

Fisheries production in Asia: Its role in food security and nutrition¹

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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 per cent of the world's total capture fisheries production and about 90 per cent 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, eicosapentaenoic 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 and nutritional roles and opportunities for value addition are also discussed.

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.) contributed up to 73 per cent 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, especially from developed countries, as a nutritious and functional food. 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 such as 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.

Fisheries production in Asia

Capture fisheries

According to the Food and Agriculture Organization of the United Nations (FAO), Asia accounts for about 50 per cent of the estimated 90 million tonnes of fish caught globally (see Figure 1). Worldwide, China ranks first with an annual average catch of 17 152 428 tonnes, followed by Japan which ranks third with a production of 5 151 514 tonnes, and Indonesia ranking sixth with a catch of 4 030 620 tonnes, India ranking eighth with 3 480 012 tonnes and Thailand ninth, with a catch of 2 926 643 tonnes (three-year average from 1998 to

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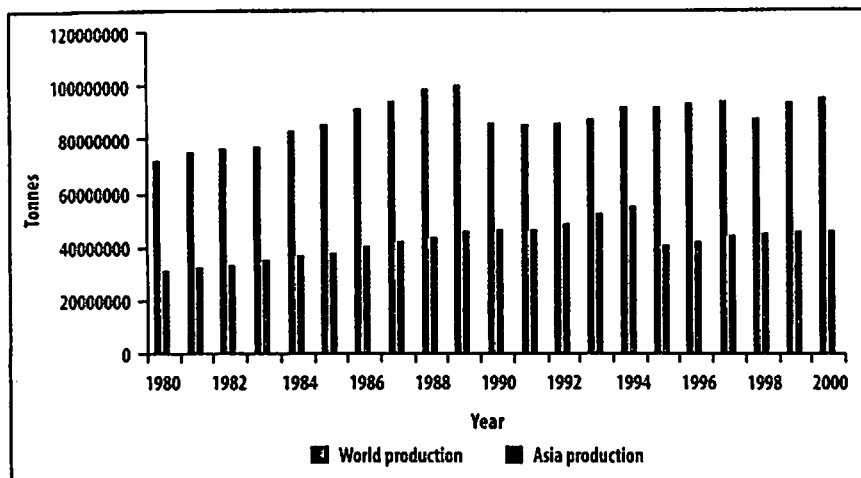


Fig. 1. World and Asia Capture Fisheries Production (data from FAO 1984; 1992a; 2002a)

2000 - FAO 2002a). Researchers from the 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 per cent 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 the WorldFish Center in 1999 indicated substantive declines in catch rates and biomass of fisheries stocks.

The decline and collapse of fisheries stocks will affect the 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 fishers 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.

Aquaculture

Asia plays an important role in the world's aquaculture production, accounting for about 90 per cent of the global production (see Figure 2). For the year 2000, seven out of the top ten principal world aquaculture producers of fish, crustaceans and molluscs were from Asia, namely Bangladesh, China, India, Indonesia, Japan, Thailand, and Vietnam. 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 2002b).

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 environmental-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 low input species such as the giant clam (*Tridacna* spp.) and sea cucumber (for example *Holothuria scabra*), which incidentally are also high value species, have many advantages over carnivores, and can be cultured by small-scale farmers in some countries. Aquaculture utilizing zero-waste technology, such as the integrated agriculture-aquaculture system is environmental-friendly, with technology suited to the poor.

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 from rivers, paddy fields, 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 per capita 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).

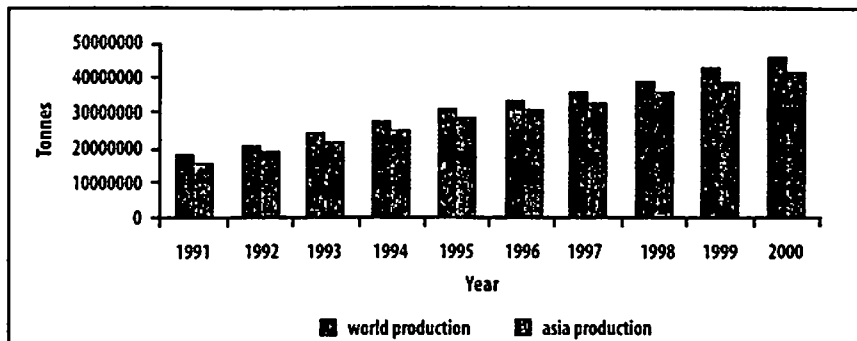


Fig. 2. World and Asia Aquaculture Production: all aquatic organisms (source: FAO 2002b)

Asia alone consumed about 55.5 per cent 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 2010. 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 protein for health benefits.

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. Fish supplies over 25 per cent of the total animal protein intake namely Cambodia (28.3 per cent), the Lao PDR (29.7 per cent), Malaysia (34.5 per cent), Vietnam (39.4 per cent), Thailand (41.5 per cent), the Philippines (42.8 per cent), the Republic of Korea (43.3 per cent), Myanmar (45.4 per cent), Japan (45.8 per cent), Bangladesh (48.3 per cent), Indonesia (53.1 per cent), Sri Lanka (54.3 per cent), Korea DPR (55.7 per cent) and Maldives (84.4 per cent). Fish comprises 20 per cent of animal protein sources to over 43 per cent 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).

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 Q₁₀ 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 the risk of bowel cancer, and reduces insulin resistance in skeletal muscles. DHA supplements promote brain cell and synapse growth, and improve disposition. 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 coldwater fish such as salmon, research carried out by Australian scientists show significant amounts of EPA and DHA in tropical species also (see Table 2). Mackerel, which is among the cheapest fish, has EPA and DHA levels higher than many of the more

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)	Population	Consumption (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: Mainland 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., the Lao PDR, Malaysia, Mongolia, Myanmar, the 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.

Table 2. Nutritive values of Atlantic salmon and some tropical fish (data sourced from Yearsley et al. 2001)

	Atlantic salmon	Asian carp	Spanish mackerel	Yellowfin tuna	Yellow-spotted rock cod	Blue threadfin	Barramundi	Saddletail seaperch	Yelloweye 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
Mono unsat./TF (%)	34	18	30	13	16	27	32	16	15
Poly unsat./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*).

expensive fish such as yellowfin tuna and rock cod.

A study conducted by the 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 contributes about seven per cent 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 the 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, with those that do not, are scarce. A study carried out in Kerala, India (see Kent 1987) indicated that slightly over 10 per cent of the population sampled were protein deficient, despite the very high numbers (above 77 per cent) 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.

Value added products

It is important to examine ways to inform 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 fishers do not utilize the proper procedures to handle fish and do not have the proper facilities to store their catch, resulting in quality degradation. 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 the fish before marketing. Adding value through organic farming is also another option to raise farm income. There is still a lack of awareness among aquaculturists from many 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 fishers 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).

Food security and fish in the 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 of 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 their livelihood are still little understood.

Given the importance of fisheries, the WorldFish Center, together with IFPRI

Appendix 1: Functions of various nutrients available from fish in human nutrition

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 a 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	Plays 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 a 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

and the 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).

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 a fisheries collapse and threats to food security.

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