

January 2014



منظمة الأغذية
والزراعة للأمم
المتحدة

联合国
粮食及
农业组织

Food and
Agriculture
Organization
of the
United Nations

Organisation des
Nations Unies
pour
l'alimentation
et l'agriculture

Продовольственная и
сельскохозяйственная
организация
Объединенных
Наций

Organización
de las
Naciones Unidas
para la
Alimentación y la
Agricultura

FAO Regional Conference for Asia and the Pacific

Thirty-second session

Ulaanbaatar, Mongolia, 10–14 March 2014

Information note

Sustainable intensification of aquaculture for food and nutritional security in the Asia-Pacific region

Table of Contents

	Paragraphs
I. The role of fish in global nutrition	1 – 12
A. Factors driving the demand for fish	3 – 6
B. Aquaculture as a major source of human food	7 – 8
C. Rising aquaculture production as a regional achievement	9 – 10
D. Need for more intensive production methods	11 – 12
II. Intensification of aquaculture	13 – 23
A. Defining intensification.....	13 – 16
B. Diversification of species	17 – 18
C. The need for skilled labour.....	19 – 21
D. Markets.....	22 – 23
III. Impact of intensification.....	24 – 39
A. Demand for feed.....	27 – 28
B. Transboundary disease	29 – 31
C. Demand for water and impact on receiving environment	32 – 34
D. Social and economic implications.....	35 – 37

*This document can be accessed using the Quick Response Code on this page;
a FAO initiative to minimize its environmental impact and promote greener communications.
Other documents can be consulted at www.fao.org*



mj303e

E. Impact of climate change.....	38 – 39
IV. Ensuring sustainable intensification of aquaculture.....	40 – 47
A. The way forward	41 – 46
B. Special recommendations for the Pacific Island countries	47
V. Conclusion.....	48

I. The role of fish in global nutrition

1. Fish and other aquatic animals play an important role in global food security and nutrition by providing low-cost animal protein, healthy fats and other micronutrients to people. Eighty-five percent of the world's total fish production is directly consumed for food¹ providing 20 percent of total animal protein consumption for 4 billion people and 15 percent of animal protein intake for an additional 3 billion people (2009 figure).² From 2010 to 2012, fish and other aquatic animals comprised 30 percent of the world's animal food production (including eggs³).⁴ The average global supply of food-fish increased 39 percent from 1990 to 2011, reaching 18.8 kg annually per capita (2011 data).⁵

2. Fish play an important, even vital, role in the diet of people in least developed countries. Fish are often one of the few affordable sources of animal protein available to poor and nutritionally challenged people and can account for more than half the dietary protein intake in some countries such as Cambodia, where the figure exceeds 80 percent. In 2009, fish contributed 24 percent of the animal protein consumed by people in low-income food-deficit countries compared with an average of 19 percent in developing countries (2009 figure).⁶ In addition to being a major source of protein, fish contain fatty acids and other micronutrients which are particularly important for children's normal development and pregnant women's health. The role of locally sourced fish in the human diet is being increasingly recognized, especially small-sized fish since these are consumed whole, including bones, heads and organs where there are the highest concentrations of micronutrients.⁷

A. Factors driving the demand for fish

Asian perspective

3. Already the most populous region in the world (4.18 billion people in 2011⁸), Asia's population is forecasted to grow by more than 700 million by 2030.⁹ This population growth and economic development are expected to result in significant increases in the global demand for fish in the coming decades. FAO has estimated that by 2030, the world will require at least another 23 million tonnes of aquatic animal food above the current production level to sustain the current per capita level of fish consumption. This increased demand for fish could conceivably double if economic growth factors leading to increased preference for fish are taken into consideration. Asia is expected to make major contributions to meeting the increased global demand for fish through further aquaculture growth.

¹ OECD–FAO. 2013. *Agricultural Outlook 2013-2022*

² FAO. 2013. *The State of World Fisheries and Aquaculture (SOFIA) 2012*

³ <http://www.thepoultrysite.com/articles/2737/global-poultry-trends-asias-population-to-grow-by-700-million#sthash.TdoV4tvZ.dpuf>

⁴ OECD–FAO. 2013. *Agricultural Outlook 2013-2022*

⁵ Idem

⁶ Idem

⁷ Halwart, M. 2013. Valuing aquatic biodiversity in agricultural landscapes, pp. 88-108. In: Fanzo, J., Hunter, D. Borelli, T. and Mattei, F. *Diversifying food and diets – using agricultural biodiversity to improve nutrition and health*. Earthscan

⁸ <http://en.worldstat.info/Asia>

⁹ OECD–FAO. 2013. *Agricultural Outlook 2013-2022*

The Pacific perspective

4. The population in the Pacific region is expected to grow by almost 50 percent by 2030.¹⁰ Just to maintain the current level of per capita fish consumption, an additional 100 000 tonnes of fish will be required for the Pacific Island countries (PICs). The need will be greatest in the rural inland areas of the PICs, where fish consumption rates are already limited by poor access to coastal fisheries.

5. Commodities with low production costs – such as tilapia, milkfish, freshwater prawn and common carp – have great potential to help meet rural populations' increasing nutritional demands. Coral reef fish, shrimp, pearl and seaweed will continue to play an important role in supporting food and nutritional security through increasing the income of coastal communities.

6. Challenges to aquaculture development include natural hazards, climate variability and climate change, biological problems, technical capacity and infrastructure, marketing channels and poor competitiveness.

B. Aquaculture as a major source of human food

7. In the past, fish for human food was sourced from wild-capture fisheries (both marine and, especially in Asia, freshwater areas). Now, global production from capture fisheries has probably reached its sustainable limit, and there are few future prospects for increased fish supplies from these sources.

8. Extensive forms of aquaculture have been practised for millennia, but despite its long history, aquaculture did not become a significant global source of fish and other aquatic animals until the mid-1980s. Through a combination of technology, systems development and innovation, aquaculture has been the fastest-growing food production sector over the past three decades, expanding by almost 12 times at an average annual rate of 8.8 percent.¹¹ From 2000 to 2010, global aquaculture production grew at an average annual rate of 6.7 percent through a combination of intensification and area expansion. By 2011, the share of world food-fish production from aquaculture had reached 48 percent (or 62.7 million tonnes), an increase from 16 percent in 1990.¹² Aquaculture now provides about half of the food-fish consumed in the world, while significant quantities of fish from capture fisheries are used for feeds for livestock and aquaculture.

C. Rising aquaculture production as a regional achievement

9. The phenomenal development of global aquaculture production has not been evenly distributed across the globe. In fact, most of the growth in aquaculture production has been in the Asian region, the place where aquaculture first started. The region's production grew by 6.5 percent per year between 2000 and 2010,¹³ and in 2009 its annual per capita food-fish supply reached 21 kg.¹⁴ In 2011, the Asia and the Pacific region produced 55.2 million tonnes of aquaculture products (excluding aquatic plants), representing 89 percent of global aquaculture production.

10. The rapid growth in production from aquaculture in the Asian region over the past three decades has largely been the result of two major factors: a) the expansion of culture areas; and b) intensification through technological advances and increased use of feed and other resources. While this growth in Asian aquaculture has contributed to food security and rural livelihoods, it has also resulted in significant environmental stress in some production systems.

¹⁰ SPC. 2013. *Status report: Pacific Islands reef and nearshore fisheries and aquaculture 2013*. Secretariat of the Pacific Community (SPC), Noumea, New Caledonia

¹¹ FAO. 2013. *The State of World Fisheries and Aquaculture (SOFIA) 2012*

¹² FAO. 2013. *FAO Fisheries and Aquaculture Statistics 1950-2011*. FAO, Rome

¹³ Funge-Smith *et al.* 2013. *Regional overview of fisheries and aquaculture in Asia and the Pacific 2012*. FAO Regional Office for Asia and the Pacific, Bangkok

¹⁴ FAO. 2013. *The State of World Fisheries and Aquaculture (SOFIA) 2012*

D. Need for more intensive production methods

11. Based on recent trends in aquaculture development, the Asian region is expected to contribute most of the growth needed to meet the increased demand for fish in the coming decades. Improving production efficiency is a major challenge for Asia, which has far less per capita availability of natural resources (especially land and water) than the global average. Asia also faces intense population pressures and consequent competition for land, water and feed resources to support these growing populations. This will further challenge aquaculture production to use resources (particularly land and water) most efficiently and to justify its production against competing demands from agriculture, livestock and urban and industrial development.

12. Water quality also is increasingly becoming a restriction for aquaculture, and aquaculture systems that use large volumes of water will be forced to improve their water-use efficiency. One exception to this are marine and possibly brackish water environments which will receive greater interest as food production areas.

II. Intensification of aquaculture

A. Defining intensification

13. The intensification of aquaculture production is achieved by increasing inputs and/or improving management of the production system to boost productivity per unit area or per unit volume of the system. These inputs include increased stocking density, use of improved breeds, increased use of artificial feed, health management and increased and improved management or manipulation of the culture environment (e.g. management of water exchange, aeration, wastes, water temperature, nutrients, ecological composition).

14. Relatively simple changes to management can result in significant increases in productivity. For example, average yield from freshwater pond fish culture in China was only 3.4 tonnes per hectare in 1994,¹⁵ but had increased by 115 percent to an average yield of 7.3 tonnes per hectare by 2012.¹⁶ During the same period, the total area of freshwater ponds in China only increased by 47 percent (from 1.75 million ha in 1994 to 2.57 million ha in 2012).

15. In Viet Nam, the average unit yield of striped catfish culture in earth ponds has reached 400-600 tonnes per hectare,¹⁷ while unit yields of white-legged shrimp in brackish water ponds can reach 20-30 tonnes per hectare in Thailand and China.

16. Economic intensification – the use of increased investment per unit of area (or volume) of production – is another important factor that has contributed to the intensification of aquaculture in the region. The cost of economic intensification is offset by the increased productivity of the system. Over the past five decades, there has been a major change in aquaculture from largely subsistence production to highly market-oriented production. Aquaculture production has therefore increasingly become an important source of household income rather than merely a source of supplementary household food. The development of regional and international markets for Asian aquaculture products (especially shrimp, striped catfish, seaweed and, to a lesser extent, tilapia) has also boosted commercial potential and interest. Developing aquaculture has therefore been taken up by many Asian governments as an important strategy to achieve economic growth, poverty alleviation and national food and nutrition security.

B. Diversification of species

17. The increased economic intensification of aquaculture is also highly associated with shifts in the species being cultured. Today, aquaculture involves farming of over 540 species of finfish, molluscs, crustaceans and other invertebrates; about 35 species of seaweed; over 30 species of

¹⁵ Bureau of Fisheries. 1996. *China Fisheries Statistic Yearbook 1995*. MOA, Beijing

¹⁶ Bureau of Fisheries. 2013. *China Fisheries Statistic Yearbook 2012*. MOA, Beijing

¹⁷ S. De Silva and B. Davy (eds.). 2009. *Success Stories in Asian Aquaculture*. Springer, 214 pp.

freshwater macrophytes; a few species of amphibians and aquatic reptiles; and about 50 species of microalgae and invertebrates as fish-food organisms in hatcheries. There have been noticeable shifts in the top ten cultured species in the region over the past decade, and these now include species that are both high-value and carnivorous or dependent on high animal protein feeds.

18. Freshwater species with current production exceeding 100 000 tonnes include Asian swamp eel, Japanese eel, largemouth black bass, mandarin fish and snakeheads (all increasing from 11 to 18 percent per year between 2000 and 2010). In marine waters, production is generally dominated by high-value carnivorous/high protein feed-dependent species such as penaeid shrimp, jacks, seabass, seabream, croakers, groupers, turbot, halibut and cobia. There has also been a tendency to increase the production of fed species vs non-fed species.¹⁸

C. The need for skilled labour

19. The aquaculture sector not only contributes directly to food security, but also to development through the economic power, employment and livelihoods it generates.

20. The intensification of culture operations significantly increases labour requirements. Over the past five years, the number of people engaged in fish farming has increased by 5.5 percent annually. Globally, it is now estimated that about 16.6 million people (about 30 percent of the world's total number of people directly engaged in fisheries and aquaculture) are engaged in fish farming.¹⁹ These figures are significantly underestimated, largely because of the nature of mixed production systems in small farms, where fishers and crop farmers have shifted entirely or partially to fish farming, but have not been fully captured by agricultural statistical systems.

21. This employment is highly concentrated (97 percent) in Asia,²⁰ where most tasks are still performed manually because mechanization and automated systems are still relatively uncommon. One effect of this is that aquaculture is becoming an increasingly important employer and source of rural livelihoods. In addition, intensified aquaculture may provide higher incomes than other agricultural activities as the economic return of aquaculture per unit area can be as much as 3-5 times that of traditional crops.

D. Markets

22. Intensification of aquaculture results in more concentrated and scheduled production and more standardized products, which greatly facilitates the processing and marketing of aquaculture products. In addition to meeting local demand, aquaculture products can be effectively marketed and distributed outside of the production areas and to the international market. The Asian region has been developing international markets for its key aquaculture commodities, but the bulk of its production is still traded and consumed domestically or within the region.

23. The region's share of global aquaculture production value has grown by 10.5 percent per year since 2000, and in 2010 it amounted to US\$95.2 billion or 80 percent of the total value of global aquaculture. When aquatic plant production is included (the vast majority of global aquatic plant production also originates in Asia and the Pacific region), the region becomes even more dominant: in 2010, it produced 91 percent of the world's 78.9 million tonnes and 81 percent of the world's aquaculture value of US\$125.2 billion.²¹

III. Impact of intensification

24. While intensification of aquaculture has contributed significantly to increased food and nutritional security, livelihoods and economies in the region, the rapid pace of development has had its

¹⁸ FAO. 2013. *The State of World Fisheries and Aquaculture (SOFIA) 2012*

¹⁹ Idem

²⁰ Idem

²¹ Funge-Smith *et al.* 2013. *Regional overview of fisheries and aquaculture in Asia and the Pacific 2012*. FAO Regional Office for Asia and the Pacific, Bangkok

impacts. Strategic planning and regulatory frameworks are often slow to catch up with development, and at the farm level, crowding, effluents, and transmission of disease can severely impact the productivity and efficiency of farming systems.

25. One result of the rapid growth of the previous decades is that the global production growth rate has now slowed. Over the last decade, the average growth of aquaculture has been 6.3 percent annually, compared with average annual growth rates of 10.8 percent and 9.5 percent in the 1980s and 1990s respectively.

26. Within the Asia-Pacific region, aquaculture production has not increased evenly, with some countries experiencing negative or zero growth in production from 2000 to 2010.²² This is largely confined to smaller industrialized countries and seems to be primarily linked to increasing production costs, limitations on farming area and increased regulation of the sector, resulting in reduced competitiveness.

A. Demand for feed

27. Intensification of aquaculture significantly increases the need for higher quality feed ingredients. The aquaculture industry demands large quantities of feed ingredients, and the supply of some ingredients are very limited, particularly fish meal. This has increased the market price for fish meal, which has significantly affected production costs in recent years. In the long term, the availability of fish meal can be a potential threat to the sustainability of species that require a high level of fish meal in their feed. The use of trash/low-value fish from capture fisheries as feed in some culture systems also has significant implications for the sustainability of the region's capture fisheries.

28. As aquaculture has become more intensive in the region, commercial feed use has also increased. Feed is becoming a significant proportion of the total production costs, ranging between 50 and 70 percent in semi-intensive to intensive systems. Over the last decade, there has been a continuous increase in the price of all the major aquaculture feed ingredients, including fish meal, soybean meal and maize. Although the cost of feed ingredients has pushed the aquaculture feed prices to historically high levels, there has been little corresponding increase in the market price for the major aquaculture commodities (especially whiteleg shrimp, tilapia and pangassius). This has resulted in declining profit margins and a tendency to drive the intensity of production to try to compensate for the low unit price.

B. Transboundary disease

29. Intensification of aquaculture has been often associated with diversification of cultured species in the region. Many aquaculture farmers in the region are dependent on seed (e.g. postlarvae, fry, fingerling and broodstock) from non-local sources through transboundary shipment. Lack of effective mechanisms and good governance in health risk control of movement of aquaculture animals have cause large-scale outbreaks of a number of transboundary diseases, such White Spot Syndrome Virus Disease (WSSV), Taura Syndrome Virus (TSV) disease and, most recently, Acute Hepatopancreatic Necrosis Syndrome (AHPNS) disease in shrimp. WSSV almost destroyed the entire black tiger culture industry in the region and AHPNS has resulted in heavy losses in shrimp production in China, Thailand and Viet Nam since 2010. The Thai Department of Fisheries expected the cultured shrimp production would be reduced by 30 percent because of the disease in 2014.²³

30. In general, most countries in the region have rather weak capacity to effectively control transboundary aquatic animal disease through good biosecurity control. Intensification of aquaculture won't be sustainable unless this aspect of biosecurity governance is significantly improved.

²² Idem

²³ FAO. 2013. *Report of the FAO/MARD Technical Workshop on Early Mortality Syndrome (EMS) or Acute Hepatopancreatic Necrosis Syndrome (AHPNS) of Cultured Shrimp (under TCP/VIE/3304)*. Hanoi, Viet Nam, on 25–27 June 2013. <http://www.fao.org/docrep/018/i3422e/i3422e00.htm>

31. There is also a clear need to understand better the interaction between diseases and an ecosystem perspective that considers environmental and other human-induced triggering factors.

C. Demand for water and impact on receiving environment

32. In many cases, intensification requires a high rate of water exchange in culture installation, which significantly increases the demand for water, a rather scarce natural resource in the region. Also, the higher levels of inputs (e.g. feed and other materials), which are required by the greater intensity of stocks in aquaculture, often lead to high levels of nutrients being discharged in the effluent from aquaculture installations. This is largely because of poor management practices in production. This waste discharge to natural bodies of water may have a significant impact on the natural environment because of eutrophication, sedimentation affecting benthic communities and the spread of disease from or to wild populations.

33. Countries have taken actions to limit the impact on receiving waters, although zonation and rational management of aquaculture is still relatively uncommon in the region. This also means that aquaculture is often developed alongside other activities that may threaten water or environmental quality (e.g. intensive agriculture, livestock, industrial or urban developments). Therefore, intensive aquaculture farms try to isolate the on-farm environment from external impacts by using reservoirs and storage ponds, recirculation and treatment systems and a much higher focus on biosecurity. The intensification of management in this manner also significantly increases the consumption of energy (and therefore the unit production cost) because of the need for aeration and increased water circulation.

34. Some countries in the region have taken actions to stop aquaculture in some inland natural bodies and restrict effluent discharge from aquaculture installations. These increasingly stringent environmental protection measures will require improvement in aquaculture performance to minimize its external impacts, which will be a challenge if prices for fish do not significantly increase.

D. Social and economic implications

35. Intensification of aquaculture has radically changed the business operations of aquaculture, and this has affected small-scale farmers. Typically, small-scale farmers have become more dependent on input suppliers (e.g. for feed, hatcheries and equipment) and distant markets, about which they have little knowledge or influence. As a result, when small-scale farmers produce aquaculture products for export, they are vulnerable to global price fluctuations, economic slowdowns and trade restrictions. Small-scale farmers are the disadvantaged group along the aquaculture value chain, and there have been clear examples of these impacts in the shrimp, striped catfish, Indian carp and tilapia sectors in different parts of the region.

36. Increased intensification may also lead to greater use of mechanical systems and less use of human labour, and this could have a negative impact on on-farm employment.

37. A very important impact of aquaculture growth in Asia has been opening opportunities for women's employment, particularly in the processing stage.

E. Impact of climate change

38. Because aquaculture is often located in coastal zones or low-lying areas that are unsuitable for agriculture, it is vulnerable to the impacts of climate changes. These impacts depend upon the location, but include rising sea levels, saline water intrusion and warming and more frequent extreme climate events associated with climate change, such as bad drought, serious floods and storms.

39. As aquaculture intensifies and the economic investments in operations increase, the vulnerability of farms to significant climate-related economic impacts can be expected to become more severe. There have been greater losses and uncertainties in the aquaculture business because of more frequent natural disasters, climate variability and the impacts of climate change in the Asia-Pacific region.

IV. Ensuring sustainable intensification of aquaculture

40. The Asia-Pacific region – the world’s leading aquaculture region contributing nearly 90 percent of global production – faces both opportunities and responsibilities. Asia’s forecasted population and economic growth means that increasing future food production by 60 percent while maintaining environmental integrity will be a major challenge. All agricultural sectors will be required to reduce their unit production environmental footprint, and many farming practices that are currently considered to be sustainable may not be when conducted on a larger scale and under changed circumstances. There is an urgent need to improve the efficiency of the farming systems and implement better farming practices now and for tomorrow. Competition for essential resources, such as land, water, suitable farming sites, energy, fish meal, fish oil and other feed ingredients, will inevitably challenge the growth of the aquaculture industry.

A. The way forward

41. Several regional consultations²⁴ have reviewed the major thematic issues pertaining to sustainable intensification of aquaculture and identified major issues and constraints in the Asian and Pacific regions. Regional technical workshops²⁵ have also reviewed thematic areas which relate to sustainable intensification of aquaculture (e.g. improving quality aquaculture seed and feed production; establishing national aquaculture health management and biosecurity control systems; reducing dependence of marine finfish culture on direct use of trash fish as feed; promoting best management practices in aquaculture; group certification of small-scale farmers and aquaculture information management systems for informed aquaculture planning and management).

42. Aquaculture is still a relatively new food production industry. Current national policy, management systems, technology, knowledge and human capacity are far from adequate to support sustainable intensification in the region. The aquaculture industry in Asia and the Pacific faces both great opportunities and challenges to move forward in order to meet the increasing regional and global fish demand. To promote the sustainable intensification of aquaculture in the region, concerted efforts will be required from governments, international and regional organizations, the private sector and development partners.

43. Asian aquaculture has achieved outstanding growth over the past three decades, largely through intensification. Such rapid growth has come along with some significant issues, particularly resource consumption and environmental impacts. The continuing growth of aquaculture presents significant opportunities for increasing the supply of fish for food, and as long as it is undertaken sustainably without massive dependence on fish meal, it has significant prospects for meeting the world’s increasing demand for fish. However, it will not be possible to meet the future fish demand by continuing past development patterns and farming practices which can have irreversible negative environmental impacts. The intensification of aquaculture, while inevitable, has to be achieved through balancing its demands on water, land and feed resources.

44. To achieve this, Asian countries will need to effectively manage the growth of the aquaculture sector in a manner that protects the ecosystem base upon which it rests. This will require a balance between giving the private sector the means by which it can use its dynamic power to adapt and grow, while still maintaining the regulatory systems which prevent aquaculture from becoming a victim of its own success. The rational management of aquaculture planning becomes ever more essential as the

²⁴ FAO/NACA/APFIC “Regional Consultation on Sustainable Intensification of Aquaculture in Asia and the Pacific” (Bangkok, Thailand, 5-7 October 2013); FAO/SPC “Regional Scoping Workshop: Development of a Pacific Aquaculture Regional Cooperative Programme” (Nadi, Fiji, 11-14 October 2011)

²⁵ FAO/APFIC “Ecosystem Approach to Fisheries and Aquaculture” (Colombo, 18–22 May 2009); FAO “Prudent use of chemicals and drugs in aquaculture” (Bangkok, 15-18 December 2009); FAO “Improved on-farm feed and feeding practices in aquaculture” (Manila, 12-16 September 2010); FAO “Development and adoption of aquaculture planning and management tools” (Bangkok, 3-5 July 2012); FAO “Improving Aquaculture Statistics and Data Collection in Asia” (Hanoi, 10-14 November 2009) ; FAO/NACA “Expert Workshop on Inland Fisheries Resource Enhancement and Conservation in Asia” (Pattaya, 8-11 February 2010)

industry expands, intensifies and becomes capable of bringing about its own downfall through environmental degradation, disease or public concerns over food safety and health.

45. Implementation of an ecosystem approach to aquaculture could improve the efficient use of resources and reduce negative environmental impacts and social conflicts in the sector.

46. At the 32nd session of the Asia-Pacific Fishery Commission, Member Countries endorsed the following priority areas to enable aquaculture to effectively contribute to regional and global food and nutritional security in the coming decades.

Capacity development

- Strengthen regional capacity in aquaculture planning and management through the development and use of relevant tools.
- Develop a training course to address a regional ecosystem approach to aquaculture.
- Strengthen national and regional capacity in transboundary disease control.
- Enhance the capacity of farmers in effective prevention and control of aquaculture diseases.
- Build capacity for fish genetic improvement in the region.

Regional advice and best practices

- Develop a regional strategy and related guidelines or standards for sustainable use of aquaculture feeds, ingredients and feeding practices.
- Strengthen regulations on good hatchery/nursery operation practices.
- Establish a regional mechanism for effective sharing of aquatic genetic resources.
- Develop appropriate policy and strategies for protecting the interests of small-scale farmers through more equitable benefit-sharing mechanisms along the aquaculture value chain.
- Promote a farmer group approach in implementation of Best Management Practices/Good Aquaculture Practices and certification.
- Improve the access of small aquaculture producers to mainstream markets.
- Establish appropriate aquaculture insurance schemes and other social safety-nets to reduce the vulnerability of aquaculture farmers to natural and other hazards.
- Improve aquaculture preparedness and integration into broad climate change adaptation planning.

B. Special recommendations for the Pacific Island countries

47. Sustainable aquaculture development is vital for improving the food and nutritional security and rural income in PICs, although production has been fluctuating in recent years. The following areas are of special importance to PICs in promoting sustainable aquaculture development:

- Promote community-based small-scale aquaculture to develop commercially viable and environmentally friendly fish-farming systems with good operational and managerial practices that will result in a sustainable source of food and income for island communities.
- Establish the required capacity and regulatory schemes for aquaculture-related biosecurity control to prevent transboundary disease in culture installation and protect the natural population.
- Establish the regional capacity for self-supply of key aquaculture inputs, particularly seed and feed, through collaborative efforts in technology development and effective production and distribution systems.
- Effectively promote the trade of culture products in domestic and international markets through increasing the competitiveness of the products and improving the logistics.

V. Conclusion

48. FAO is fully committed to working jointly with other international and regional organizations and development partners to support the region's member countries in comprehensively advancing the aquaculture sector in order to meet the increasing regional and global demand for fish. This should be

accomplished through promoting sustainable aquaculture intensification by developing appropriate enabling policies and strategies, developing and implementing guidelines and standards, addressing key technical bottleneck issues and enhancing public-private partnerships. The campaign promoting sustainable aquaculture intensification will become an integral component of the FAO Global Aquaculture Advancement Programme recently endorsed by the 7th Session of the Committee on Fisheries (COFI) Subcommittee on Aquaculture.