

5. Results by regions

5.1 AFRICA

5.1.1 Development objectives

All experts believed that aquaculture should be encouraged in Africa in order to improve livelihoods through increased incomes, employment and well being (or reduced poverty) and also to improve nutrition and food security. These two objectives were given a “very important” rating. Two other objectives were ranked as “important”: aquaculture’s ability to generate foreign exchange and growth, and its potential to improve sustainability of resources. Finally, the goal of developing rural areas was given “moderate” importance.

5.1.2 Challenges

In order to identify challenges, experts were asked to indicate which constraints had handicapped the development of aquaculture in the region. After these were collated, a second round of the Delphi survey asked the experts to rate the constraints according to whether they were likely to worsen. The aim of this exercise was to assess the perceived severity of constraints, and therefore their priority. If any given constraint is likely to worsen, then that would make it a higher priority for action compared to constraints that are expected to ease in the years ahead.

Constraints were classified in three distinct categories: 1) constraints which had negatively affected aquaculture development and were expected to worsen if no corrective action were taken; 2) constraints which had negatively affected aquaculture but were not expected to worsen; and 3) factors that have not affected the sector thus far, but could slow development in the future. Later rounds of the survey asked the experts for their strategies to contain and lessen these constraints.

5.1.3 Challenges expected to further slow down development of aquaculture

The single most important factor which had negatively affected aquaculture development and was expected to impede further progress was an absence of *appropriate policies for aquaculture development*. This was sometimes viewed as a complete lack of policies or the existence of wrongly focused national policies. Experts mentioned specifically the lack of clear property rights (including land rights for women) in some countries. However, a more general concern was the absence of policies promoting commercial (business-oriented) aquaculture. This was expressed as:

- legislation that is unfriendly to the private sector, overlooking profit in promoting aquaculture;
- predominance of government- or donor-driven investments as opposed to private, commercially-oriented ventures;
- overemphasis (driven in particular by the international community) on small-scale subsistence aquaculture;
- neglect of larger, private sector investments; and
- overemphasis on aquaculture as a means of rural livelihood when first introduced in the region. According to the experts, these wrongly-focused policies had negatively affected aquaculture development in Africa and are likely to become more acute unless appropriate action is taken to reverse them.

TABLE 8
Absence of appropriate policies in Africa and suggested mitigating strategies

Constraint	Possible mitigating strategy	Contribution	Likelihood
Overlooking profit (or lack of policies) for aquaculture development	Focus on policies favouring commercial aquaculture	Very strong	Almost certain
	Free up the private sector to spur aquaculture development	Very strong	Almost certain
	Profitability is needed if farmers are to remain in aquaculture. Donors, NGOs and governments to promote aquaculture as a business rather than as a social activity; teaching farmers to be rational weighing returns against risks before making the decision to venture into aquaculture.	Very strong	Almost certain
	Recognize that aquaculture is risky and provide good governance	Strong	Almost certain
	Involve all key stakeholders in the elaboration of aquaculture policy and strategic frameworks		
	Train and expose policymakers, technocrats and farmers in aquaculture policy advocacy and making		
	Identify/formalize national aquaculture policy frameworks		
	Governments and donors (including NGOs) to develop economic models for standard aquaculture projects, focus on risks or obstacles to business		
Overfocus on small-scale subsistence aquaculture	Package and disseminate information on realistic investments in profitable aquaculture		
	Encourage aquaculture as a business including small-scale operations. It should be noted that small-scale aquaculture can only work if there are seed, feed, processing, and extension service facilities in a country. This role can also be assumed by an industrial farm that integrate small-scale producers as satellite farms	Very strong	Almost certain
	Donors (including NGOs) and governments to understand that aquaculture as a social activity seldom works, encourage them to think of long-term sustainability, which would include profitability, and encourage them to promote aquaculture as a business	Very strong	Almost certain
	Governments to insist that donors (including NGOs) prepare and present to farmers business/market plans with realistic assumptions of the aquaculture systems they promote before encouraging them into the activity		
	Pilot commercial farms through projects could be encouraged		
	Public sector should elaborate policies and a strategies aimed at profitable and commercial aquaculture		
	Sensitize potential investors on the profitability of commercial aquaculture and provide credit schemes so small-scale farmers can intensify production		
	Encourage NGOs to have a business/pragmatic approach to aquaculture		
	Explain the advantages and disadvantages of entrepreneurial investment in particular externalities (demonstration effects)		
	Illustrate how some countries have developed aquaculture from <i>non-subsistence</i> aquaculture (examples coming from South Africa or Madagascar or other continents).		
	Encourage governments and donors (including NGOs) to prepare business/market plans for hypothetical farms, and compare risks and returns from other crops		
	Disseminate information on the potential of aquaculture in the region with clear guidance on the most appropriate areas and aquaculture practices		
	In promoting aquaculture, concentrate on farmers with education and ambition		
	Provide tax relief for commercial operations		

Constraint	Possible mitigating strategy	Contribution	Likelihood
Neglect of larger private sector investments	Encourage mother-infant operations as with some agricultural products in Zambia Provide incentives to private investors Raise policy-makers and donors' awareness of the benefits of size in farming (large-scale farms) in absorbing risks and providing technological expertise and markets to small-scale farmers, as well as stimulating the fish feed industry Have a strong, commercial aquaculture group that can lobby effectively in favour of large investments For aquaculture sustainability, access to natural resources should be open to a large spectrum of the society. It is also important to maximize the social benefits from the use of these resources rather than economic profits for the few (larger private investments). Thus, larger private investments should be considered as a means of empowering semi industrial/medium-scale and small-scale farmers.	Very strong	
Slow recognition of inputs required as stand-alone industries	Organize study tours in the region where there are seed and feed enterprises Encourage experimentation in feed by larger companies Encourage broiler feed firms to enter aquaculture feed industry (diversify)		

Table 8 summarizes this “lack of suitable policies” and mitigating strategies suggested by the experts. The group of experts was asked whether mitigating strategies would make a “very strong”, “strong”, or “possible” contribution. They were also asked their opinion on the likelihood of these changes occurring over the next fifteen years: whether changes were “almost certain to happen”, “likely to happen”, had “a 50 percent probability of happening”, or had a “very low probability of happening”. Responses are shown on the two right columns in Table 8. Many mitigating strategies were not ranked by the experts (corresponding cells in Table 8 have been left blank).

Challenges related to factor inputs and expected to further slow down aquaculture development

Other factors that have negatively affected aquaculture development and are expected to continue affecting the sector *more negatively* than in the past are constraints that are specific to factors of production. Experts were asked again for practical suggestions on how to ease these constraints. Responses are listed in Appendix 1.

One identified constraint is the unavailability of, and difficult access to, *capital*. Financial resources for investment in aquaculture have been very limited in most sub-Saharan Africa, including interested commercial-level aquaculture producers. The situation has been exacerbated by the deficiency of adequate credit facilities and the reluctance of financial institutions to support aquaculture as a commercial enterprise (difficult access to loans). The lack of credibility of the industry – perceived as bearing a high risk of failure due to earlier failures of aquaculture projects – remains a major constraint in convincing farmers and investors of the economic viability of aquaculture, deters bankers from lending and limits access to credit. Mitigating strategies are suggested in Appendix 1.1.

A second factor likely to constraint development even further was the *poor technical capacity* in both government and private institutions. According to the experts, aquaculture development has been hampered and is likely to continue being hampered by the shortage of human capacity and poor technical expertise at both the administration and farm levels. Poor understanding (technical expertise) of aquaculture by key technical staff in governmental fisheries departments is especially apparent in their lack of capacity to establish visionary policies and the deficiency of entrepreneurial skills which are much needed in aquaculture development. In this regard, experts especially underlined the chronic shortage of expertise in developing aquaculture business plans and the insufficient technical and intellectual support which affects extension advice. Mitigating strategies are suggested in Appendix 1.2.

Feed and *seed* were also identified as existing constraints. The limited availability and access to reliable good quality and cost-effective fish feed and the virtual absence of a supporting industry have affected and will continue to affect regional aquaculture growth. Aquaculture development in Africa has also been slowed down by limited access to reliable, good quality and cost-effective fish seed. These constraints are likely to continue affecting the sector in the future. Mitigating strategies are suggested in Appendices 1.3 and 1.4.

Technological limitations also constrain aquaculture development. For example, limiting farming to pond culture of a few fish species, primarily tilapia, has contributed to the slow development of the sector in the region. Mitigating strategies are suggested in Appendix 1.5.

Poor extension services and *inadequate research* are additional constraints. Issues include weak government-supported extension services, inadequate extension systems, poor research-farmer linkages, and limited research information from which investors and other interested parties can learn. Mitigating strategies are suggested in Appendix 1.6.

Other identified constraints were poor basic infrastructure such as roads and electricity, and poor aquaculture-specific infrastructure such as water distribution systems. Some additional factors included limited physical resources (water and land) in some countries, poor and deteriorating national economies in most countries in general and the agriculture sector in particular, HIV/AIDS and climate change. All these factors have negatively affected aquaculture development and are expected to continue affecting the sector even more negatively than they did in the past. Mitigating strategies are suggested in Appendix 1.7.

Challenges that are expected to persist

Experts considered two factors which have negatively affected aquaculture development and would continue to do so. The first constraint was related to the *market* and included the absence of a reliable market for aquaculture products, deficient infrastructures limiting access to markets (roads), the cost and difficulty in meeting quality standards (e.g. Hazard Analysis and Critical Control Points [HACCP]), the low purchasing power of the local population, competition from capture fisheries, and consumer preferences for marine wild-caught fish or for meat. These factors have adversely affected aquaculture development in Africa. However, low prices of locally-captured fish from natural freshwaters and the large supplies of cheap marine wild-caught fish that once hindered aquaculture development are not seen as a problem in the upcoming 15 years.

With respect to marketing, and particularly international marketing, the following strategies were suggested by experts: governmental support for producer-led fish marketing; support for the establishment of strong and legally recognized national fish farmers organizations which can be internationally linked to others; promotion of intra-regional trade to obviate HACCP standards and transport costs; increased access to price information; and providing assistance to farmers to synchronize fish production in order to guarantee regular supply (see Appendix 1.8).

The second factor was *poor governance*. Weak governments, weak local farmers' and development institutions, the lack of interagency coordination, the existence of civil conflicts in many countries, corruption and ideological aversion to free markets by some government officials were included in this category. Mitigating strategies are suggested in Appendix 1.9.

Challenges that have not yet materialized but could occur in the future

The factors discussed in this section were identified by experts as not yet having affected aquaculture development in their region, but as being likely to do so in the

future unless appropriate preventive steps are taken. Some of these factors will have more negative impact than others on the sector.

The migration of trained staff (i.e. aquaculture-trained staff leaving the sector for opportunities in other areas of the economy), funding of government hatcheries (this issue generated substantial disagreement amongst experts) and inappropriate technical information packages would have a very large negative impact on aquaculture development in the future if they were to occur. The lack of political will and the lack of awareness on the economic importance of aquaculture at the decision-maker levels would have a moderate negative effect on the development of the sector (Appendix 1.10).

However, experts believe that these two last factors (lack of political will and continued funding of government hatcheries) have low chances of occurring. Policy makers are increasingly supportive of aquaculture development in many countries and financial austerity forces most decision makers to define priorities when allocating resources, which limits government spending on publicly owned hatcheries. In contrast, migration of trained staff from aquaculture was identified as having a high probability of occurrence in the future. Inappropriate technical information packages and the lack of awareness on the economic importance of aquaculture were estimated to have a 50 percent probability of occurrence.

5.1.3 Opportunities

In addition to strategies aimed at mitigating the effects of negative factors, experts were asked to suggest policies which would have a “very high” positive impact on aquaculture development in Africa over the next 15 years (if they were implemented). For brevity purposes, the list below excludes mitigation policies that were previously suggested when discussing constraining factors.

Suggestions included:

- establish a single lead agency for the sector;
- encourage formation of national, subregional, regional and international networks for information exchange and training;
- strengthen technical and organizational (fish farmers associations, groups, cooperatives) capacity of fish farmers;
- strengthen producers’ understanding of aquaculture socio-economic aspects (business plan, record keeping, etc.) and assist them with business plans for aquaculture;
- shift technical education away from the training of government extension agents to the training of fish farm managers;
- provide public sector support to private entrepreneurs in setting up the technological infrastructure required for aquaculture (hatcheries, feed mills, cold chains, etc.);
- sell or lease public infrastructure used for seeds and feed production to private producers; and
- provide high-quality technical expertise (from aquaculture managers, not researchers or development experts), probably from outside the region initially, to work with medium-scale investors (US\$20 000–30 000 start-up costs) to overcome basic marketing and technical problems. Trainees could be employed as farm managers.

Other suggested opportunities were:

- to develop a “one-stop-shop” for assistance to interested investors;
- to support the development of a fish marketing infrastructure, especially intraregional markets;
- to assist feed formulation based on locally available ingredients if fishmeal is too expensive or unavailable; and

- to facilitate the installation of private hatchery operators and support their activities.

5.1.4 Unexplored opportunities

Experts found that, if explored in detail, the following opportunities could have a “very large positive” impact on the development of aquaculture:

- the expansion of cage culture on a commercial basis;
- the establishment of complexes of nucleus and small-scale farms;
- the development of coastal aquaculture (including aquatic plants);
- the creation of national broodstock management programmes;
- the formation of links and synergies amongst national institutions to focus aquaculture growth; and
- the inspection of more suitable aquaculture lands and waters such as wetlands and rivers.

5.2 ASIA AND THE PACIFIC

5.2.1 Development objectives

Experts of the Asia-Pacific region were initially asked for the factors which had contributed to the success of aquaculture in the region and whether these factors would become more important or less important in the future. They were also asked for factors which had negatively affected aquaculture in the region and, in later rounds, for mitigating strategies.

To assist policy-makers in Asia and the Pacific, experts were asked for their ideas on unexplored opportunities, and also effective and practical means that would help develop aquaculture over the next fifteen years. Later, these were ranked by all experts according to whether they would have a “very large positive” effect or a “large positive” effect. This ranking could help policy-makers prioritize their strategies.

As in other regions, all experts believed that aquaculture should be encouraged in Asia and the Pacific. The most important reason for developing aquaculture was its role as a source of food. Reasons that were “important” rather than “very important” were aquaculture’s role as a source of income, employment and foreign exchange, and its ability to enhance the sustainability of fisheries.

5.2.2 Factors generating positive impacts and related challenges

When asked which factors had contributed to the past success of aquaculture in Asia and the Pacific, the “very large positive factors” were of economic and environmental nature. The economic explanation for past successes was mostly related to the increased market demand for fish, whether domestic or international. Over the next fifteen years, market demand is expected to be even “more important than before”. Experts anticipate that accessibility to international markets and aquaculture’s ability to produce fish that cannot be provided by capture fisheries will be particularly important. The emphasis on substituting aquaculture for capture fisheries is linked with concerns over possibly stagnating, even declining, catches from fisheries. Also “more important than before” were the economic benefits of aquaculture and its employment potential.

In addition to economic factors, environmental conditions such as the suitability of culture environments, the availability of species and the stagnating supply of fish from the wild fisheries sector had had a “very large positive impact” on aquaculture growth in the region. There was some divergence among experts about the adequacy and suitability of natural resources in the region. Weak environmental controls were considered to have had a large positive effect during the initial development of aquaculture, but experts rated these as no longer relevant in the future.

Factors which had a “large” rather than a “very large” past impact were technology and its dissemination, financial and technical support from international agencies and governments, and adequate infrastructure. Of particular importance was also the priority given by governments, as demonstrated by plans and policies, to aquaculture. According to the experts, one of the obstacles to aquaculture development in the past was the subordination of aquaculture to agriculture and capture fisheries, indicating a low profile for the activity. A clear commitment towards aquaculture is the only factor cited that is expected to become “much more important than before” over the next fifteen years. Experts therefore consider that the priority governments place on aquaculture will be critical in determining its future development in the region.

5.2.3 Factors generating negative impacts and related challenges

Experts were asked to cite factors which they think had slowed development of aquaculture in Asia and the Pacific and whose negative impacts are expected to become *more important* in the future. Such factors are of large concern to policy-makers. In the second round, experts were asked to identify practical means to lessen or contain the negative impact of these factors. Factors and mitigation strategies are summarized in Appendix 2.

Negative factors include trade barriers, environmental destruction, difficult access to land and water resources combined with overexploitation of coastal resources, poor farmer training, genetic degradation, sensationalist media, bio-security risks, poorly planned aquaculture enterprises, lack of financial resources, and lack of domestic feed industries. Specific suggestions on how to mitigate these problems are given in Appendix 2.1. Experts highlighted two factors as potentially having a “very large negative impact” on aquaculture development in Asia and the Pacific: lack of feed (whether formulated or trash fish) and conflicts over resource use. The latter was estimated to be “very likely to happen” over the next fifteen years.

5.2.4 Opportunities

Experts were asked for their ideas on opportunities for aquaculture development in Asia and the Pacific. Some of these strategies were already being implemented whereas others were unexplored. Experts were asked to rank opportunities according to whether they would have a “very large” or “large” positive impact. The goal was to advise policy-makers in the region on which strategies experts consider should be regarded as priorities.

Four opportunities (whether already being implemented or unexplored) that would have a “very large positive impact” are: raising quality standards, appropriate environmental management, genetic improvement of fish and promoting cooperative fish farming. The latter was intended to improve the livelihoods of small-scale local farmers. Raising quality standards was linked to concerns over continued access to markets. Experts considered that market demand had contributed to past success in the region, and would become “more important” over the next fifteen years.

In addition to the opportunities likely to generate a very large positive impact, a long list of opportunities could potentially yield a “large positive impact”. These can be subsumed into a few categories. For improved environmental management, experts suggested that there should be clear planning guidelines for new sites, more use of portable recirculating systems and the introduction of incentives as an alternative to regulatory instruments. Economic-oriented policies that would have a strong positive impact include exploring the potential for exports of freshwater species, increasing value added, and developing intraregional trade. Other important opportunities involve providing additional incentives to investors, including exemption from income and other taxes for ten years, and providing more information to the public about aquaculture.

Technical opportunities that would have a strong impact are: near-shore and offshore aquaculture, marine culture, including molluscs and seaweed, introducing pen/cage culture in a profit-sharing agreement with local communities, coral reefs, development of new species, integrated aquaculture, raceway aquaculture using irrigated water, and improving technical extension services.

Cooperation was seen as another venue for opportunities. In general, experts emphasized that cooperation would generate a “very large positive impact”. This includes partnerships between government agencies, local governments and industries, and a collaborative rather than competitive approach between regions. This was reinforced by another suggestion that there should be pilot projects and networks to encourage regional collaboration.

A final general category of opportunities is subsumed under “improving policies”. These include: developing integrated aquaculture development plans, improving the efficient allocation of budgets, ensuring that local communities benefit from aquaculture, and supporting land-lease programmes involving technical assistance, pond design, training and feed and seed supply.

5.3 LATIN AMERICA

5.3.1 Development objectives

Experts in Latin America were also asked initially for the factors that had contributed to the success of aquaculture in the region and whether these factors would become more or less important in the future. They were also asked for factors that negatively affected aquaculture in the region; in later rounds, they were also asked for mitigating strategies.

To assist policy-makers in Latin America, experts were asked for their ideas on unexplored opportunities in addition to effective and practical means that would help develop aquaculture over the next fifteen years. Suggestions were then ranked by all experts according to whether they would have a “very large positive” effect or a “large positive” effect. This ranking could assist policy-makers in defining priorities for strategy implementation.

All experts believed that aquaculture should be encouraged in Latin America. The most important reason cited was aquaculture’s contribution to economic development. Reasons that were “important” rather than “very important” were aquaculture’s contribution to employment generation and to diversification of economic activities. Its role as a source of protein was judged as only “moderately” important.

5.3.2 Factors generating positive impacts and related challenges

When asked which factors had contributed to the past success of aquaculture in the region, the “very large positive factors” were of economic and technological nature. As in Asia, the increased market demand for fish, whether domestic or international, had a very large economic impact on past successes. Demand provided immediate market opportunities. The private sector capacity (also ranked “very important”) ensured that entrepreneurs availed themselves of these opportunities. It is interesting to note that the private sector capacity is expected to become less important over the next fifteen years; experts considered that the private sector is now well established and ahead of governments and regulations. Combined with the increased price of fish was a decline in the price of agricultural alternatives for farmers (rice and sugar), which induced a movement into fish farming. The decline of agricultural prices is expected to become even more important in the future.

Declining production from the marine capture fisheries is also expected to be “much more important” than before, which will reinforce the relative attractiveness of aquaculture. Thus, experts consider that the historic success of aquaculture in Latin America has been due to both “pull” and “push” forces. High fish prices

have increased the profitability of aquaculture while low agricultural prices have discouraged investment in agriculture. Experts also anticipate that these same forces will become even more important over the next fifteen years, further inducing aquaculture expansion in Latin America. Fish prices, and therefore the incentive to farm fish, are expected to increase while at the same time price declines of traditional crops are expected to accelerate. Market conditions are likely to be even more important than in the past.

As a technological factor, new farming techniques had *a very large* positive impact in the past. Somewhat less important were low production costs, production efficiency and better management of diseases, nutrition, genetics, biotechnology and environmental issues, which were thought to have had *a large* impact (although not a very large impact). Experts thought these technological factors would become more important over the next fifteen years.

Notably, the contribution of the public sector was expected to become increasingly important. Experts in both Africa and Asia did not mention this factor. Hence a second round of questions asked the experts to clarify and suggest policies for the public sector.

Suggestions on improving capacity of the public sector and enhancing public policy were ranked by the experts in order of importance. The most important strategy was to establish and enforce adequate administrative procedures to facilitate orderly expansion. The second most important policy cited was the need to increase training for public sector employees. Other public sector improvements would involve ensuring that it is proactive and adaptable, encouraging public-private partnerships (implicating municipal and local governments), and increasing awareness of the public sector's capabilities and limitations (Appendix 3.1). When asked which public policies could affect aquaculture negatively, lack of legislation and codes of practice were ranked as major impediments. Lack of technical support was also ranked as having a "very large" negative contribution to aquaculture development.

5.3.3 Factors generating negative impacts and related challenges

Experts were asked to cite and rank factors that might slow development of aquaculture in Latin America over the next fifteen years. Factors that would have a very large negative impact are:

- lack of technical support;
- lack of financing for aquaculture;
- lack of technologies to farm endogenous species; and
- occurrence of natural disasters such as hurricanes. Lack of technical support and lack of financing for aquaculture were judged "likely to happen", which should seriously concern policy-makers.

Factors with a detrimental effect on aquaculture development but not as severe as the ones mentioned above are:

- lack of administrative procedures and legislation;
- environmental concerns;
- macroeconomic problems;
- lobbying by NGOs;
- spread of diseases;
- civil unrest; and
- decreased availability of fish feed.

The first three factors were judged "almost certain to happen". Lobbying by NGOs and decreased availability of fish feed were considered "likely to happen", while spread of diseases and developing technology to farm endogenous species had "a 50 percent probability of happening". Again these are potential priorities for aquaculture policy-makers, particularly the first two (administrative procedures and environmental

measures). As mentioned above, establishing procedures for the orderly (sustainable) expansion of aquaculture was considered the top priority for public policy.

In the second round, experts were asked to identify practical means to lessen or contain the negative impact of these factors. These are summarized in Appendix 3.2.

5.3.4 Opportunities

Experts were asked for their ideas on explored and unexplored opportunities for aquaculture development in Latin America. Experts were very optimistic in general. Comments were made on the excellent locations and available water resources, on the good climatic conditions, on the existence of surplus labour, and on regional integration. They also saw “very large positive” impacts from the culture of tilapia. Government policies focused on providing proactive procedural and legislative frameworks and on education would make a very large contribution to development. The emphasis on administrative and procedural arrangements is consistent with their top policy priority, which was to implement appropriate legislation and regulations. Education was defined in the broadest terms: from training in the private and public sectors to educating the general public on the potential of aquaculture.

Opportunities that would have “large” (as opposed to “very large”) positive impacts include:

- farming native species (particularly marine and new species) and ornamental fish;
- improved investment incentives such as preferential interest rates, making farming technology more accessible;
- diminishing the level of uncertainty for new entrepreneurs through demonstration projects and technical assistance; and
- community aquaculture.

5.4 NORTH AMERICA

5.4.1 Development objectives

As done previously with Asia and Latin America, experts in North America were initially asked for the factors that had contributed to the success of aquaculture in the region and whether these factors would become more or less important in the future. They were also asked for factors that had affected aquaculture negatively in the region and, in later rounds, for mitigating strategies.

To assist policy-makers in North America, experts were asked for their ideas on unexplored opportunities and effective and practical means that would help develop aquaculture over the next fifteen years. Subsequently, opportunities were ranked according to whether they would have a “very large positive” effect or a “large positive” effect. This ranking could help policy-makers prioritize their strategies.

All experts believed that aquaculture should be encouraged in North America. There were two reasons considered “very important”: increasing food supply and improved sustainability. Aquaculture’s potential contributions to sustainability were of varied nature: re-establishing Canada as a world leader in sustainable aquaculture, reducing the depletion of wild stocks, making productive use of arid land or abandoned quarries, and employing native species. Reasons that were “important” as opposed to “very important” were aquaculture’s contribution to employment generation and to economic development. Its contribution to maintaining traditional ways of life (e.g. preservation of a maritime culture and economic support to isolated rural communities) was judged as only “moderately” important.

5.4.2 Factors generating positive impacts and related challenges

When asked which factors had contributed to the past success of aquaculture in the region, the “very large positive impacts” were generated by economic factors and by partnerships. As noted for Asia, the increased market demand for fish (whether

domestic or international) had a very large economic impact on past successes. This demand was reflected in consumer preferences for fish, and the availability and competitive prices of inputs for aquaculture ventures. Linked to market demand was the emphasis on quality to satisfy food safety concerns. The availability of suitable sites and good environmental conditions were also contributing factors. Partnerships were ranked as “very large positive factors” because scientists and producers were organized. There have been a number of productive research partnerships between universities, governments and aquaculture businesses.

Some factors had a “large” rather than a “very large” impact. These factors were:

- high profitability;
- research, technical, capital and government support; and
- rural development programmes and policies.

High profitability was linked to the willingness of entrepreneurs to take risks and recognition of the economic potential and technical feasibility of aquaculture at the national level. Research and technological development was linked to academic-public partnerships as mentioned above. Capital and government support was particularly useful in the early years when the farming of particular species was unknown. Policies for creating employment and social benefits and for reducing trade deficits were already in place; aquaculture was perceived as a useful activity within these general goals.

In the future the importance of these factors is expected to change. Market positioning and technological development are expected to become “much more important than before”. Market positioning was linked to advantageous geographical locations. The focus of technological development was on the development of environmentally sustainable practices. Two illustrations were made: integrated multitrophic aquaculture and offshore aquaculture.

Employment policies, research partnerships, availability of local inputs and an emphasis on quality to meet food safety concerns were considered to become “more important” than before.

5.4.3 Factors generating negative impacts and related challenges

Experts were asked to identify factors that had been a constraint to aquaculture development in North America in the past. These constraints appear to be country-specific, at least in part. Experts were asked to suggest mitigating policies (see Appendix 4.1). They were then asked to cite factors that might slow development of aquaculture over the next fifteen years, and to rank them according to the severity of their impacts.

The most important constraint to aquaculture development has been difficult access to financing; this was ranked as a “very large negative” factor. Constraints which had “large negative” impacts include:

- full utilization of available sites;
- problems accessing land sites in Mexico;
- emphasis on profits at the expense of the environment (Mexico);
- aboriginal land and water claims;
- preferences of coastal residents for water front properties; and
- lack of, or poor, policies to protect the environment.

The suggested mitigating policies are ranked in Appendix 4.1 according to the degree of impact they would have.

Over the next fifteen years, two recent factors are expected to have a “very detrimental” impact on aquaculture development. The first is public opposition to aquaculture. This opposition manifests itself as negative media reports and/or a general negative perception by the public. This opposition is in some cases led by particular interest groups (e.g. the fishing industry) or residential cottagers who do not want their ocean view marred by cages. Linked to this is the second expected

major impediment: an increasing residential population near aquaculture sites. The experts considered that increasing spatial constraints are “almost certain to happen”.

Constraints that would have a “large” impact are:

- negative externalities such as disease and environmental problems;
- political and regulatory impediments such as a failure to establish regulations for offshore aquaculture;
- politicians reacting to vocal opposition to aquaculture;
- lack of capital;
- international competition;
- exports hurt by foreign exchange appreciation;
- economic constraints such as rising prices of fish feed and lack of economies of scale; and
- the failure of producers to organize into coherent marketing and lobby groups.

Growing international competition is “almost certain to happen” while opposition to aquaculture, lack of capital, negative externalities and legal impediments to aquaculture are “likely to happen”. Specific suggestions to mitigate these constraints are given in Appendix 4.2.

5.4.4 Opportunities

Experts were asked for their ideas on opportunities for aquaculture development in North America. Some of the identified opportunities were unexplored.

The experts saw “very large positive” impacts from more land based aquaculture, diversification into new species, value-added processing and multitrophic aquaculture. From the policy perspective, very large benefits would flow from simplifying regulations, giving aquaculture a higher priority in government bureaucracies, better access to financing, and investing in innovations.

There was no consensus on the impact of offshore aquaculture. For some experts in Mexico it was not technically feasible whereas for others there were concerns over its environmental and social implications. Some experts, however, viewed offshore aquaculture as a means of solving aesthetic concerns (because cages would be submerged) and of providing more space for aquaculture.

Opportunities that would have a “large”, rather than “very large”, positive impact include the use of abandoned gravel quarries, which are abundant in Mexico and are used for trash (with perhaps fiscal incentives to quarry owners), and the development of alternative species. From the legislative and regulatory perspectives, there should be high-level aquaculture development programmes with support from federal and provincial/state governments, and even regional aquaculture plans with full participation of all stakeholders. Extension of leases was also thought to have a “large” positive impact. To increase markets, generic seafood advertising should be encouraged to augment per capita consumption of fish; a comprehensive nutritional programme in rural areas would also be beneficial.

5.5 EASTERN EUROPE

5.5.1 Development objectives

Experts in Eastern Europe were initially asked for the factors that had contributed to the success of aquaculture in the region and whether these factors would become more or less important in the future. They were also asked for factors that had negatively affected aquaculture in the region and, in later rounds, for mitigating strategies.

To assist policy-makers in Eastern Europe, experts were asked for their ideas on unexplored opportunities and on effective and practical means that would help develop aquaculture over the next fifteen years. Subsequently, opportunities were ranked according to whether they would have a “very large positive” effect or a “large positive” effect. This ranking could help policy-makers prioritize their strategies.

All experts believed that aquaculture should be encouraged in Eastern Europe, primarily because of economic reasons. Employment through economic growth and rural development were the two reasons cited as “very important”.

5.5.2 Factors generating positive impacts and related challenges

When asked what factors had contributed to the past success of aquaculture in the region, abundance of water and availability of cage sites were cited as having generated “very large positive impacts”. Equally important was the profitability of salmonid culture. Of these three factors, only the profitability of salmonid culture was expected to become *much more important* than before. Abundance of water and availability of cage sites were expected to be *more important*.

Factors considered to have had a large positive impact in Eastern Europe were economic and political transformations, market demand, environmental quality and experience in freshwater aquaculture. Market demand and environmental quality are expected to become *much more important* than before, whereas the other factors will be as important as in the past.

5.5.3 Factors generating negative impacts and related challenges

Experts were asked to identify factors that constrained past aquaculture development in Eastern Europe. They were also asked to suggest mitigating policies (see Appendix 5). Subsequently, they were asked to cite factors that might slow development of aquaculture over the next fifteen years, and to rank them by the severity of their impacts.

The most important constraint to past aquaculture development was the rise in price of feed ingredients and of electricity. Somewhat less important were the limited number of commercial species, a lack of legislative and regulatory frameworks, the financial debt of farms, a drop in demand for aquaculture products, and the tax policy. Additional factors were the lack of skilled personnel, the lack of competitiveness in aquaculture and the unavailability of high-quality, reasonably priced feed. In the future, factors that will become *much more important* are: the lack of skilled personnel, the lack of competitiveness and the unavailability of quality feed.

Factors that are expected to be *as important as before* are the financial debt of farms, a drop in demand for aquaculture products, and the high price of feed and seed. Lack of commercial species, poor legislative frameworks, energy prices and tax policies will be *less important*.

For policy-makers intending to mitigate constraints, the two that appear most susceptible to policy action are the lack of skilled personnel and the unavailability of quality feed. Both factors have had a large negative impact in the past and are expected to become much more important over the next fifteen years. The lack of competitiveness reflected in non-optimal conditions for aquaculture is less susceptible to policy.

Other factors that might contribute to reduce aquaculture development in Eastern Europe are the lack of integrated coastal management, diseases, environmental pollution and the lack of environmental regulations. These areas also could be the focus of policy-makers.

5.5.4 Opportunities

Experts were asked for their ideas on opportunities for aquaculture development in Eastern Europe. Some of the identified opportunities had been previously unexplored.

Experts saw “very large positive” impacts from the introduction of new species, incentives to farmers, and fish breeding. In general, experts considered that markets would grow with rising per capita incomes, but marketing would be useful and have a large positive impact. Integrated coastal management and the development of sound,

widely accepted codes of conduct were policies that would also have a large positive effect.

5.6 WESTERN EUROPE

5.6.1 Development objectives

Experts in Western Europe were initially asked for the factors that had contributed to the success of aquaculture in the region and whether these factors would become more or less important in the future. They were also asked for factors that had negatively affected aquaculture in the region and, in later rounds, for mitigating strategies.

To assist policy-makers in Western Europe, experts were asked for their ideas on unexplored opportunities and on effective and practical means that would help develop aquaculture over the next fifteen years. Subsequently, opportunities were ranked according to whether they would have a “very large positive” effect or a “large positive” effect. This ranking could help policy-makers prioritize their strategies.

All experts believed that aquaculture should be encouraged in Western Europe, primarily in order to improve the sustainability of fisheries resources. Generating job opportunities, aquaculture’s impact on growth, and promoting coastal and rural communities were considered somewhat less important. Maintaining traditional ways of life was considered of only moderate importance.

5.6.2 Factors generating positive impacts and related challenges

When asked what factors had contributed to the past success of aquaculture in the region, financing and the dedication and professionalism of farmers were factors considered to have generated “very large positive impacts”. Farmers’ dedication was expected to play *a more important* role over the next fifteen years. Financing was expected to be *as important* as it was in the past.

Factors that had generated a large positive impact in Western Europe were research and technological development (e.g. scientific progress in farm management and techniques). General market opportunities (including transport and consumer demand for fish) and institutional policy support for the sector were also considered important. In the future, consumer demand and institutional support, together with farmer dedication, are expected to be even more important. Experts therefore considered that the development of aquaculture in Western Europe in the past was “largely” due to government support and they expect that this support will become even more important in the future. This should be of interest to policy-makers.

5.6.3 Factors generating negative impacts and related challenges

Experts were asked to identify factors that constrained past aquaculture development in Western Europe. Experts were then asked to suggest mitigating policies (see Appendix 6). They were then asked to cite factors that might slow development of aquaculture over the next fifteen years, and to rank them based on the severity of their impacts.

The identified most important constraints to past aquaculture development were competition over coastal resources, bureaucracy and public administration, environmental protection policies and media exposure by NGOs. These constraints, in addition to the increasing importance of nature conservation, high interest rates, competition from developing countries, market access, poor breeding programmes for important species and public concerns over the negative impact of aquaculture, were ranked as “very largely negative”. Concerns over administration appear to be linked to lengthy procedures and lack of public personnel, with little expectation of change in the future: the lengthy procedures are judged to be “very likely to happen”.

Some of these constraints are expected to worsen over the next fifteen years. One constraint that is expected to become “even more important” in the future is market access. Public concern over the negative impacts of aquaculture, competition over coastal use, competition from developing countries, breeding programmes and the stress on nature conservation are expected to become “more important than before”. The others constraints will remain as important.

Other factors might contribute to reduce aquaculture development in Western Europe. Economic instability in places such as Turkey might have a very large negative impact. Other constraints include environmental issues, access to water, market failure, health concerns, and high input costs. These are factors thought to be “highly likely to happen”.

5.6.4 Opportunities

Experts were asked for their ideas on opportunities for aquaculture development in Western Europe. As found with other regions, some ideas represented unexplored opportunities.

The experts saw “very large positive” impacts from new technology, which could increase (marine) yields, and enhance the environment. Two other policies that would have a very large positive impact are identification of marine sites suitable for mariculture and the use of economic incentives.

Other opportunities exist with a “large” rather than “very large” positive impact. They include innovative technology such as offshore and multitrophic aquaculture, water-recirculation techniques, and alternative sources of fish feed.

With regard to public policy, opportunities are focused on a few general areas. One is improved public administration. As mentioned above, experts thought that bureaucracy and environmental policies had had a very large negative impact in past aquaculture development in Western Europe. Suggestions for improvement included simplification of bureaucratic procedures in obtaining licences, a more flexible administration of the sector by officials, industry-friendly legislation, development of national aquaculture strategies and incentives for the promotion of rural aquaculture. Increased public awareness of the sector could generate a “large positive” impact. Better public information, image development and continuing education for farmers were also proposed. Finally, policies to promote and enhance the image of aquaculture among the public would also have a strong impact. Market strategies oriented towards standards and labels and ensuring quality products were also suggested.

