulations) and the intensive aquaculture industry (through codes of practice and certification) is attempting to deal with these fears. Exploring the potential benefits of working with some of those organizations that have, up to now, been active opponents of aquaculture should not be neglected (Davy and MacKay 1999). I have always promoted dialogue, not conflict. Perhaps the existence of **'Aquaculture without Frontiers'** would provide an opportunity for cooperation, not conflict. However, there are some NGOs, such as PETA (who believe that 'animals are not ours to eat') with which cooperation would be impossible !

Obviously, the initiation of **'Aquaculture without Frontiers'** would require detailed planning, publicity, fund raising, etc. This is not the time to enter that organizational minefield; this is just an opportunity to suggest the concept for serious consideration. I believe that such an organization could help to achieve the twin goals of responsible aquaculture in developing countries and poverty alleviation. I also believe that its fund-raising campaigns and its work would be very beneficial to all types of responsible aquaculture, whether large- or small-scale and whether located in industrialized or developing areas.

Davy and MacKay (1999) pointed out that meetings such as this conference in Brazil are important in highlighting the issues; however, while they are strong on rhetoric, it is even more important for them to result in some actions. Perhaps the development of **'Aquaculture without Frontiers'** might be a useful follow up to our discussions this week. Despite the cautionary advice of a good friend and colleague who, in a paper about African aquaculture development given during the WAS meeting in 2001 (which, incidentally was held in the fantasy environment of Disneyworld in Florida !), called for 'a little less idealism and much more realism' (T. Hecht, pers. comm. 2003), I hope that my ideas about **'Aquaculture without Frontiers'** will provoke some reactions; if they do, please write to me at Michael.New@compuserve.com

I end with another quotation from Oscar Wilde (Rolfe 1997):

'Nothing is worth doing except what the world says is impossible'.

ACKNOWLEDGEMENTS

Nearly fifty friends and colleagues have contributed copies of relevant papers and personal communications during the preparation of this review. I am extremely grateful to them and I apologize that it is impossible to name them all individually; they will recognize their names amongst the references and in the text.

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Table 1. Numbers (thousands) of fish farming workers 1990-2000 (FAO 2002d)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Africa				5	6	14	62	55	56	57	75
North & Central America	53	73	101	206	206	176	182	185	191	190	190
South America	16	15	15	20	30	43	44	42	41	42	41
Asia	3,698	3,882	4,292	4,927	5,389	6,003	6,051	6,569	6,758	6,930	7,132
Europe	11	12	13	23	26	18	23	25	25	26	27
Oceania					1	1	4	5	5	5	5
World	3,778	3,982	4,421	5,181	5,658	6,255	6,366	6,881	7,076	7,250	7,470

Table 2. Top 25 LIFDC aquaculture producers in 2001 and proportion of total fish production from aquaculture (derived from FAO 2003)

	Aquaculture (mt)	Capture and aquaculture (mt)	Aquaculture as proportion of total (%)	Rank (#)
Armenia	1,331	2,197	61	25
Bangladesh	687,000	1,687,000	41	4
Cambodia	15,500	412,700	4	14
China	26,050,101	42,579,490	61	1
Cuba	54,330	110,380	49	9
Ecuador	67,969	654,539	10	7
Egypt	342,864	771,516	44	6
Ghana	6,000	451,287	1	18
Guatemala	4,200	14,300	29	21
Honduras	9,000	16,451	55	15
India	2,202,630	5,965,280	37	2
Indonesia	864,276	5,069,107	17	3
Korea DPR (North)	63,700	263,700	24	8
Laos	50,000	80,000	63	10
Madagascar	7,749	143,364	5	17
Morocco	1,362	1,084,641	<1	24
Nepal	16,570	33,270	50	12
Nicaragua	5,721	28,520	20	20
Nigeria	24,398	476,544	5	11
Pakistan	16,405	623,425	3	13
Philippines	434,657	2,382,315	18	5
Sri Lanka	8,370	288,508	3	16
Syria	5,880	14,171	41	19
Uganda	2,360	223,086	1	23
Uzbekistan	4,082	8,152	50	22

Table 3. Codes of conduct: examples applicable to aquaculture

Name	Targets and topics	References
FAO Code of Conduct for Responsible Fisheries (CCRF)	Includes aquaculture	FAO (1995)
Philippines Fisheries Code	Includes aquaculture	Yap (1998)
Thai Code of Conduct	Shrimp farming	Tookwinas and Songsangjinda (2003)
Federation of European Aquaculture Producers (FEAP) Code of Conduct	European aquaculture	www.feap.info
Nutreco Code of Conduct	Commercial aquafeed and aquaculture producer	Anonymous (2002a)
Codex Alimentarius	Food safety and quality standards, including 29 relevant to fresh and processed fisheries products	www.fao.org/es*/esn/codex
Australian Aquaculture Forum National Code of Conduct	Australian aquaculture	Shelley (1999)
Draft Code of Conduct (Brazil)	Environmental issues	Santiago Caro Ros (2002)
Thai Code of Conduct	Shrimp farming	Fegan (1999); Anonymous (2000a,b,c); Tookwinas <i>et al.</i> (2000)
Codes of Conduct US Department of Commerce Code of Conduct	Shrimp farming Responsible aquaculture development in the EEZ (draft to be published Summer 2003)	Boyd (1999) C. Nash (pers. Comm. 2003)

Table 4. Codes of practice: examples applicable to aquaculture

Name	Targets and topics	References and notes
Guidelines for GMPs ⁶	Shrimp farming	Annex D in FAO (2001)
Thai GMPs	Shrimp farming	Tookwinas <i>et al.</i> (2000)
Malaysian Code of Practice	Aquaculture	Anonymous (1999a)
Malaysian Code of Practice	Shrimp farming	Anonymous (2002d)
Australian Prawn Farmers Environmental Code of Practice	Shrimp culture	Anonymous (2001a) www.apfa.com.au
Consortium Program on Shrimp Aquaculture and the Environment (CPSAE)	Developing BMPs ⁷	www.enaca.org/shrimp/bettermanagement.htm
Guidelines on GMPs Global Aquaculture Alliance Codes of Practice	Shrimp farming Responsible shrimp farming	AA (2002) www.gaalliance.org Adopted (e.g.) by producer associations in Ecuador, Honduras and Nicaragua in 1999 (Anonymous 1999b)
Sundry codes of practice or BMPs produced by net-pen, oyster, and shrimp farmers, etc. in the USA	Various industry sub-sectors	C. Nash (pers. Comm. 2003) Likely to set national quality standards, which would also need to be met by exporters from developing countries

⁶ Good Management Practices (sometimes referred to as Best Management Practices)

⁷ Best Management Practices (sometimes known as Good Management Practices)

Table 5. Guidelines, policies and strategies for responsible aquaculture: examples

Name or type of document	Targets and topics	References
FAO Technical Guidelines	Aquaculture development	FAO (1997)
Strategy for the sustainable development of European aquaculture	Aquaculture development	EC (2002b); New (2003)
NACA/FAO Strategy for Aquaculture Development beyond 2000	Aquaculture development	NACA/FAO (2001)
Holmenkollen Guidelines	Sustainable aquaculture	NATS (1997); Sundli (1999)
Draft framework Guidelines	General aquaculture Improved technology in traditional and improved traditional shrimp farming in India	Ackefors and White (2002) AA (1999)
Guidelines	Effluent treatment in shrimp farms in India	AA (2001a)
Audubon Guide to Seafood	NGO evaluating captured and culture species	www.audubon.org Chamberlain (1999)
Environmental Defense	NGO (300,000 members in the US) evaluating captured and culture species	www.environmentaldefense.org
Sustainability indicators Guidelines (India)	Aquaculture Sustainable aquaculture	Pullin <i>et al.</i> 2003 in press www.mpeda.com
Recommended policy (Taiwan)	Sustainable aquaculture (shrimp farming)	Liao (1998)
Global planning and management	Sustainable coastal aquaculture development	GESAMP (2001)

Table 6. Certification schemes

Name or type of document	Targets and topics	References
IFOAM Draft standards	Organic aquaculture	Anonymous (2002f) www.ifoam.org
Marine Stewardship Council Certification	Currently applies to capture but has ambitions to extend to aquaculture	www.msc.org
International Organisation for Standardization (ISO)	Environmental labels and declarations (ISO 14000 and 14020 series)	www.iso.ch
Natureland Certification	Organic aquaculture	www.naturelandzeichen.de
Aquaculture Certification Council (ACC)	Shrimp farming facilities	www.aquaculturecertification.org
SCS Marine Certifications	Accredited certifier of marine fisheries, with ambitions to extend to aquaculture	ACC (2002) www.scs1.com
World Wildlife Fund (WWF)	Works with MSC on fishery certification. Involved (with NACA etc.) in CPSAE	www.wwf.org
International Organisation for Standardization (ISO)	Environmental labels and declarations (ISO 14000 and 14020 series)	www.iso.ch

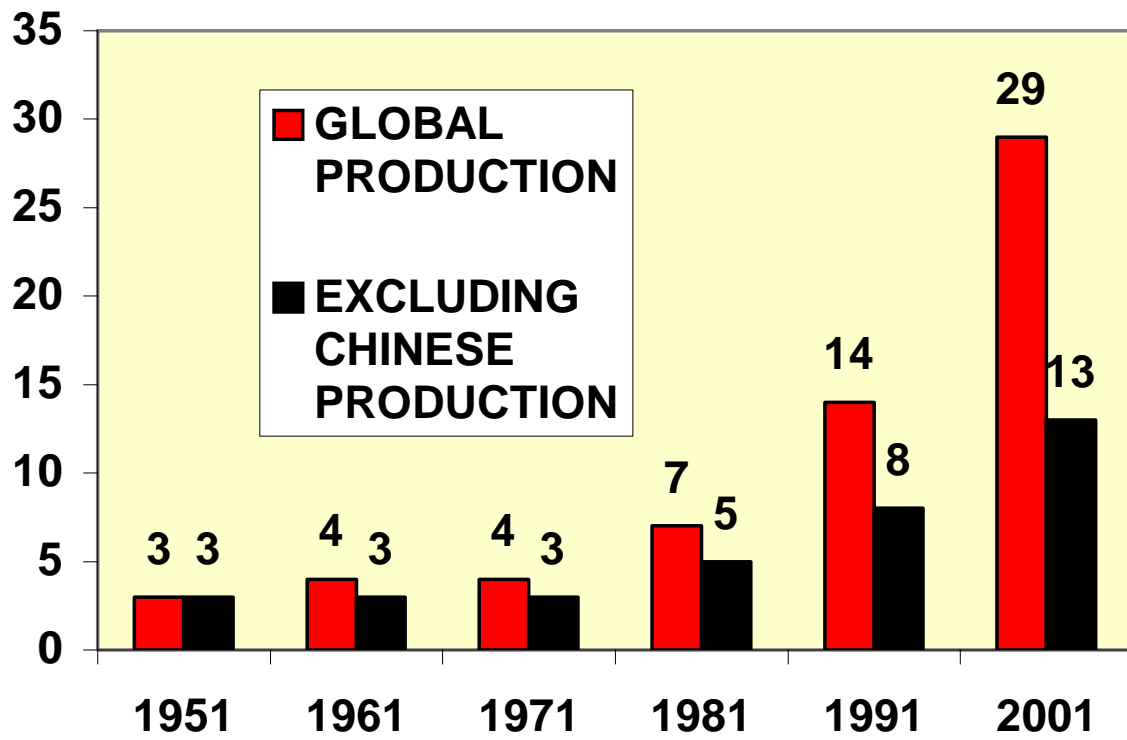


Figure 1. Contribution of aquaculture (%) to total foodfish supplies 1951-2001 (FAO 2003)

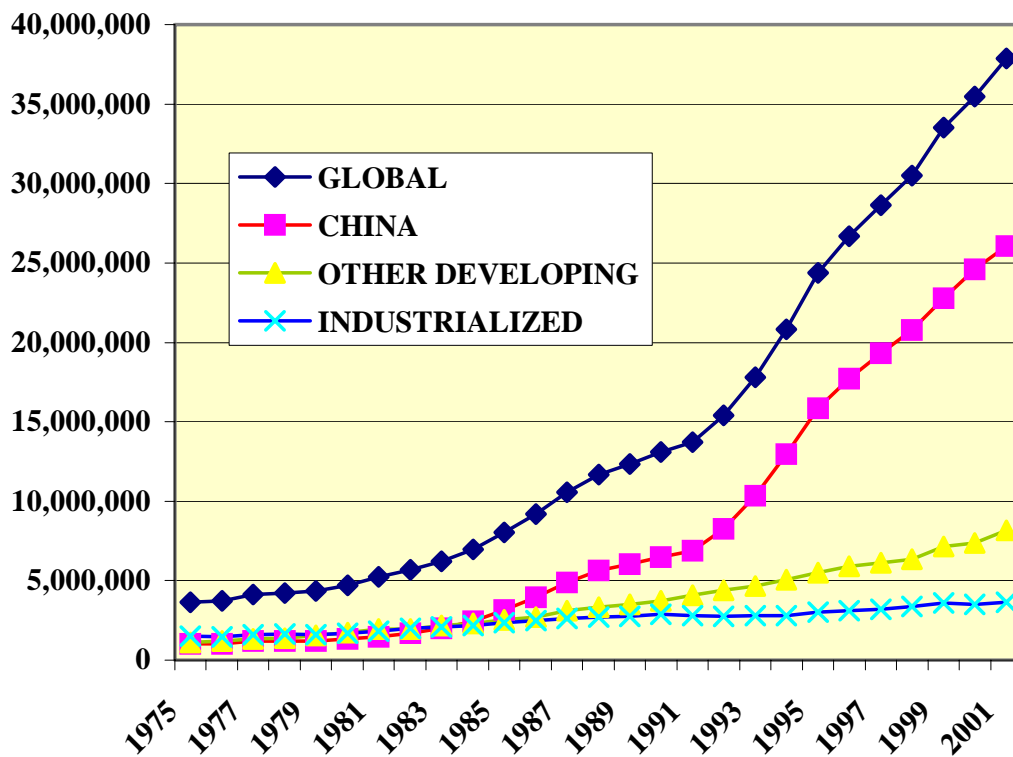


Figure 2. Aquaculture production (mt) 1951-2001 (FAO 2003)

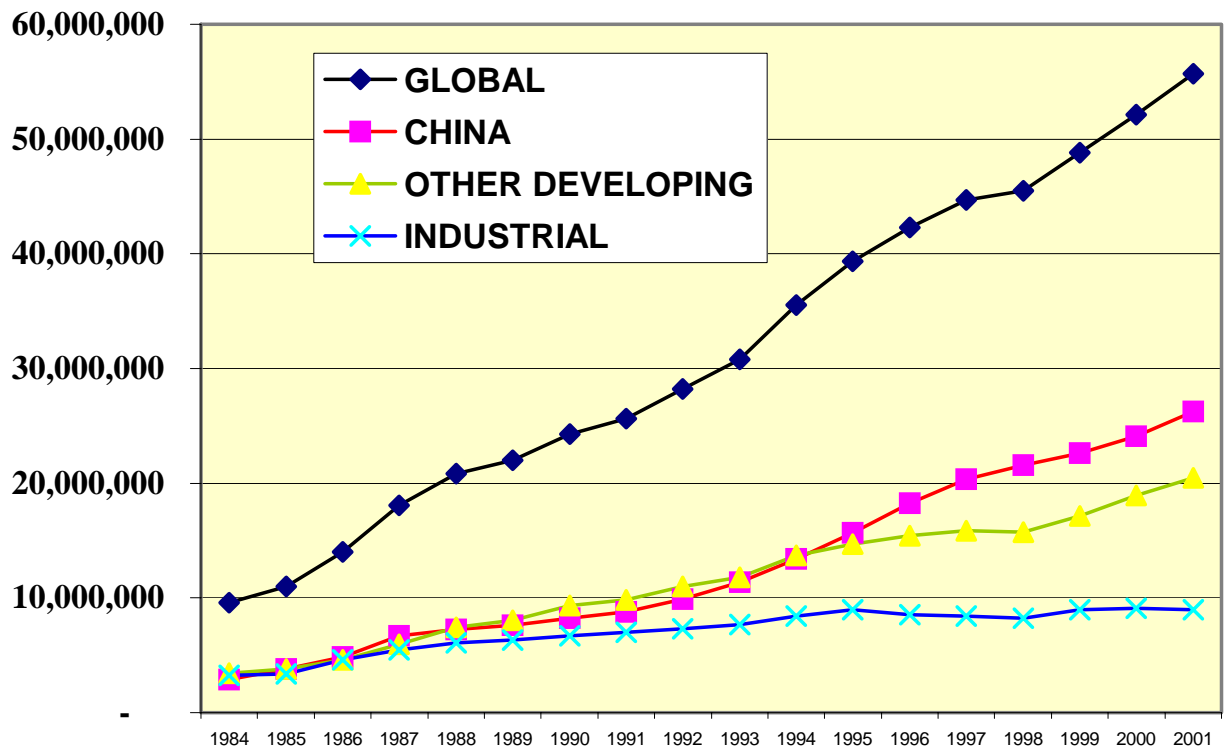


Figure 3. Value of aquaculture products (US\$ '000) 1984-2001 (FAO 2003)

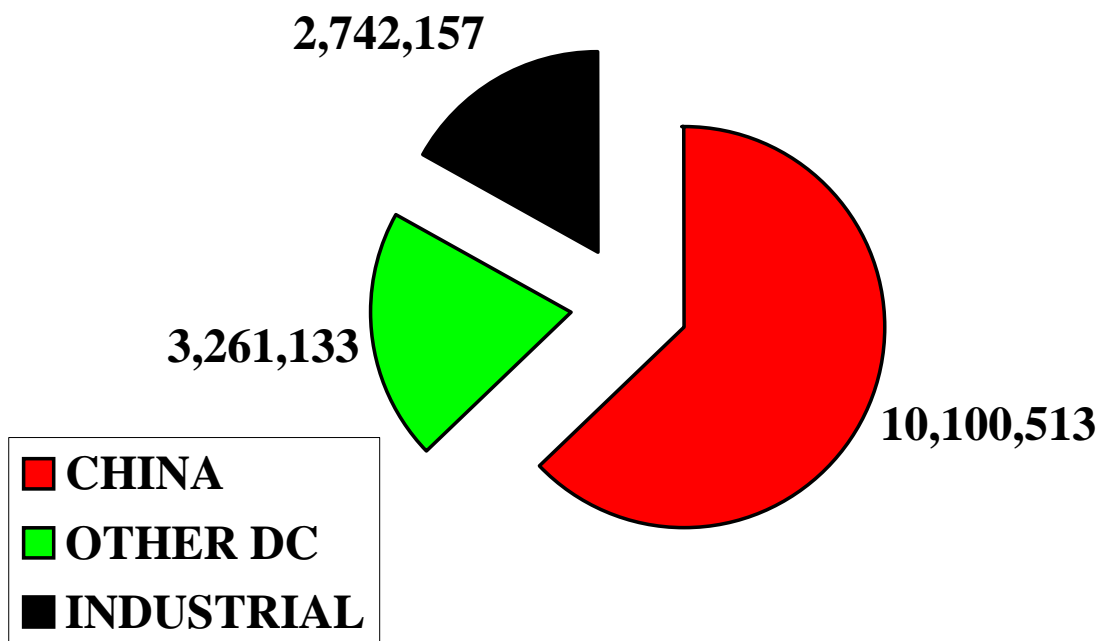


Figure 4. Coastal aquaculture production (mt) by economic group in 2001 (FAO 2003)

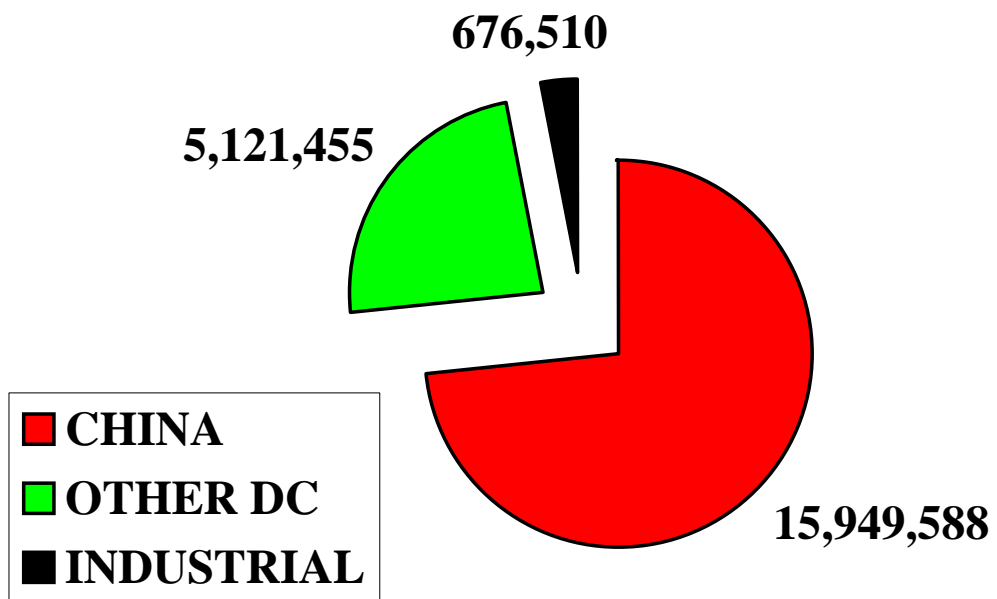


Figure 5. Freshwater aquaculture production (mt) by economic group in 2001 (FAO 2003)

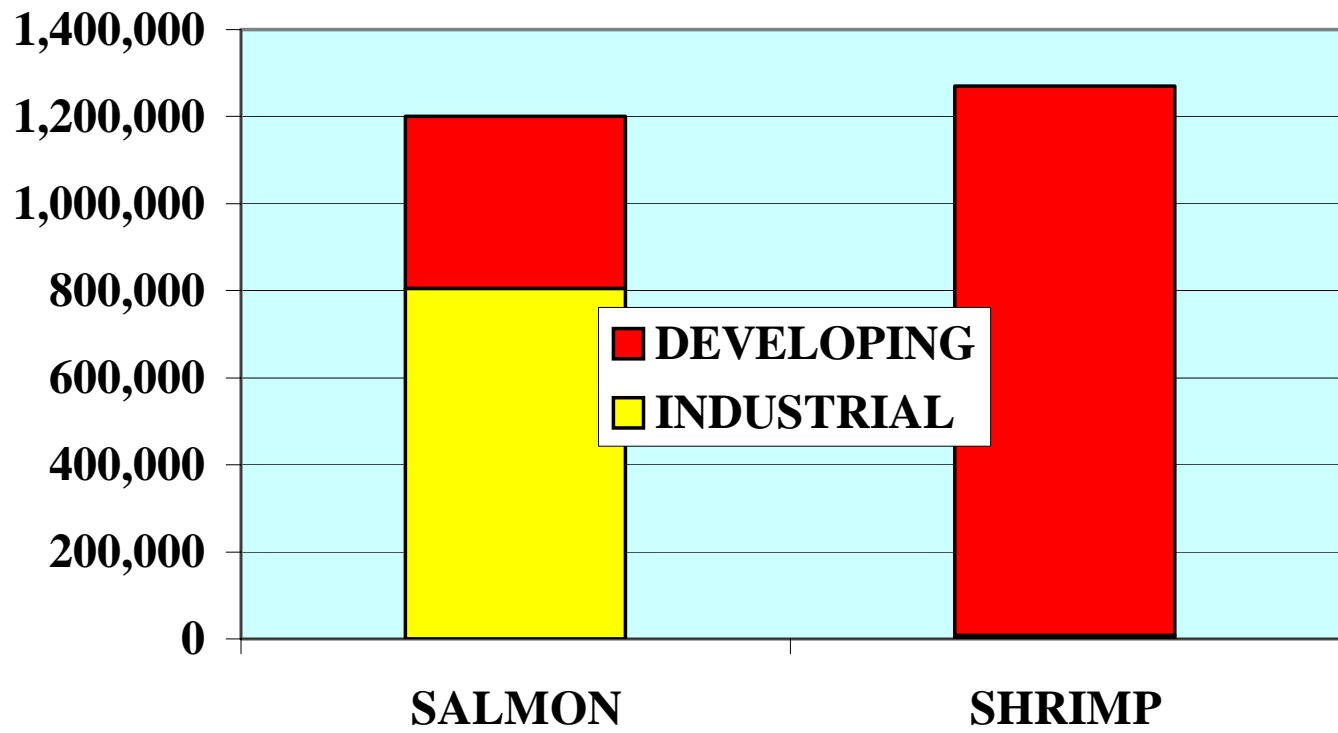


Figure 6. Aquaculture production (mt) of salmon and shrimp in 2001 (FAO 2003)

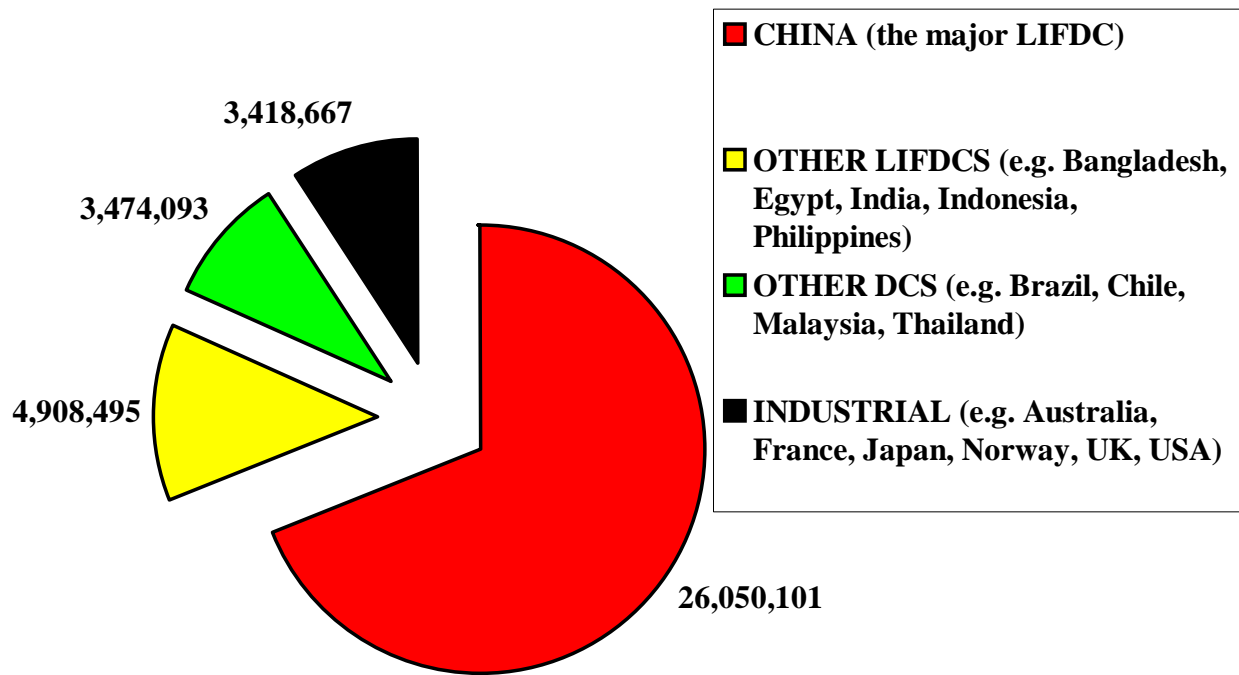


Figure 7. Importance of aquaculture production in low income food deficit countries in 2001 (derived from FAO 2003)

Figure 8. Marine shrimp farm in (awaited from Kutty)



Figure 9. Site of 180 mt shrimp farm near La Foa, New Caledonia, before (left) and after construction (Courtesy: H. Lemonier, SMAI, via Yves Harache)



Figure 10. CP shrimp farm, Lampung, Indonesia (Courtesy: Nyan Taw)



Figure 11. Pumping water into sources used by other farmers is a major way to spread disease (Courtesy: M.C. Nandeesh)



Figure 12. A freshwater prawn farming project managed by the NGO CARE has helped to alleviate poverty in some areas of Bangladesh (courtesy M.C. Nandeesh)



Figure 13. The NGO 'PADEK' helped to create nutritional & economic security in Cambodia through aquaculture (Courtesy: M.C. Nandeesh)

