[1]Fisheries Production in Asia: its role in food security and nutrition

Meryl J. Williams and Choo Poh- Sze
WorldFish Center
PO Box 500 GPO
10670 Penang, Malaysia

ABSTRACT

Prediction of the worsening condition of fisheries stocks worldwide and of aquatic ecosystems in crisis, together with the uncertainty on whether the emphasis given to intensive aquaculture production (which is still heavily reliant on fish meal and fish oil) is sustainable and is able to contribute to net growth in fisheries production, have been vigorously discussed and well documented in recent years. These challenges were recognized by the World Summit on Sustainable Development in 2002. The future of fisheries and their sustainability will have great consequences in Asia, where large populations live in riparian and coastal states and are heavily dependent on fisheries and its products for food and for livelihoods. Asian countries produce almost 50% of the world's total capture fisheries production and about 90% of the world's aquaculture production. Coastal and riparian states in Asia rely heavily on fish as a source of food, and statistics from FAO indicated that per caput consumption of fish from the East and Southeast Asian countries (24.0 kg), and China (24.7 kg) surpassed the global average of 15.8 kg. Some Asian countries are also important seafood exporting countries, with Thailand, China, China-Taiwan, Indonesia and the Republic of Korea ranking among the top ten world exporters of seafood.

Fish and other living aquatic animals have often been classified as a good source of protein, vitamins and minerals. In recent years, fish has been acknowledged as a functional food and has important roles in the prevention and management of heart disorders, neurological diseases and mood swings. Important products such as fish leather, squalene, chitosan, eicosapantaenoic acid (EPA) and docosahexaenoic acid (DHA) are also obtained from fish and fisheries products.

This paper reviews the status and some management issues of fisheries production in Asia, as well as the supply and demand situation. Its food security role, its nutritional role and opportunities for value addition are also discussed.

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1. Introduction

Unlike protein supplies from terrestrial sources, which are derived mainly from livestock farming, fish supplies are heavily reliant on natural sources. In 2000 capture fisheries (fish, crustaceans and molluscs etc) contribute up to 73% of the world's total fisheries production (FAO 2002b). Fishing is akin to hunting on land, which is no longer able to meet the world's demand for animal protein and presently is regarded more as a sport rather than as a means for food production. In the last three or four decades, capture fisheries production has come under intense exploitation, and global landings have reached a plateau of around 90 million tonnes. To meet the demands for fish from the world's growing population and to ensure food security, it is now necessary to increase fisheries production through aquaculture, since production from capture sources is already fully exploited and unlikely to expand further.

Fish demand in recent years has been growing, not only because of the increasing needs of the growing population especially from developing countries, but also because of the growing demand for fish as a nutritious and functional food especially from developed countries. Fish and other aquatic animals have often been classified as a good source of easily digested protein, vitamins and minerals. In recent years, scientific evidence has shown that fish play important roles in the prevention and management of many human diseases such as heart disorders, neurological diseases and mood swings. Health products such as eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), chitosan and squalene, and other commercial products like leather from fish skin and artificial crabmeat (surimi) from trash fish are some of the downstream value-added products derived from fish.

This paper reviews the status and some management issues of fisheries production in Asia, as well as the supply and demand situation. Its food security role, its nutritional role and opportunities for value addition are also discussed.

2. Fisheries Production in Asia

2.1 Capture Fisheries

According to the Food and Agriculture Organization of the United Nations (FAO), Asia accounts for about 50% of the estimated 90 million tonnes of fish caught globally (see Figure 1). Worldwide, China ranks first with an annual average (3-year average from 1998 to 2000- FAO 2002a) catch of 17,152,428 tonnes, followed by Japan, which ranks third with a production of 5,151,514 tonnes, with Indonesia ranking sixth with a catch of 4,030,620 tonnes, with India ranking eighth with 3,480,012 tonnes caught annually and Thailand ninth, with a catch of 2,926,643 tonnes. Researchers from WorldFish Center and their partners have shown that we are fishing down the food web and the present patterns of exploitation are unsustainable (Pauly et al. 1998). Williams (1996) noted that the estimation of fish stock is not easy, and to sustain the resource is also a difficult task, especially when immediate social and economic pressures push for exploiting not just the surplus but also the resource base. In a multi-species situation found in tropical waters with high biodiversity, the estimation of sustainable yields is even more difficult.

The crisis situation in capture fisheries has been well documented. A study conducted by FAO (FAO 1992b) showed that out of 200 fished stocks in all parts of the world, more than 25% were over-exploited, depleted, or recovering and would produce greater catches only if returned to a healthier state. Results from a three-year, eight-country study on Sustainable Exploitation of Tropical Coastal Fish Stocks in Asia initiated by WorldFish Center in 1999 indicated substantive declines in catch rates and biomass of fisheries stocks.

The decline and collapse of fisheries stocks will affect food security and livelihood of the poor, and finding better ways to manage fisheries has become an imperative. Williams and Choo (2000) noted several possible reasons for the failures in fisheries management, which range from deficiency in data and information, poor management and enforcement of regulations. Provision of subsidies and financial assistance usually enhance the problem. Steele (1998) believed that the reason why we have not achieved fisheries sustainability is because we treat the fishermen and not the fish as the endangered species, and our response to gross overfishing is to switch to less valuable but ecologically acceptable alternatives, making it difficult to apply the concept of ecological sustainability to these regime shifts.

2.2 Aquaculture

Asia plays an even more important role in the world's aquaculture production, accounting for about 90% of the global production (see Figure 2). For the year 2000, seven (China, India, Indonesia, Japan, Thailand, Bangladesh, Vietnam) out of the top ten principal world aquaculture producers of fish, crustaceans and molluscs were from Asia. China alone produced 24,580,671 tonnes, which is about 2.2 times the quantity produced by the rest of the world's major producers at 11,004,440 tonnes (FAO 2000b).

Aquaculture is the only sector which may see a net increase in fisheries production, provided the right kind of culture is practised (see ICLARM 2000- Farming fish the right way). Generally, feeding fish to raise fish may not lead to an increase in net fisheries production (Naylor et al. 2000), and culturing aquatic organisms lower in the trophic level such as molluscs, which are filter feeders and derive their food from plankton or detritus, or herbivorous or omnivorous species which do not require or require only minimal use of fish meal and fish oil, are more suitable for increasing net fisheries production.

Only environmentally friendly aquaculture should be considered. The culture of carnivores, such as brackishwater shrimp and salmon has met with resistance from environmentalists. In the earlier days, the former was usually cultured in ponds sited in mangrove areas while salmon farms in certain areas drew complaints that they spoil the aesthetics of the coasts and also is the cause of eutrophication and accumulation of organic matter under the cages.

To minimize environmental problems, environmental impact assessments should be conducted before aquaculture is developed, especially if the farms are to be sited in sensitive ecosystems. Species selection is also important- environmentally benign and high-value species such as the giant clam (*Tridacna* spp.) and sea cucumber (for example *Holothuria scabra*) have many advantages over carnivores. Aquaculture utilizing zero-waste technology, such as the integrated agriculture-aquaculture system is environmentally friendly, with technology suited to the poor.

3. Fish in the Asian diet and dependence on fish by the poor

Since ancient times, rice and fish have been staples in the diet of many Asians, especially those living in riparian and coastal states, where farmers initially obtained their fish either from rivers or padi fields or from coastal areas, and later through aquaculture. Fish is consumed in larger quantities in many Asian countries compared to the rest of the world, due to their generally high caput consumption as well as their large population. China, with its huge population, accounted for an annual consumption of more than 31 million tonnes, East and Southeast Asia with over 13 million tonnes and Southern Asia over 6 million tonnes (see Table 1). Asia alone consumed about 55.5% of the fisheries and fisheries products produced in 2000. By the year 2010, the Southeast Asian population is expected to reach 640 million (Menasveta 2001). Basing on the per caput consumption rate of 24 kg for that region, the demand for fish in Southeast Asia alone would be 15,360,000 tonnes by then. However, as the standard of living improves, the per caput consumption may also increase, especially among the middle-income earners who may increase their fish intake over other forms of animal proteins for health benefits.

Table 1: Per caput and total consumption of fisheries products in Asia in 2000 (per caput and population figures from FAO 2002c)

Region	Per caput consumption (kg/yr)	Population	Quantity consumed (tonnes)
China	24.7	1,260,807,000	31,141,933
Southern Asia	5.2	1,284,864,000	6,681,293
East & Southeast Asia	24.0	577,075,000	13,849,800
Near-east(Asia)	5.5	244,194,000	2,077
Total Asia	-	3,366,940,000	51,675,103
Total World	15.8	5,898,091,000	93,189,838

China: China, Hong Kong, Macao, Taiwan
Southern Asia: Bangladesh, India, Maldives, Nepal, Pakistan, Sri Lanka
East & Southeast Asia: Brunei, Cambodia, Indonesia, Korea D. P., Korea Rep., Laos, Malaysia, Mongolia, Myanmar, Philippines, Singapore, Thailand, Vietnam
Near-east (Asia): Afghanistan, Bahrain, Cyprus, Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen

Laureti (1999) reported that food fish play an important dietary role in human protein nutrition in many Asian developing countries (because of their availability and affordability) by supplying over 25% of the total animal protein intake namely - 28.3% in Cambodia, 29.7% in Laos, 34.5% in Malaysia, 39.4% in Vietnam, 41.5% in Thailand, 42.8 % in the Philippines, 43.3% in the Republic of Korea, 45.4 % in Myanmar, 45.8 % in Japan, 48.3% in Bangladesh, 53.1% in Indonesia, 54.3 % in Sri Lanka, 55.7 % in Korea DPR and 84.4% in Maldives. Fish comprises 20% of animal protein sources to over 43% of the world's population living in low-income food-deficit countries – LIFDCs (FAO 2000). In many of the coastal states in Asia, fish rank as the cheapest source of protein as shown by the study of Cruz (1997) in the Philippines. Fish therefore play a critical role in food security especially for the poor. Fish and fisheries products are also the most important food commodity exported from developing countries (Delgado and Courbois 1999). The world's top ten exporters of seafood in 2000 include four countries from Asia, namely China, China-Taiwan, Indonesia and the Republic of Korea, with a net flow of fish from developing to developed countries (FAO 2002c). Kent (1997) noted that the benefits derived from fish exports will inevitably benefit the rich more than the poor; although the country will benefit from foreign exchange, the net gain to the rich is likely

to be at the expense of the poor. Rapid increase in fish exports may also result in increases in domestic fish prices (Kent 1987).

4. Nutritive value of fish

Fish provides a good source of readily digested high-quality animal protein together with a high concentration of vitamins A and D, a significant source of phosphorus and iron, as well as high concentrations of calcium and phosphorous in the bones (see Thilsted and Roos 1999). It is also a good source of selenium, co-enzyme Q_{10} and taurine (Anon 2001). Marine fish has a high concentration of iodine, and those from cold temperate seas contain high levels of omega-3 fatty acids such as EPA and DHA. Functions of these nutrients in human nutrition are described in Appendix I.

The benefits of omega-3 fatty acids are widely documented. Reports from various sources (Hibbeln 1998; Anon 2001; Conquer and Holub 2002) noted that fish oils significantly lower blood pressure, protect against blood vessel constriction, thrombosis and heart arrhythmia. Increased consumption of finfish reduces the risk of sudden death from heart attacks, improves symptoms of rheumatoid arthritis, decreases risk of bowel cancer, and reduces insulin resistance in skeletal muscle. DHA supplements promote brain cell and synapse growth, and improve mood in people. Pregnant women must ensure adequate intake of omega-3 fatty acids for normal development of the human foetus. Recent findings showed that consuming two or more servings of fish with high omega-3 fatty acids may lower the risk of age related macular degeneration, which may cause blindness or vision impairment (INFOFISH 2002a).

Although high levels of EPA and DHA are normally associated with cold water fish such as salmon, research carried out by Australian scientists on tropical species show significant amounts of EPA and DHA as well (see Table 2). Mackerel, which is among the cheapest fish, has EPA and DHA levels higher than many of the more expensive fish such as yellowfin tuna and rock cod.

Table 2: Nutritive values of Atlantic salmon and some tropical fish (Source: Yearsley et al. 2001)

Species Per 100g	Atlantic salmon	Asian Carp	Spanish mackerel	Yellowfin tuna	Rock Cod	Thread Fin	Barra-mundi	Sea-perch	Mullet
Kilojoules	541	617	na	521	na	Na	na	Na	549
Protein (g)	18.4	16.4	na	23.8	na	Na	na	Na	19.3
Cholesterol (mg)	18	24	36	30	27	39	45	21	28
Sodium (mg)	44	57	na	37	na	Na	na	Na	131
Total fat (TF) (g)	2.7	0.5	3.0	0.5	0.6	0.9	0.9	0.4	0.4
Sat. fat/TF (%)	31	31	50	33	35	44	43	31	32
Monounsated/TF(%)	34	18	30	13	16	27	32	16	15
Polyunsated/TF (%)	35	51	20	54	49	29	26	53	53
EPA (mg)	171	36	75	14	13	53	11	11	34
DHA (mg)	378	101	281	100	152	119	50	117	87
Arachidonic Acid (mg)	71	29	66	15	25	46	57	38	26

Note: Scientific names of fish: Atlantic salmon (*Salmo salar*); Asian carp (*Cyprinus carpio*); Spanish mackerel (*Scomberomorus commerson*); yellowfin tuna (*Thunnus albacares*); yellow-spotted rock cod (*Epinephelus areolatus*); blue threadfin (*Eleutheronema tetradactylum*); barramundi (*Lates calcarifer*); saddletail seaperch(*Lutjanus malabaricus*); yelloweye mullet (*Aldrichetta forsteri*)

A study conducted by WorldFish Center and the International Food Policy Research Institute (IFPRI) showed that fish is the primary source of animal protein for an estimated

one-sixth of the world's population and contribute about 7% of the world's total food supply (Normile 2002). With several fisheries on the verge of collapse, global fish production may not be able to keep up with the demand and the rising prices may drive fish out of the reach of the poor who may then be affected nutritionally. The Fish for All initiative, recently launched by WorldFish Center in conjunction with its 25th anniversary, aims to address this problem together with many other fisheries issues identified in the World Summit on Sustainable Development (WSSD).

Comparison of the health status of the poor who consume significant amounts of fish from those that do not, are scarce. A study carried out in Kerala, India (see Kent 1987) indicated that slightly over 10% of the population sampled were protein deficient, despite the very high numbers (above 77%) who consumed fish. Protein intake levels in Kerala were lower than the national average, despite the very high level of fish consumed in the State, implying that distribution of fish was skewed and was beyond what the poor could afford.

5. Value Addition

It is important to examine ways to uplift the status of the poor so that they will not remain poor forever. For fishers and fish farmers, one way of increasing their income is to enhance the quality of their fish through proper post-harvest handling procedures to ensure freshness and food safety. In many developing countries in Asia, artisanal fishermen do not utilize the proper procedures to handle fish and do not have the proper facilities to store their catch, resulting in loss of freshness. Farmers, even the poor ones utilizing low-technology farming methods, should be taught good aquaculture practices including the correct way of using approved chemicals and drugs, as well as the correct way to harvest and clean fish before marketing. Value addition through organic farming is also another option to raise farm income. There is still a lack of awareness among aquaculturists from developing countries on the technical know-how and market prospects for organic aquaculture, which is seen as one of the most dynamic growth sectors in the international market.

Finding new uses for byproducts of fish may also raise income of fishermen or create job opportunities. Production of chitosan from prawn shells, squalene from shark liver oil and leather from fish skins has already found widespread industrial uses. More recent developments include the production of artificial skin from fish and prawn to produce a collagen-chitosan membrane to treat burns in humans and the production of gelatine from cod skin to coat photographic paper (INFOFISH 2002b).

6. Food Security and Fish in World Food Model

Policies and management strategies for sustaining fisheries resources should be given urgent attention by all countries**,** since a decline or collapse of the resources may have major repercussions globally and will threaten food security**.** Our knowledge on the role of fish in poverty alleviation in developing countries is patchy and even less is known of the nutritional status of the poor who rely on fish and how they compare with the other poor who are less dependent on fish. A dwindling fish supply will see an inevitable price increase, which may place fish beyond the means of many poor people. Kent (1997) noted that this is already evident in India and the Philippines where middle- income earners can no longer afford to eat fish**.** This will also affect the health of the poor- those

that rely on fish for their nutritional needs. Globalization and its impacts on fisheries and trade, and on those who rely on fish for livelihood are still little understood.

Given the importance of fisheries, the WorldFish Center, together with IFPRI and FAO are presently developing for the first time, approaches for including fish in the existing world food models. The model will enable the prediction of the true and changing importance of fish, and help to develop appropriate country policies to sustain fisheries resources (Delgado et al. 2000).

7. Conclusion

About one billion people in developing countries rely on fish as a major source of food and livelihood, 50 million people are involved in small-scale fisheries through catching, processing and marketing, and fish production provides about 150 million people with employment (ICLARM 1992). Many of the world's resources are in imminent danger of collapse, and may trigger a threat to fish security. The World Summit on Sustainable Development held in August 2002 urged that fisheries stocks be maintained or restored to levels that can produce the maximum sustainable yield with the aim of achieving these goals for depleted stocks on an urgent basis and where possible not later than 2015 (WSSD 2002). More effective fisheries management coupled with a better understanding of fisheries issues are therefore an imperative to avoid fisheries collapse and threats to food security.

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Appendix I

Functions of various nutrients available from fish in human nutrition

Nutrients	Functions
Vitamin A	Required for growth and differentiation of epithelial, nervous and bone tissues; 11-Cis retinal is a constituent of rhodopsin and other light pigments
Vitamin D	1,25-Dihydroxy-vitamin D_3 is major hormonal regulator of bone mineral (calcium and phosphorous) metabolism
Phosphorus	Constituent of bones, teeth, ATP, phosphorylated metabolic intermediates. Nuclei acids
Iron	Heme enzymes (hemoglobin, cytochromes etc)
Iodine	Involved in transport and metabolism of thyroid hormones
Calcium	Constituent of bones, teeth; regulation of nerve, muscle function
Selenium	Play a major role in enzyme systems (glutathione peroxidase) that control the accumulation of free radicals in the body
Co-enzyme Q_{10}	Functions as an antioxidant at the sub-cellular level
Taurine	An amino acid which plays its role in the formation and excretion of bile salts, which are the breakdown products of cholesterol
EPA	Essential for structural integrity of mitochondrial membrane; involved in prostaglandin and leukotriene formation
DHA	Essential nutrient in the brain and retina for optimal neuronal functioning and visual performance

Source: Martin et al. 1985; Anon 2001