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THE ROLE OF AQUACULTURE IN SUSTAINABLE DEVELOPMENT

INTRODUCTION

1. The Global production of fish from aquaculture has grown rapidly during the past four decades, contributing significant quantities to the world's supply of fish for human consumption. Aquaculture now accounts for nearly half (45 percent) of the world's food fish¹ and this increase is expected to reach 50 percent in 2015 (Figure 1). Started primarily as an Asian freshwater food production system, aquaculture has now spread to all continents, encompassing all aquatic environments and utilizing a range of aquatic species. From an activity that was principally small-scale, non-commercial and family-based, aquaculture now includes large-scale commercial or industrial production of high value species that are traded at the national, regional and international levels. Although production remains predominantly Asian and is still largely based on small-scale operations, there is a wide consensus among many that aquaculture has the potential to meet the growing global demand for nutritious food fish and to contribute to the growth of national economies, while also supporting the sustainable livelihoods of many communities.

¹ "Food fish" or simply "fish" in this document refers to production of aquatic animals (fish, crustaceans, molluscs, amphibians). Aquatic plants are excluded or are considered separately.

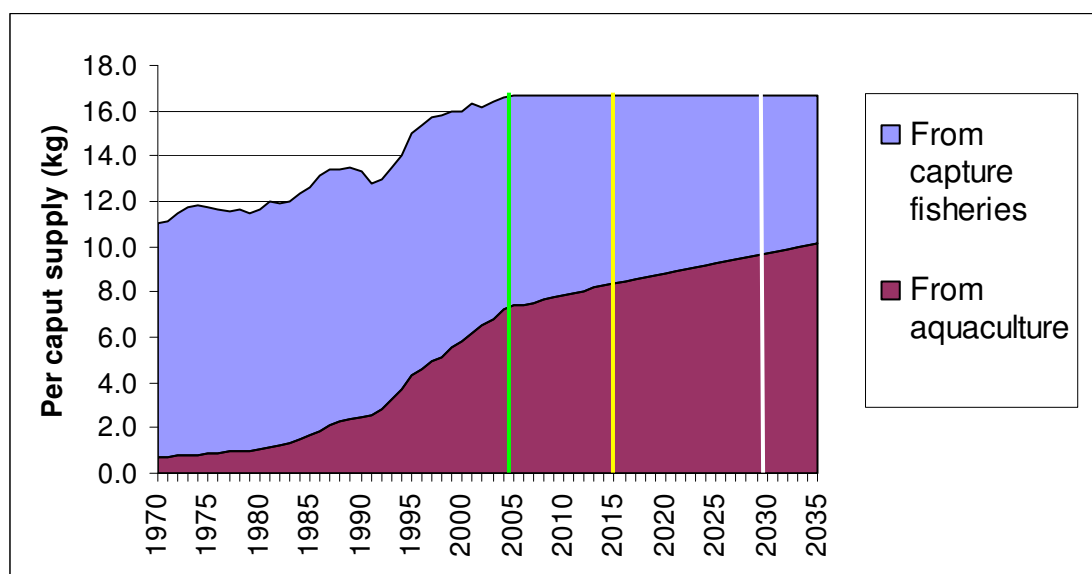


Figure 1. Projected supply of food fish originating from aquaculture and capture fisheries; based on assumed constant capture fisheries production, constant production of fish meal, constant demand for food fish and projected population increases. The line at 2015 represents the point where the food fish supply from aquaculture is projected to equal that from capture fisheries.

PRODUCTION TRENDS

2. World aquaculture grew tremendously during the last fifty years from a production of less than a million tonnes in the early 1950s to 48.1 million tonnes in 2005²; an average annual growth rate of 8.8 percent. The current production had a farm-gate value of US\$70.3 billion, increasing significantly in value as farmed products move along the market chain to consumers. Of the production, 32.4 million tonnes, or 67.3 percent was produced in the People's Republic of China (hereafter referred to as China) and 22.3 percent from the rest of the Asia-Pacific region (Table 1). Western Europe contributed 4.2 percent with 2.0 million tonnes (valued at US\$6.2 billion), while Central and Eastern Europe contributed 270 000 tonnes, or 0.6 percent. Latin America and the Caribbean and North America contributed 2.9 percent and 1.3 percent, respectively. Finally, production from the Near East and North Africa and sub-Saharan Africa accounted for 1.2 percent and 0.2 percent, respectively, of the global total for 2005 (Table 2). In addition to fish production, aquaculture activities in 2005 produced 14.8 million tonnes of aquatic plants worth US\$7.1 billion. The vast majority of aquatic plant production (99.8 percent) came from Asia-Pacific.

²

All production data provided in this document are based on 2005 production statistics given in FAO FishStat+ 2007 database.

Table 1. Top 20 food fish aquaculture producing countries

Country	Production (1000 tonnes)	Percentage	Cumulative Percentage
China	32,414	67.3%	67.3%
India	2,838	5.9%	73.2%
Viet Nam	1,437	3.0%	76.2%
Indonesia	1,197	2.5%	78.7%
Thailand	1,144	2.4%	81.1%
Bangladesh	882	1.8%	82.9%
Japan	746	1.5%	84.4%
Chile	698	1.5%	85.9%
Norway	657	1.4%	87.3%
Philippines	557	1.2%	88.4%
Egypt	540	1.1%	89.5%
Myanmar	475	1.0%	90.5%
United States of America	472	1.0%	91.5%
Korea, Republic of	436	0.9%	92.4%
Taiwan, Prov. of China	305	0.6%	93.0%
France	258	0.5%	93.6%
Brazil	258	0.5%	94.1%
Spain	222	0.5%	94.6%
Italy	181	0.4%	94.9%
Malaysia	176	0.4%	95.3%
Rest of world	2,257	4.7%	100.0%
WORLD TOTAL	48,150	100.0%	

Table 2. Aquaculture production (volume and value) in 2005 in different regions of the world.

Country/Region	Production Volume (Million Tonnes)	Production Volume Percentage	Production Value (Billion US\$)	Production Value Percentage
China*	32.4	67.3	35.99	51.2
Rest of Asia-Pacific	10.7	22.3	20.6	29.3
Western Europe	2	4.2	5.42	7.72
Latin America and the Caribbean	1.4	2.9	5.24	7.47
North America	0.6	1.3	1.3	1.86
Near East and North Africa	0.6	1.2	0.83	1.19
Central and Eastern Europe	0.3	0.6	0.67	0.91
Sub-Saharan Africa	0.1	0.2	0.25	0.36
WORLD TOTAL	48.1	100	70.3	100

* For ease of reference, Asia-Pacific region is separated into China and rest of Asia-Pacific.

3. Production within each region is diverse. In Asia-Pacific, aquaculture production from South Asia, China and most of Southeast Asia consists of cyprinids, while that from the rest of East Asia consists of high-value marine fish. In global terms, 97.5 percent of cyprinids, 88.6 percent of penaeids and 95.0 percent of oysters come from the Asia-Pacific region. Meanwhile, 53.1 percent of the world's farmed salmonids come mainly from the northern part of Western Europe. Carps, however, dominate in Central and Eastern Europe, both in quantity and in value.

4. In North America, channel catfish and salmon are the top aquaculture species. In the Latin America and Caribbean region, over the last decade, salmonids have overtaken shrimp as the top aquaculture species group. This trend was partly influenced by disease outbreaks in major shrimp producing countries in Latin America and by the rapid growth in salmon production in Chile.

5. Although Sub-Saharan Africa has significant water and land resources, it has, to date, been only a minor player in aquaculture for a variety of reasons. Although some improvements are taking place, the situation in Sub-Saharan Africa underlines that economics, human demand and interest, institutional aspects and a wide variety of other factors unrelated to the resource potential, all are contributing to this situation.

CONTRIBUTION TO FOOD SECURITY, NUTRITIONAL WELL-BEING, POVERTY REDUCTION AND ECONOMIC GROWTH

6. Aquaculture plays an important role in global efforts towards eliminating hunger and malnutrition by supplying fish and other aquatic products rich in protein, essential fatty acids, vitamins and minerals. Aquaculture can also make significant contributions to development by improving incomes, providing employment opportunities and increasing the returns on resource use. According to FAO figures, aquaculture directly created 12 million full-time jobs in Asia in 2004. It significantly contributes to the national GDPs in many developing countries in Asia and Latin America. With appropriate management, the sector appears ready to meet the expected shortfalls in fish supplies for the coming decades and to improve global food security.

7. Availability of sufficient and good quality food, access to this food by households and individuals and its utilization for nutritious diets and good health are inter-dependent dimensions of food security. With respect to food availability, aquaculture contributes to food quantity through the supply of aquatic products from domestic farming and supply of food purchased using foreign exchanges. In terms of food quality, aquatic products bring significant health benefits and contribute to nutritional well-being.

8. The availability of food is a necessary, but not sufficient condition for food security. Affordability is a major aspect of food access. By providing farmers with revenues obtained through the sale of their produce and by creating employment, aquaculture enhances households' disposable incomes and their ability to purchase food. Increasing the availability of aquatic products to domestic markets can lower the price of these products, thereby making them affordable and more accessible to local consumers. Beyond individuals and households, at a macro-economic level, aquaculture can also contribute to countries' economic performance and growth by generating profits and producing tax and export revenues. Good infrastructures and investments in human

capital will improve the productivity of labour and capital, benefiting local businesses and enhancing the development of rural communities.

9. With existing resources and technological advances, food fish production from aquaculture can be further expanded in a more sustainable manner. This is only possible if the sector's socio-economic benefits accrue to a large social spectrum. The main challenge for policy makers and development agents is thus to create an “enabling environment” for the aquaculture sector to maintain its growth whilst meeting societal needs and preserving the natural resource base it needs. This enabling environment is multi-faceted and requires significant political will, sustained policy, public sector support, and investment.

ADDRESSING ENVIRONMENTAL AND SOCIAL ISSUES AND OTHER RISKS

10. The environmental impacts of aquaculture development have received a high degree of attention in the past two decades, typically in cases where societal benefits were negatively affected by unregulated aquaculture development. With the increasing demand for products and services in a situation of diminishing land, water and feed resources, this attention is likely to become more pronounced in the coming decades.

11. With weak or improper regulations for the allocation and use of natural resources, there is always a tendency for conflicts to emerge between resource users. Invariably, less influential and disadvantaged stakeholders are denied access to these resources. Unregulated or improperly regulated aquaculture development also results in a high discounting rate on the use of natural resources and, therefore, encourages practices that exploit them beyond carrying capacity.

12. As a result of strong public scrutiny on the environmental impacts of some forms of inconsiderate aquaculture development, starting about a decade ago and gathering considerable momentum over the past five years, significant progress in addressing many of the key concerns in the environmental management of aquaculture has been made. This public pressure and continued commercial necessity have led the aquaculture sector to reduce its environmental impacts and the governments to increasingly recognize that aquaculture, when well planned and well managed, can yield broad societal benefits without concomitant environmental degradation.

13. Indeed, it is now increasingly recognized that aquaculture can make a positive contribution to the environment or, wherever possible, help reduce the negative impacts of other industries and activities. There are aquaculture systems that contribute to environmental rehabilitation or mitigate the impacts of effluents from other agricultural and even industrial operations. The most well-known are integrated farming systems such as rice-fish farming and fish farming in irrigated systems and rehabilitation of endangered populations through stocking. The use of mollusc culture to improve carbon sequestering and seaweed culture in coastal areas to reduce aquatic nutrients loading are also good examples of where aquaculture practices can serve as environmental sentinels and at the same time contribute to socio-economic development.

14. Despite the recent progress made, there is no room for complacency. Continuing improvements, interventions and investments are required to ensure a higher degree of environmental sustainability and economic viability in the sector as pressure on the

natural resource base and public awareness of environmental issues is reaching unprecedented levels. An ecosystem approach to aquaculture development can help reconcile the human and environmental objectives of sustainable development.

COPING WITH GLOBALIZATION, FOOD SAFETY, TRADE AND MARKETS

15. In 2005, about 40 percent (live weight equivalent) of world food fish production was internationally traded, with a value of US\$78.4 billion. New markets are emerging worldwide. As high-value species are increasingly exported (intra- or inter-regionally) and low-value products are imported (a particular trend in Asia), there is a clear need for aquaculture farmers to improve the quality and safety of their products in order to gain a wider access to export markets. However, with the more stringent requirements of export markets, small-scale farmers are facing difficulties in producing for export. As they strive to meet export consumer requirements, they become uncompetitive. The lack of competitiveness could drive them out of the sector. Empowering small farmers to become competitive in global trade is becoming urgent, and, perhaps, a significant corporate social responsibility.

16. Through trade and market access, globalization is increasingly playing an important role in aquaculture development. Its requirements are two-fold: (a) to strengthen national, inter-provincial or inter-state, as well as regional and international biosecurity and food safety measures; and (b) to enhance ability, through training, legislation, codes of practice, certification, traceability schemes of governments and producers, to comply with trade and market access requirements for safe and quality products. These requirements are creating a considerable drive for importing and exporting countries to collectively harmonize standards and protocols as well as to address issues of certification of products and processors.

17. Certification in aquaculture can have positive effects by spurring new competitive advantages and investments but it can also disguise underlying intentions to protect domestic industries and restrict market access. Compliance with some certification requirements could be costly and difficult for small farmers. As certification programs proliferate, questions will be raised about which certification programs best serve consumer protection, the environment, the public and the producers. Addressing these issues requires the promotion of harmonization and equivalence in certification schemes and simplified compliance procedures.

18. As a consequence, policymakers emphasize the need for better governance of the sector. They are aware that policies can be much more effective if producers participate in decision making and regulation processes. Such recognition has led governments to build national capacities to assist producers and processors in complying with mandatory food safety regulations, whilst empowering farmers and their associations for greater self-regulation. This move is contributing to improving the management of the sector at the farm level, typically through the promotion of “better management” practices and “codes of practice” of well-organized associated producers.

THE CHALLENGE OF GOOD GOVERNANCE

19. Declining resource availability, regulatory environment, economics and increasing demand for fish and fishery products are forcing the aquaculture sector to intensify. Of these factors, the declining availability of suitable locations or constraints imposed by competition for water and increased regulation on discharges and abstraction appears to be the main driving force.

20. In addition to calling for intensification, these constraints create opportunities elsewhere. For example, there is an increasing trend towards sea-farming, with many countries experimenting open-ocean aquaculture. The challenge is for policymakers to properly regulate the sector so as to ensure its orderly development and to discourage high discount rates on the use of natural resources and, thus, their exploitation beyond carrying capacity, while ensuring maximum benefits to society.

21. One of the pre-requisites for sustainable development of aquaculture is the government's commitment to provide appropriate support to the sector. Such commitment is expressed in the form of clear articulation of policies, plans and strategies and availability of adequate funding for their implementation.

22. While a government's commitment is necessary for aquaculture development, it is not sufficient to ensure sustainability. The aquaculture sector needs to operate under sound macro-economic, institutional and legal frameworks. Most successful aquaculture is driven by private sector investments. Private investments are vulnerable to political and legal instabilities. Albeit external to the sector, these factors seriously affect institutional development and deter private investors.

INCREASING FLOW OF INFORMATION AND NETWORKING

23. In recent years, with the rapid growth of the aquaculture sector, demand for reliable and timely information on the status and trends of aquaculture has greatly increased. The demand stems from the need to formulate and monitor sound policies and development plans, respond to reporting requirements of international agreements and respond to public demand for transparency and accountability. There have been many attempts to improve the information base on aquaculture, globally. In Asia, improvement of the information base was made possible through more formal networking among countries and institutions. There is a thrust for establishing more of such networks in other parts of the world.

24. Many networks of producer associations and groups, assisted by the private sector as well as donor and development agencies, do exist and have contributed significantly to the sector development. From aquaculture self-help groups, including women's groups in poor villages in Asia, to the more formal regional and international associations with their headquarters in Europe and the United States of America, producer groups have increasingly been playing a major role in global aquaculture development.

SPECIAL CONSIDERATION FOR AFRICA

25. As noted above, a counterpoint to the rapid development of global aquaculture is its limited development in sub-Saharan Africa. This is the only region where per capita consumption of fish has dropped, a trend we can ill afford to see continue or worsen, especially when the decline in fish consumption has not been offset by the increase in consumption of other animal proteins. It is also the only region where the contribution to the world aquaculture output remains below one percent. There is a strong belief that Africa has the full resource potential for aquaculture growth. Experience shows that aquaculture is slowly finding its niche in many countries in Africa. In spite of recent developments, the overall contribution could be improved considerably, making Africa a high priority region for aquaculture development.

26. Therefore, there is a need for development agents and institutions to join hands to ensure that aquaculture and fish production in sub-Saharan Africa becomes part of the overall development process for the continent. Most countries in sub-Saharan Africa have limited resources to deliver quality public goods and services and many do not have a private sector (albeit under-developed) that could operate in its stead. There is thus a need for renewed and long-term focussed assistance to Africa's aquaculture sector, with a novel approach for development, making public-private-partnerships (PPP) possible, which builds on lessons learned from past mistakes and capitalizes on the emerging potential of the private sector.

FUTURE PROSPECTS

27. The aquaculture sector is expected to contribute more effectively to global food security, nutritional well-being, poverty reduction and economic development by producing - with minimum impact on the environment and maximum benefit to society - 85 million tonnes of aquatic food by 2030, an increase of 37 million tonnes over the 2005 level.

28. Identifiable trends in development of the aquaculture sector are the following: (a) continuing intensification of aquaculture production; (b) continuing diversification of species use; (c) continuing diversification of production systems and practices; (d) increasing influence of markets, trade and consumers; (e) enhancing regulation and improving governance of the sector; and (f) increasing attention on better management of the sector. These trends do not apply equally to all the regions due to intra- and inter-regional differences in the stages of aquaculture development, but do reflect the behaviour of the sector in those countries where aquaculture is well established.

29. Even with expected increases in aquaculture production, the question remains whether the industry can grow fast and sustainably enough to meet the projected levels necessary to maintain fish supply while preserving the natural resource base it needs to thrive. Assuming sustained demand for fish (the world is prepared to pay for fish as a desirable food product), there are plenty of unexplored opportunities which could enable aquaculture to significantly contribute to countries' sustainable development. These include: (a) application of innovative capacity enhancement programs by producers; (b) search for new production systems and technologies; and (c) development of new aquatic products and markets and integration into eco-tourism sector. Although some of

the areas are not strictly unexplored, considerable support is required to realize their full potential.

30. Although there are indications that aquaculture could cover the gap between the expected demand and food fish supply from the wild, there are many constraints which could dampen or even stall production increases, thereby preventing aquaculture supply from meeting expected demand in decades to come. Aquaculture would fail to contribute further to sustainable development globally in general and in fish farming nations in particular, should supply decrease or stall.

31. There is a concern that the available marine resources (e.g. fishmeal and fish oil) may not be sufficient to meet the demand of projected aquaculture production. Even though the production of these resources from capture fisheries has remained stagnant over the last decade and any significant increase is not anticipated in the foreseeable future, there will be a substantial decrease in the amount of fishmeal use by the animal production sector. Further, it is also expected that the proportion of fishmeal and fish oil use in aquafeeds will substantially be reduced through the increasing use of vegetable-based protein and oil as well as greater efficiencies in feeding. Under these scenarios, it is unlikely that the supply of fishmeal and fish oil will be a major limiting factor in aquaculture feeding.

32. One of the greatest constraints could be the unpredictable and uncharacterized impact of climate change on aquaculture. Climate change presents unquantifiable threats of temperatures, weather and water supply. There is a need for the aquaculture sector to join other economic sectors in preparing to address the potential impacts of the planet's warming. One of the practical responses to climate change in aquaculture could be to strengthen the adaptive capacity and resilience of the sector, particularly that of small farmers and aquatic resources users. Increased resilience is a desirable feature of any sector; it can mitigate the future impact of unforeseen events (e.g. economic change, disease epidemics, Tsunamies, etc.) including those unrelated to climate. There is some knowledge and experience from aquaculture itself and from the broader area of agriculture and natural resources management which could be learnt from.

33. Science can be useful in understanding and reducing risks, uncertainties and vulnerabilities, but unwavering government will and support are essential elements in enhancing aquaculture development. Whilst the level of commitment will inevitably vary within and among regions, according to the importance of aquaculture in national economies, it is expected that in countries where aquaculture contributes, or has the potential to contribute, substantially to food security, nutritional well-being, poverty reduction and economic growth, the commitment will hold and the level of support is expected to increase.

Additional reading

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