PART 1

WORLD REVIEW OF FISHERIES AND AQUACULTURE

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Fisheries resources: trends in production, utilization and trade

OVERVIEW

Capture fisheries and aquaculture supplied the world with about 110 million tonnes of food fish in 2006 (all data presented are subject to rounding), providing an apparent per capita supply of 16.7 kg (live weight equivalent), which is among the highest on record (Table 1 and Figure 1). Of this total, aquaculture accounted for 47 percent. Outside China, per capita supply has shown a modest growth rate of about 0.5 percent per year since 1992 (following a decline from 1987), as growth in supply from aquaculture more than offset the effects of static capture fishery production and a rising population (Table 2 and Figure 2). In 2006, per capita food fish supply was estimated at 13.6 kg if data for China are excluded. Overall, fish provided more than 2.9 billion people with at least 15 percent of their average per capita animal protein intake. The share of fish proteins in total world animal protein supplies grew from 14.9 percent in 1992 to a peak of 16.0 percent in 1996, declining to about 15.3 percent in 2005. Notwithstanding the relatively low fish consumption by weight in low-income

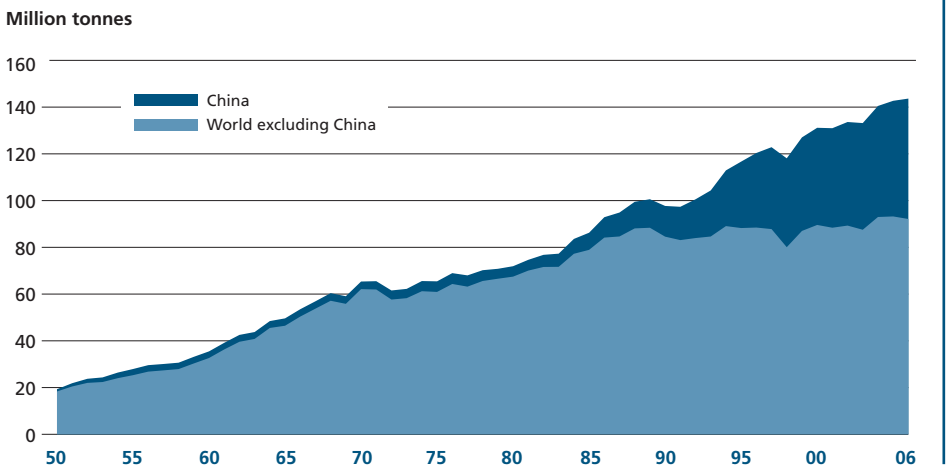
Table 1
World fisheries and aquaculture production and utilization

	2002	2003	2004	2005	2006
	(Million tonnes)				
PRODUCTION					
INLAND					
Capture	8.7	9.0	8.9	9.7	10.1
Aquaculture	24.0	25.5	27.8	29.6	31.6
Total inland	**32.7**	**34.4**	**36.7**	**39.3**	**41.7**
MARINE					
Capture	84.5	81.5	85.7	84.5	81.9
Aquaculture	16.4	17.2	18.1	18.9	20.1
Total marine	**100.9**	**98.7**	**103.8**	**103.4**	**102.0**
TOTAL CAPTURE	93.2	90.5	94.6	94.2	92.0
TOTAL AQUACULTURE	40.4	42.7	45.9	48.5	51.7
TOTAL WORLD FISHERIES	**133.6**	**133.2**	**140.5**	**142.7**	**143.6**
UTILIZATION					
Human consumption	100.7	103.4	104.5	107.1	110.4
Non-food uses	32.9	29.8	36.0	35.6	33.3
Population (*billions*)	6.3	6.4	6.4	6.5	6.6
Per capita food fish supply (*kg*)	16.0	16.3	16.2	16.4	16.7

Note: Excluding aquatic plants.

Figure 1

World capture and aquaculture production



food-deficit countries (LIFDCs) of 13.8 kg per capita in 2005, the contribution of fish to total animal protein intake was significant – at 18.5 percent – and is probably higher than indicated by official statistics in view of the under-recorded contribution of small-scale and subsistence fisheries.

Table 2

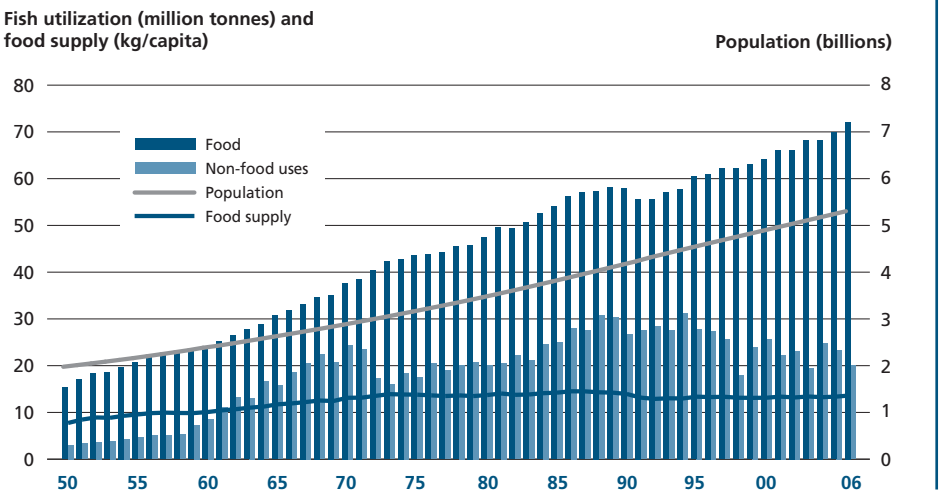
World fisheries and aquaculture production and utilization, excluding China

	2002	2003	2004	2005	2006
	(Million tonnes)				
PRODUCTION					
INLAND					
Capture	6.5	6.5	6.5	7.2	7.5
Aquaculture	7.1	7.8	8.9	9.5	10.1
Total inland	**13.5**	**14.2**	**15.4**	**16.7**	**17.6**
MARINE					
Capture	70.2	67.2	71.2	70.0	67.4
Aquaculture	5.5	6.0	6.4	6.6	7.1
Total marine	**75.8**	**73.3**	**77.6**	**76.6**	**74.5**
TOTAL CAPTURE	76.7	73.7	77.7	77.1	74.9
TOTAL AQUACULTURE	12.6	13.8	15.3	16.1	17.2
TOTAL FISHERIES	**89.3**	**87.5**	**93.0**	**93.2**	**92.1**
UTILIZATION					
Human consumption	66.2	68.1	68.3	69.9	72.1
Non-food uses	23.2	19.4	24.7	23.3	20.0
Population *(billions)*	5.0	5.1	5.2	5.2	5.3
Per capita food fish supply *(kg)*	13.2	13.4	13.2	13.4	13.6

Note: Excluding aquatic plants.

Figure 2

World fish utilization and supply, excluding China



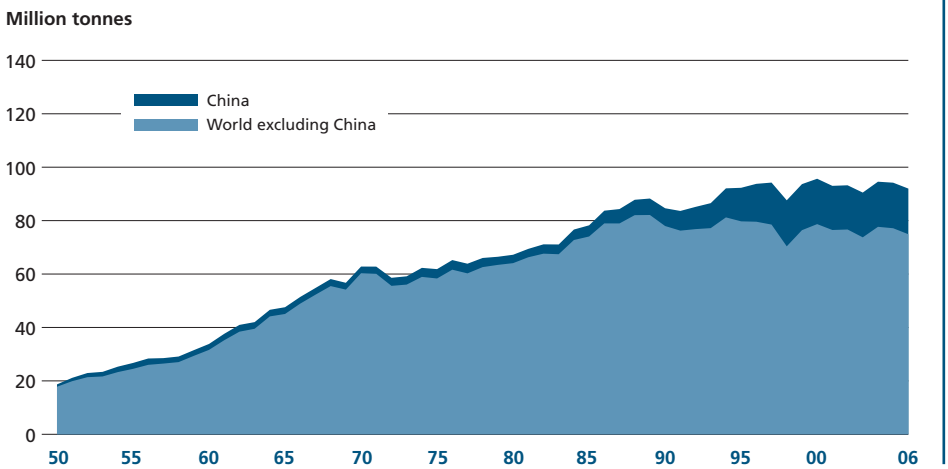
China remains by far the largest producer, with reported fisheries production of 51.5 million tonnes in 2006 (17.1 and 34.4 million tonnes from capture fisheries and aquaculture, respectively), providing an estimated domestic food supply of 29.4 kg per capita as well as production for export and non-food purposes. However, there are continued indications that capture fisheries and aquaculture production statistics for China may be too high, as noted in previous issues of *The State of World Fisheries and Aquaculture*,[1] and that this problem has existed since the early 1990s. Because of the importance of China and the uncertainty about its production statistics, as in previous issues of this report, China is generally discussed separately from the rest of the world. In 2008, China indicated that it was working to revise its fishery and aquaculture production statistics downwards based on the outcome of the National Agricultural Census of 2006, which included for the first time questions relating to fisheries and aquaculture, as well as fishery surveys. Revised statistics for a period of years are expected to be made available by 2009 and to be reflected subsequently in FAO statistics and in future issues of *The State of World Fisheries and Aquaculture*.

In 2008, China reported a downward revision of total fishery and aquaculture production for 2006 of more than 10 percent, corresponding to a reduction of more than 2 million tonnes in capture production and more than 3 million tonnes in aquaculture production. Preliminary estimates for 2007 based on reporting by some major fishing countries indicate that world fishery production excluding China is 96 million tonnes, representing approximately a 3 percent increase for capture production and a 7 percent increase for aquaculture production compared with 2006.

Global capture fisheries production in 2006 was about 92 million tonnes, with an estimated first-sale value of US$91.2 billion, comprising about 82 million tonnes from marine waters and a record 10 million tonnes from inland waters (Table 1 and Figure 3). China, Peru and the United States of America remained the top producing countries. World capture fisheries production has been relatively stable in the past decade with the exception of marked fluctuations driven by catches of anchoveta – a species extremely susceptible to oceanographic conditions determined by the El Niño Southern Oscillation – in the Southeast Pacific (Figure 3). Fluctuations in other species and regions tend to compensate for each other to a large extent. China remains by far the global leader with more than 17 million tonnes in 2006. Asian countries accounted for 52 percent of the global capture production. Overall catches in the Western Central

Figure 3

World capture fisheries production



Pacific and in the Western Indian Ocean continued to increase, whereas capture production decreased in both the Western and Eastern Central areas of the Atlantic Ocean. In the Eastern Indian Ocean, total catches in 2006 returned to growth after the decrease in 2005 caused by the destructive effects of the tsunami of December 2004. Catches from inland waters, almost two-thirds of which were taken in Asia in 2006, have shown a slowly but steadily increasing trend since 1950, owing in part to stock enhancement practices and possibly also to improved reporting.

Aquaculture continues to be the fastest growing animal food-producing sector and to outpace population growth, with per capita supply from aquaculture increasing from 0.7 kg in 1970 to 7.8 kg in 2006, an average annual growth rate of 6.9 percent. It is set to overtake capture fisheries as a source of food fish. From a production of less than 1 million tonnes per year in the early 1950s, production in 2006 was reported to be 51.7 million tonnes with a value of US$78.8 billion, representing an annual growth rate of nearly 7 percent. World aquaculture is heavily dominated by the Asia–Pacific region, which accounts for 89 percent of production in terms of quantity and 77 percent in terms of value. This dominance is mainly due to China's enormous production, which accounts for 67 percent of global production in terms of quantity and 49 percent of global value. China produces 77 percent of all carps (cyprinids) and 82 percent of the global supply of oysters (ostreids). The Asia–Pacific region accounts for 98 percent of carp, 95 percent of oyster production, and 88 percent of shrimps and prawns (penaeids). Norway and Chile are the world's two leading producers of cultured salmons (salmonids), accounting for 33 and 31 percent, respectively, of world production. Aquatic plant production by aquaculture in 2006 was 15.1 million tonnes. The culture of aquatic plants has increased consistently, with an average annual growth rate of 8 percent since 1970. In 2006, it contributed 93 percent of the world's total supply of aquatic plants, or 15.1 million tonnes (US$7.2 billion), some 72 percent of which was produced by China. However, growth rates for aquaculture production are slowing, partly owing to public concerns about aquaculture practices and fish quality. Genetically modified organisms (GMOs) remain a controversial issue. In response to these concerns, integrated multitrophic aquaculture (which promotes economic and environmental sustainability) and organic aquaculture are on the rise.

Fisheries and aquaculture, directly or indirectly, play an essential role in the livelihoods of millions of people around the world. In 2006, an estimated 43.5 million people were directly engaged, part time or full time, in primary production of fish either in capture from the wild or in aquaculture, and a further 4 million people were engaged on an occasional basis (2.5 million of these in India). In the last three

decades, employment in the primary fisheries and aquaculture sector has grown faster than the world's population and employment in traditional agriculture. Eighty-six percent of fishers and fish farmers worldwide live in Asia, with China having the greatest numbers (8.1 million fishers and 4.5 million fish farmers). In 2006, other countries with a significant number of fishers and fish farmers were India, Indonesia, the Philippines and Viet Nam. Most fishers and fish farmers are small-scale, artisanal fishers, operating on coastal and inland fishery resources. Currently, fleet-size reduction programmes in China and other countries, aimed at tackling overfishing, are reducing the number of full-time and part-time fishers. Globally, the number of people engaged in capture fisheries declined by 12 percent in the period 2001–06. On the other hand, in recent decades, major increases in the total number have come from the development of aquaculture activities. In 2006, the estimated number of fish farmers was nearly 9 million people, with 94 percent operating in Asia. For each person employed in the primary sector, it has been estimated that there could be four employed in the secondary sector (including fish processing, marketing and service industries), indicating employment of about 170 million in the whole industry. Taking account of dependants, about 520 million people could be dependent on the sector, or nearly 8 percent of the world population.

The number of fishing vessels powered by engines is estimated to have been about 2.1 million in 2006, of which almost 70 percent were concentrated in Asia. Of the remaining vessels, most were accounted for by Africa, followed by Europe, the Near East, Latin America and the Caribbean. As almost 90 percent of motorized fishing vessels in the world are less than 12 metres long, such vessels dominate everywhere, particularly in Africa, Asia and the Near East. The fishing fleets in the Pacific region, Oceania, Europe and North America tend to consist of vessels that, on average, are slightly larger. This characteristic is confirmed by the distribution of industrialized fleets (vessels of more than 100 gross tonnage [GT], roughly more than 24 m long, extracted from Lloyds Fairplay database), which shows them as rather evenly distributed among Asia, Europe, Latin America and the Caribbean, and North America. Correspondingly, there is a higher proportion of vessels of more than 100 GT in the Europe, North America and Latin America and Caribbean regions than in the Africa and Asia regions. Fleet reduction schemes have had mixed success. The numbers of both fishing vessels and fish carriers have stayed around the same level in the last ten years. While the size of the fishing fleet has declined slightly in terms of gross tonnage, the fleet of fish carriers in 2006 was less than half that of 1990, as recently built fish carriers have been much smaller than their predecessors. Moreover, scrapped vessels have on the whole been much larger than those built to replace them.

An overall review of the state of marine fishery resources confirms that the proportions of overexploited, depleted and recovering stocks have remained relatively stable in the last 10–15 years, after the noticeable increasing trends observed in the 1970s and 1980s with the expansion of fishing effort. In 2007, about 28 percent of stocks were either overexploited (19 percent), depleted (8 percent) or recovering from depletion (1 percent) and thus yielding less than their maximum potential owing to excess fishing pressure. A further 52 percent of stocks were fully exploited and, therefore, producing catches that were at or close to their maximum sustainable limits with no room for further expansion. Only about 20 percent of stocks were moderately exploited or underexploited with perhaps a possibility of producing more. Most of the stocks of the top ten species, which together account for about 30 percent of world marine capture fisheries production in terms of quantity, are fully exploited or overexploited. The areas showing the highest proportions of fully-exploited stocks are the Northeast Atlantic, the Western Indian Ocean and the Northwest Pacific. Overall, 80 percent of the world fish stocks for which assessment information is available are reported as fully exploited or overexploited and, thus, requiring effective and precautionary management. As stated before in *The State of World Fisheries and Aquaculture*, the maximum wild capture fisheries potential from the world's oceans has probably been reached, and a more closely controlled approach to fisheries

management is required, particularly for some highly migratory, straddling and other fishery resources that are exploited solely or partially in the high seas.

Accounting for more than 10 million tonnes in 2006, inland fisheries contributed 11 percent of global capture fisheries production, and landings from inland waters remain essential and irreplaceable elements in the diets of both rural and urban people in many parts of the world, especially in developing countries. Although global landings from inland fisheries have grown continuously, there are few examples of collapsing fisheries, and a number of fish stocks, especially in Latin America, remain lightly exploited. Thus, adopting a precautionary approach, the fisheries could be developed further.

Results from five case studies of river and lake fisheries show that inland fisheries are highly complex and that, where ecosystem processes remain largely undisturbed, stock dynamics are basically controlled by environmental processes and factors external to the fisheries, such as natural fluctuations in climate, flood patterns, and variations in nutrient inputs (whether natural or resulting from pollution). However, anthropogenic ecosystem impacts in the form of species introductions, pollution, habitat fragmentation and changes in the flood cycle can reduce the resilience of fish stocks to fishing pressure. Inland fisheries management requires an ecosystem approach, particularly in the catchment areas of large lake and river systems. The values and benefits of inland fisheries can be increased if such fisheries are protected through more effective governance and management.

In 2006, more than 110 million tonnes (77 percent) of world fish production was used for direct human consumption. Almost all of the remaining 33 million tonnes was destined for non-food products, in particular the manufacture of fishmeal and fish oil. In 2006, 48.5 percent of the fish destined for human consumption was in live and fresh form, which is often the most preferred and highly priced product form. Fifty-four percent (77 million tonnes) of the world's fish production underwent some form of processing. Seventy-four percent (57 million tonnes) of this processed fish was used for manufacturing products for direct human consumption in frozen, cured and prepared or preserved form, and the rest for non-food uses. Freezing is the main method of processing fish for food use, accounting for 50 percent of total processed fish for human consumption in 2006, followed by prepared and preserved (29 percent) and cured fish (21 percent). The utilization and processing of fish production have diversified significantly in the last two decades, particularly into high-value fresh and processed products, fuelled by changing consumer tastes and advances in technology, packaging, logistics and transport. The quantity of fish used as raw material for fishmeal in 2006 was about 20.2 million tonnes, representing a 14 percent decrease compared with 2005, and still well below the peak level of more than 30 million tonnes recorded in 1994. Another emerging application of fish, crustaceans and other marine organisms is as a source of bioactive molecules for the pharmaceutical industry.

Fish and fishery products are highly traded, with more than 37 percent (live weight equivalent) of total production entering international trade as various food and feed products. World exports of fish and fishery products reached US$85.9 billion in 2006. In real terms (adjusted for inflation), exports of fish and fishery products increased by 32.1 percent in the period 2000–06. Exports of fish for human consumption have increased by 57 percent since 1996. Available data for 2007 indicate further strong growth to reach about US$92 billion. Although some weakening in demand was registered in late 2007 and early 2008, as turmoil from the financial sector started to affect consumer confidence in major markets, the long-term trend for the trade in fish is positive, with a rising share of both developed and developing country production arriving in international markets. Prices of fishery products followed the general upward trend of all food prices in the course of 2007 and early 2008. This is the first time in decades that real prices of fish have increased. China further consolidated its position as the leading fish exporter with exports amounting to US$9.0 billion in 2006 and US$9.3 billion in 2007. China's fishery exports have increased remarkably since the early 1990s owing to its growing fishery production, as well as the expansion of its fish-processing industry. China has also experienced a significant increase in

its fishery imports in the past decade. In 2006, it was the sixth-largest importer with US$4.1 billion in fishery imports. In 2007, this figure rose to US$4.5 billion, partly owing to imports of raw material for processing and re-export. The fishery net exports of developing countries (i.e. the total value of their exports less the total value of their imports) continue to be of vital importance to the economies of many fish-exporting developing countries. They have increased significantly in recent decades, growing from US$1.8 billion in 1976 to US$24.6 billion in 2006. The contribution of farmed products to international trade has grown considerably, with export growth rates for species such as catfish and tilapia now exceeding 50 percent per year. These species are entering new markets where, only a few years ago, they were practically unknown. This highlights the potential for further growth in the production, trade and consumption of species and products that respond to the consumers' needs for moderately-priced white-meat fillets.

Preliminary estimates for 2006 indicate a slight increase of global per capita fish supply, to about 16.7 kg, after 16.4 kg in 2005. World apparent per capita fish consumption has been steadily increasing from an average of 9.9 kg in the 1960s, 11.5 kg in the 1970s, 12.5 kg in the 1980s, 14.4 kg in the 1990s, reaching 16.4 kg in 2005. However, this increase has not been evenly distributed across regions and it has mainly been due to increased apparent consumption in China, for which there is an impending revision of production statistics. In the last three decades, the per capita fish supply has remained almost static in sub-Saharan Africa (SSA) but has risen dramatically in China and in the Near East/North Africa region. It is estimated that fish provides at least 50 percent of total animal protein intake in some small island developing states, as well as in Bangladesh, Cambodia, Equatorial Guinea, French Guiana, the Gambia, Ghana, Indonesia and Sierra Leone. The contribution of fish proteins to total world animal protein supplies rose from 13.7 percent in 1961 to a peak of 16.0 percent in 1996, before declining somewhat to 15.3 percent in 2005. Corresponding figures for the world, excluding China, show an increase from 12.9 percent in 1961 to 15.4 percent in 1989, slightly declining since then to 14.7 percent in 2005. Whereas fish provided about 7.6 percent of animal protein in North and Central America and more than 11 percent in Europe, in Africa it supplied around 19 percent, in Asia nearly 21 percent and in the LIFDCs including China about 19 percent.

Fisheries management poses challenges for all countries, especially those that are capacity poor. In some countries, improvements in resource management are proceeding hand-in-hand with public-sector reform and measures to promote better governance. These outcomes are increasingly being incentive-linked to the provision of development assistance. A key fisheries management issue is the lack of progress with the reduction of fishing capacity and related harmful subsidies. The 2007 session of the FAO Committee on Fisheries (COFI) referred to the lack of progress in this area and the need to match fishing capacity with sustainable harvesting levels. The United Nations General Assembly Resolution 62/177 in 2007 deplored the fact that fish stocks in many parts of the world are overfished or subject to sparsely regulated fishing effort. The relationship between excess capacity and illegal, unregulated and unreported (IUU) fishing was also highlighted in COFI, the United Nations General Assembly and regional fora. There was only limited progress in the implementation of measures *inter alia* to mainstream the precautionary and ecosystem approaches to fisheries, eliminate bycatch and discards, regulate bottom-trawl fisheries, manage shark fisheries, and deal with IUU fishing in a comprehensive manner. A sharp focus on capacity building for fisheries management is a priority both for developing and developed countries. A further and important reason to promote capacity building occurs where regional cooperation and collaboration underpin the implementation of agreements. Regional fisheries management organizations (RFMOs), the cornerstones of international fisheries governance, are struggling to fulfil their mandates despite concerted efforts to improve their performance. This situation results partly from the frameworks within which they operate and partly from an apparent lack of political will by members to implement decisions in a timely manner. In an effort to improve their effectiveness, many RFMOs are implementing performance reviews. Steps have been taken, or are being taken, to establish new RFMOs where none existed previously. Once these are

established, nearly all of the world's major fish stocks will be covered by RFMOs, the major exception being straddling stocks in the Southwest Atlantic Ocean. International cooperation is strengthened and many problems resolved through consultation and the timely exchange of information. For RFMOs, such exchanges are critical in dealing with common issues such as IUU fishing and the harmonization of data formats. FAO and non-FAO regional fishery bodies (RFBs) have met biennially since 1999 to consider matters of common concern and to learn how different bodies handle and resolve similar problems. These meetings marked a watershed in cooperation among RFBs. In 2007, the nature and scope of cooperation was taken a step further with the First Meeting of Regional Fishery Body Secretariats Network. The international dimension of aquaculture governance is gradually gaining ground.

There is an extensive array of international agreements, standards and procedures already in place for various aspects of aquaculture and its value chain elsewhere. Compliance with some of these agreements, standards and procedures is mandatory, and recognized competent authorities are empowered to verify compliance. New disciplines governing the use of subsidies in the fisheries sector are being negotiated in the World Trade Organization (WTO), and much progress has been achieved since the negotiations were launched.

CAPTURE FISHERIES PRODUCTION

Total capture fisheries production

According to the data compiled by FAO on the basis of reports from national authorities and other sources (e.g. regional fishery organizations), global capture production in 2006 was about 92 million tonnes. This represents a decrease of 2.2 million tonnes in comparison with 2005 (Table 1 and Figure 3). As in previous years, the change in total world capture production was mostly caused by environmentally-driven fluctuations in anchoveta catches. While total inland water catches increased significantly in 2005 and 2006, total global marine capture production (excluding anchoveta catches) has remained fairly stable since 2002 at between 74.3 and 75.3 million tonnes. However, important groups of species, countries and fishing areas do show different trends. These are discussed below in the section on marine capture production.

According to preliminary statistics by major fishing countries excluding China, total capture production in 2007 increased by about 3 percent in comparison with 2006. However, China's capture production decreased by more than 2 million tonnes following the adjustment to the national data collection system (as mentioned in the "Overview" section [above]).

The estimated first-hand value of global capture fisheries production amounted to US$91.2 billion, representing a 4.5-percent growth over the value recorded for 2005. Of this total, fish for reduction purposes had a first-hand value of US$3.4 billion.

China has remained by far the global leader with more than 17 million tonnes and a very stable capture production, as the variation from one year to the next in its reported total catches was less than 1 percent in the period 1986–2006. Compared with 2004, the ranking of the top ten producer countries (Figure 4) remained unchanged, with two exceptions. For 2006, Chile ranked two places lower as a consequence of the anchoveta catch decrease, and the Philippines replaced Norway in tenth position. In addition to the six Asian countries among the top ten producers, four other Asian countries (i.e. Myanmar, Viet Nam, the Republic of Korea and Bangladesh) occupied positions 12–15. This was reflected in Asia's share of total catches, which exceeded 52 percent of the global capture fisheries production in 2006, the largest share so far recorded.

World marine capture fisheries production

Global marine capture production was 81.9 million tonnes in 2006, the third lowest since 1994. Only in 1998 and 2003 was production lower, as also in those years anchoveta catches decreased considerably.

Although the ranking of the first eight principal marine fishing areas in 2006 (Figure 5) was still the same as in 2004, trends in the single regions diverged. Overall

Figure 4

Marine and inland capture fisheries: top ten producer countries in 2006

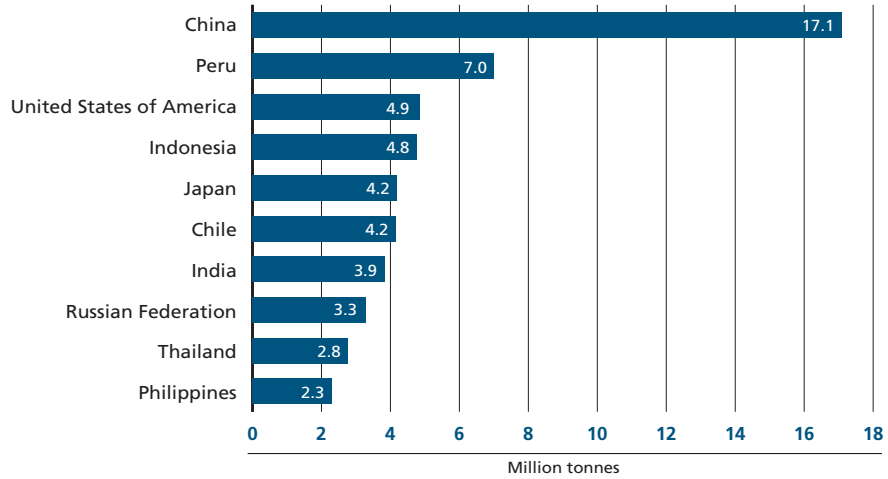
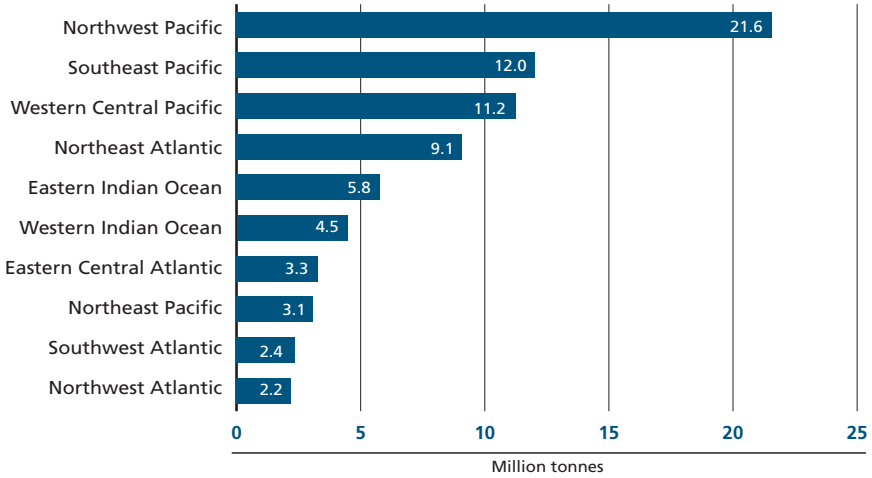


Figure 5

Capture fisheries production: principal marine fishing areas in 2006

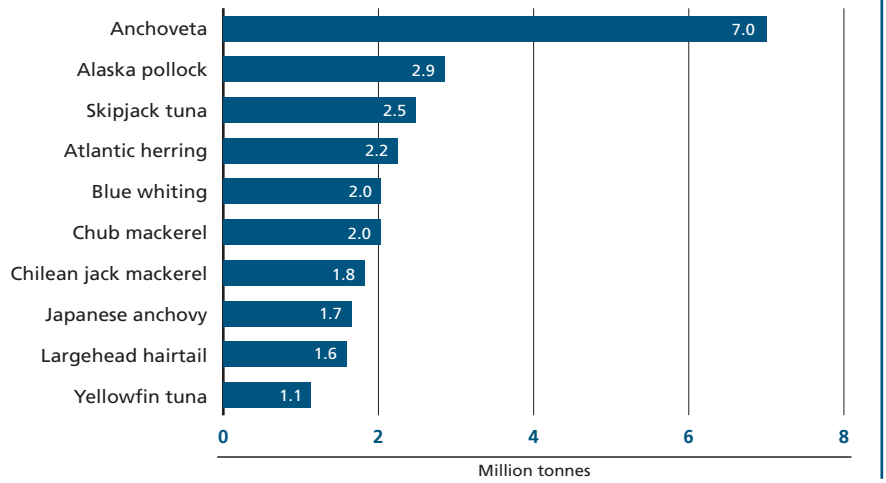


Note: Fishing areas listed are those with a production of at least 2 million tonnes.

catches in the Western Central Pacific and in the Western Indian Ocean continued to increase. In contrast, capture production decreased by more than 10 percent after 2000 in both the Western and Eastern Central areas of the Atlantic Ocean, although they are quite different in terms of the main fishery resources and type of fishing. In the Eastern Indian Ocean, total catches in 2006 rebounded after the decrease in 2005 caused by the destructive effects of the tsunami that affected parts of this region in December 2004. After submission to FAO of final catch statistics for 2005, it became clear that, among the Eastern Indian Ocean countries, those most affected by the tsunami in terms of reduced catches had been Sri Lanka (–51.1 percent), Malaysia (–12.1 percent) and India (–8.4 percent). However, in Indonesia, the 2004 total catch was maintained, as the tsunami impacts on fishing activities in the western part (Banda Aceh) of the country were offset by increased catches in other regions.

Figure 6

Marine capture fisheries production: top ten species in 2006



Among the temperate areas of both hemispheres, it is worth noting the considerable increase in 2006 catches of Argentine shortfin squid in the Southwest Atlantic, and of European anchovy in the Mediterranean and Black Seas. These increases contributed significantly to the overall 29 and 13 percent respective rise in total catches compared with the previous year. In contrast, in both the Southeast Atlantic and the Southwest Pacific, total catches fell by more than 10 percent in 2006. In the Southeast Pacific, the drop was even sharper. However, it affected fish for human consumption only marginally as it stemmed mostly from the decrease in anchoveta catches, the majority of which are processed into fishmeal and fish oil. In the Northeast Atlantic, catch decline has been progressive, with total catches falling by almost one-quarter in ten years.

In 2006, the ten species that contributed most to global catches (Figure 6) were the same as in 2004. There were only some minor changes in the ranking. This group of species, which represent more than 30 percent of the total global marine catch, consists of five small pelagic species (anchoveta, Atlantic herring, chub and Chilean jack mackerels, and Japanese anchovy), two tunas (skipjack and yellowfin), two low-value gadiformes (Alaska pollock and blue whiting) that are mostly marketed in processed forms, and the largehead hairtail, a bentho-pelagic species for which 90 percent of the catches are reported by China.

Total catches of some species groups continued to increase in 2006, setting new records. However, different trends can be noted within each group. The tunas reached a new maximum at more than 6.4 million tonnes, with skipjack catches higher than ever, whereas yellowfin catches were reported to have decreased by about 20 percent from the peak reached in 2003. Cephalopod catches also reached a new high in 2006 at 4.3 million tonnes. Within this group, recent catch trends for the three main species show very different patterns. Catches of jumbo flying squid in the Eastern Pacific continued to boom, growing almost fivefold since 2000. However, in the same period, catches of Japanese flying squid in the Northwest Pacific declined. In the Southwest Atlantic, catches of the Argentine shortfin squid recovered after a dramatic drop in 2004–05. Marine crustaceans as a whole totalled 5.7 million tonnes in 2006, with the crab and lobster groups at the highest level ever, and shrimps only slightly lower than the peak reached in 2004. Harvests of bivalves (scallops, clams, oysters and mussels) and gastropods decreased for most species groups in 2005, but they showed signs of recovery in 2006.

After reaching a high of about 0.9 million tonnes in 2003, catches of the "sharks, rays and chimaeras" group have declined. In 2006, they totalled 0.75 million tonnes, a

drop of 15 percent from the peak. When analysing the trend in shark catches in the last decade, it should be taken into account that this species group has been at the centre of the attention of international institutions (e.g. the FAO-promoted International Plan of Action for the Conservation and Management of Sharks, known as IPOA–Sharks), regional fishery organizations and the public. This raised awareness has helped to improve the reporting of catches for this group.[2] However, this improvement in reporting makes it difficult to identify the trends for actual exploitation. To obtain the best possible collation of available shark data, FAO also complements data reported by countries with those collected by the regional tuna bodies. However, collection and reporting of shark data still need to improve significantly as the formulation of appropriate management measures requires detailed information.

A significant number of tuna and shark species are classified as oceanic (epipelagic and deep-water). Box 1 analyses trends for such species in more detail.

World inland capture fisheries production

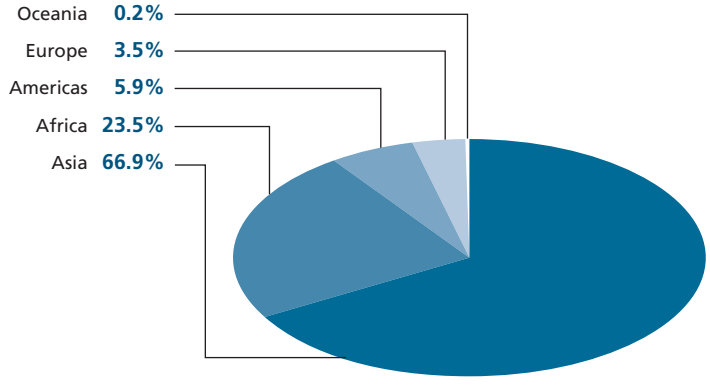
In 2006, reported global inland water catches exceeded 10 million tonnes for the first time. Compared with final 2004 data, this represented an increase of 12.8 percent. However, the reliability of inland water catch statistics reported by several countries remains questionable. It is also difficult to distinguish between real increases in catches and increased production reported as a consequence of an improved data collection system.

Almost all of the increase registered in the last two years for which data are available has come from Asia. This continent now accounts for two-thirds of total global inland capture production. With 2.4 million tonnes, Africa is a clear second in the ranking by continent (Figure 7) but its production decreased by 2.7 percent in 2006 after a decade-long rising trend. Total catches in the Americas were down slightly from the 2004 high, while the opposite occurred in Europe, with production recovering from the lowest total catch registered in 2004. However, figures for this continent are largely influenced by those of the Russian Federation, which accounts for about 60 percent of Europe's production.

China and other developing countries together now account for 95 percent of global inland capture production (Table 3). In several developing countries, inland fisheries constitute a primary source of animal proteins, and a significant addition to the main diet in many others. On the other hand, in most industrialized countries, the number of recreational fishers now greatly exceeds that of professional ones, as inland water harvests have been significantly reduced.

Figure 7

Inland capture fisheries by continent in 2006



Note: World inland capture fisheries production amounted to 10.1 million tonnes in 2006.

Table 3
Inland capture fishery production by economic class

	Production in 2006	
	(Million tonnes)	*(Percentage share of total)*
China	2.54	25.3
Other developing countries	7.01	69.7
Economies in transition	0.33	3.3
Industrial countries	0.18	1.8
Total	**10.06**	

The top ten producers have remained the same as in 2004 (Figure 8 on page 16). Bangladesh has replaced India in second spot, but it is still a long way behind China. Cambodia has gained four positions with an increase of 30 percent compared with 2005. This impressive performance probably in part reflects an extended coverage

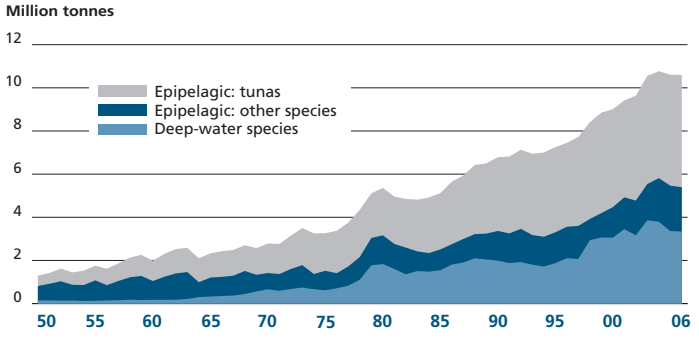
Box 1

Trends in high seas catches

Marine catches are reported by countries to FAO according to Fishing Areas set up in the 1950s, many years before the establishment of exclusive economic zones (EEZs). Because the boundaries of the FAO Fishing Areas and of the EEZs do not correspond, data on catches in the high seas (the ocean areas outside the national EEZs) cannot be obtained from the data submitted to FAO. In an attempt to obtain some information on high seas catches, oceanic species that occur in the FAO capture fisheries database (and are likely to be caught in the high seas) have been identified and classified into "epipelagic" and "deep-water" species according to their biological characteristics. The catch data for these two groups of species provide an indication of the trends in high seas catches.

The latest available release (2006 data) of the FAO capture database includes 133 species items classified as deep-water. This number has more than doubled since the first classification[1] based on 1999 data, although this also reflects greater global attention to deep-water fishing rather than only increased activities. In fact, the global catch of deep-water species had

World catches of oceanic species occurring principally in high seas areas



of the data collection system. In percentage terms, China still accounts for more than 25 percent of global production, and the share of the top ten producers as a group has grown as the total for inland catches by all the other countries has decreased to 31.6 percent.

Many countries do not report any species breakdown of their inland water catches but only a single amount for overall national production under the "freshwater fishes NEI (not elsewhere included)" species item. For 2006, more than 57 percent of the global inland water capture was registered under this category in the FAO database, an increased share as also most of the production gain in the last two years was reported as not identified by species or major group of species. The "miscellaneous freshwater fishes" (which includes the "freshwater fishes NEI" item but also another 65 species items) is by far the predominant group (Figure 9). The "carps, barbels and other cyprinids" group, which grew substantially in 2005 and maintained the same level in 2006, is now second, having overtaken the "tilapias and other cichlids" group. However, as most of the unidentified catches are reported by Asian countries such as Bangladesh, China and Myanmar, it is very probable that the great majority of this inland water production belongs to the cyprinid group, which is by far the most common in the continent.

grown to 3.9 million tonnes in 2003 (see accompanying figure) but it then decreased to 3.3 million tonnes in 2006. This reduction was mainly due to smaller catches of blue whiting, but also to measures taken by the regional fishery organizations (e.g. the North East Atlantic Fisheries Commission and the South East Atlantic Fisheries Organization) to manage fisheries in high seas areas. However, catches of valuable deep-water species, such as the orange roughy (which has an extended geographical distribution and is vulnerable as it grows very slowly and reaches sexual maturity late), have fallen to 20 000 tonnes, a decrease of 78 percent from the high reached in 1990, mostly as a consequence of overexploitation. On the other hand, overall catches of oceanic tunas (about 5.2 million tonnes in 2006) are still growing, and those of other epipelagic oceanic species were stable at about 2 million tonnes in 2004–06 as opposing trends in the main oceanic squid species have offset one another.

In an effort to move towards a better separation of catches taken inside and outside national EEZs, FAO is collaborating with regional fishery organizations on the modification of the statistical division boundaries. The first change was agreed with the South East Atlantic Fisheries Organization, whose Convention Area covers all waters in Fishing Area "47 – Southeast Atlantic" with the exclusion of the EEZs of the continental states. Starting with the 2007 inquiry, countries fishing in Area 47 are requested to return catch statistics according to revised statistical divisions that distinguish between catches taken within and outside the EEZs of the coastal states. This separation of catches will be helpful in evaluating the effects of the International Guidelines for the Management of Deep-sea Fisheries in the High Seas once they have been adopted.

[1] FAO. 2003. *Trends in oceanic captures and clustering of large marine ecosystems – two studies based on the FAO capture database*, by L. Garibaldi and L. Limongelli. FAO Fisheries Technical Paper No. 435. Rome.

Figure 8

Inland capture fisheries: top ten producer countries in 2006

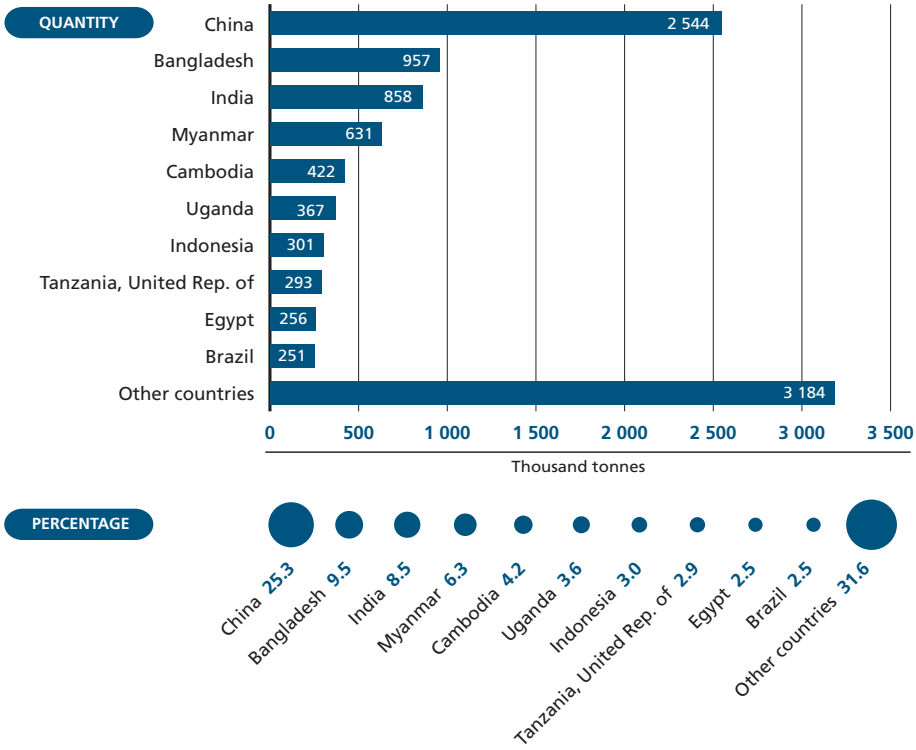
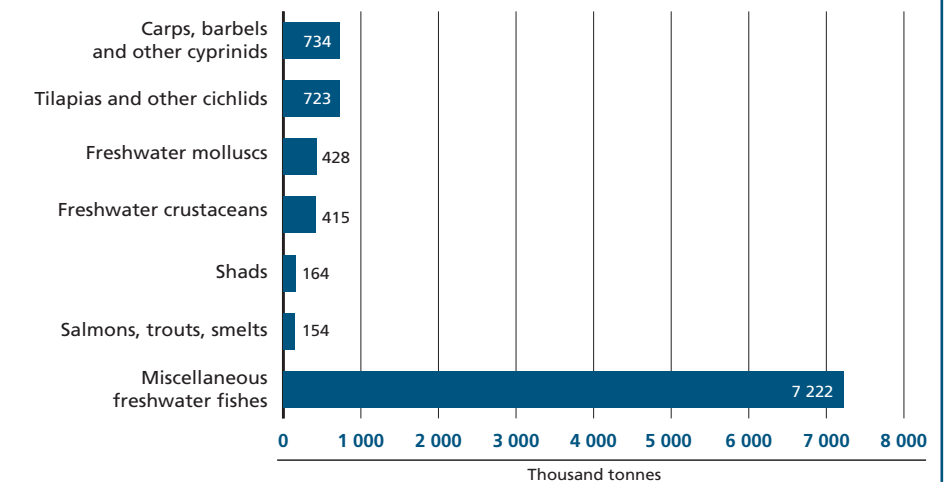


Figure 9

Inland capture fisheries: major species groups in 2006



AQUACULTURE

Aquaculture production

The contribution of aquaculture to global supplies of fish, crustaceans, molluscs and other aquatic animals[3] has continued to grow, increasing from 3.9 percent of total production by weight in 1970 to 36.0 percent in 2006. In the same period, production from aquaculture easily outpaced population growth, with per capita supply from aquaculture increasing from 0.7 kg in 1970 to 7.8 kg in 2006, an average annual growth

rate of 7.0 percent. Aquaculture accounted for 47 percent of the world's fish food supply in 2006. In China, 90 percent of fish food production comes from aquaculture (2006). This indicates that aquaculture production in the rest of the world accounts for 24 percent of food fish supply.

In 2006, China contributed 67 percent of the world's supply of cultured aquatic animals and 72 percent of its supply of aquatic plants.

World aquaculture has grown dramatically in the last 50 years. From a production of less than 1 million tonnes in the early 1950s, production in 2006 was reported to have risen to 51.7 million tonnes, with a value of US$78.8 billion. This means that aquaculture continues to grow more rapidly than other animal food-producing sectors. While capture fisheries production stopped growing in around mid-1980, the aquaculture sector has maintained an average annual growth rate of 8.7 percent worldwide (excluding China, 6.5 percent) since 1970. Annual growth rates in world aquaculture production between 2004 and 2006 were 6.1 percent in volume terms and 11.0 percent in value terms.

If aquatic plants are included, world aquaculture production in 2006 was 66.7 million tonnes and worth US$85.9 billion.

In 2006, countries in the Asia and the Pacific regions accounted for 89 percent of production by quantity and 77 percent of value. Of the world total, China is reported to produce 67 percent of the total quantity and 49 percent of the total value of aquaculture production (Figure 10).[4]

An analysis of production by region for the period 1970–2006 shows that growth has not been uniform (Figure 11). The Latin America and the Caribbean region shows the highest average annual growth (22.0 percent), followed by the Near East region (20.0 percent) and the Africa region (12.7 percent). China's aquaculture production increased at an average annual rate of 11.2 percent in the same period. However, recently, China's growth rate has declined to 5.8 percent from 17.3 percent in the 1980s and 14.3 percent in the 1990s. Similarly, production growth in Europe and North America has slowed substantially to about 1 percent per year since 2000. In France and Japan, countries that used to lead aquaculture development, production has fallen in the last decade. It is apparent that, while aquaculture output will continue to grow, the rate of increase may be moderate in the near future.

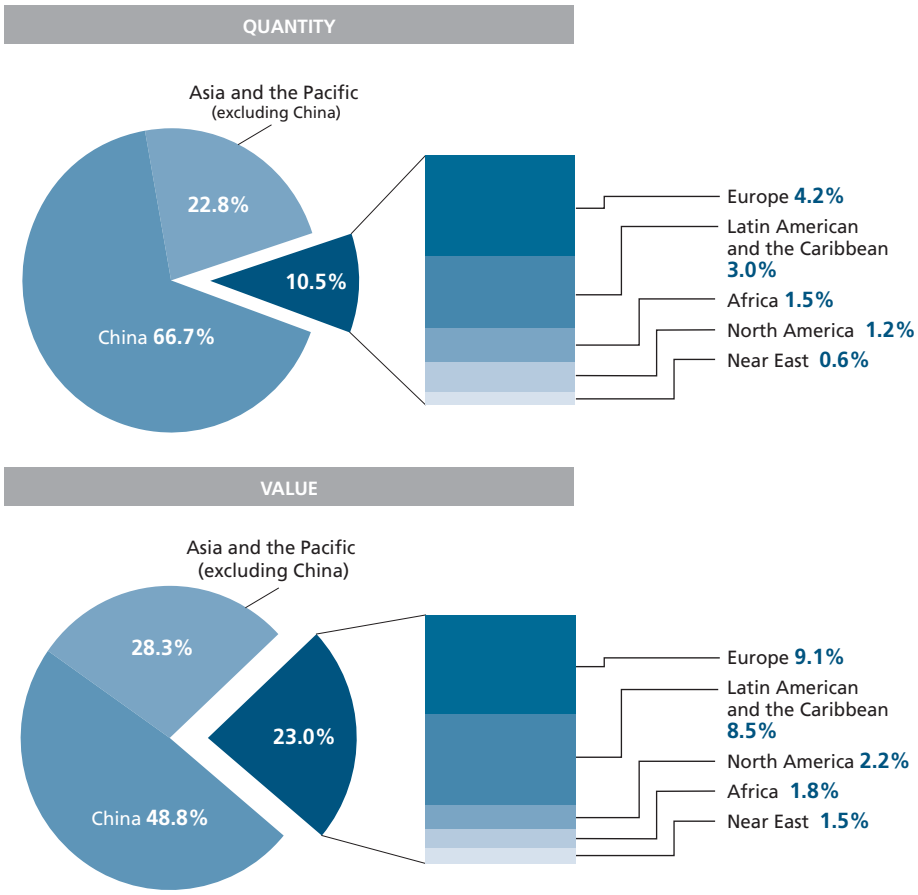
Table 4 lists the top ten producing countries for cultured aquatic animals in 2006, as well as the top ten countries in terms of annual growth in aquaculture production for the two-year period 2004–06 (but including only those countries that reported production of more than 1 000 tonnes in 2006). Chile and the Philippines have improved their position in the 2006 ranking – compared with that of two years earlier – while Japan and the United States of America have slipped down the list.

Most aquaculture production of fish, crustaceans and molluscs continues to come from inland waters (61 percent by quantity and 53 percent by value). An allocation of aquaculture production by aquatic environments shows that the freshwater environment contributes 58 percent by quantity and 48 percent by value. Aquaculture in the marine environment contributes 34 percent of production and 36 percent of total value. While much marine production is high-value finfish, production in this environment also consists of a large amount of relatively low-priced mussels and oysters.[5] Although brackish-water production represented only 8 percent of production in 2006, it contributed 16 percent of the total value, reflecting the prominence of high-value crustaceans and finfish. While production from brackish waters shows the highest growth in terms of quantity since 2000 (11.6 percent per year), the increase in value has stagnated at 5.9 percent. In the same period, the average annual increases in aquatic products from the freshwater and marine water environments have been 6.5 and 5.4 percent in terms of quantity and 7.8 and 8.3 percent in value terms, respectively.

In 2006, more than half of global aquaculture production was freshwater finfish. Output amounted to 27.8 million tonnes, worth US$29.5 billion. In the same year, molluscs accounted for the second-largest share, 14.1 million tonnes (27 percent of total production), worth US$11.9 billion. The much smaller amounts of crustaceans – 4.5 million tonnes – were worth significantly more: US$17.95 billion (Figure 12).

Figure 10

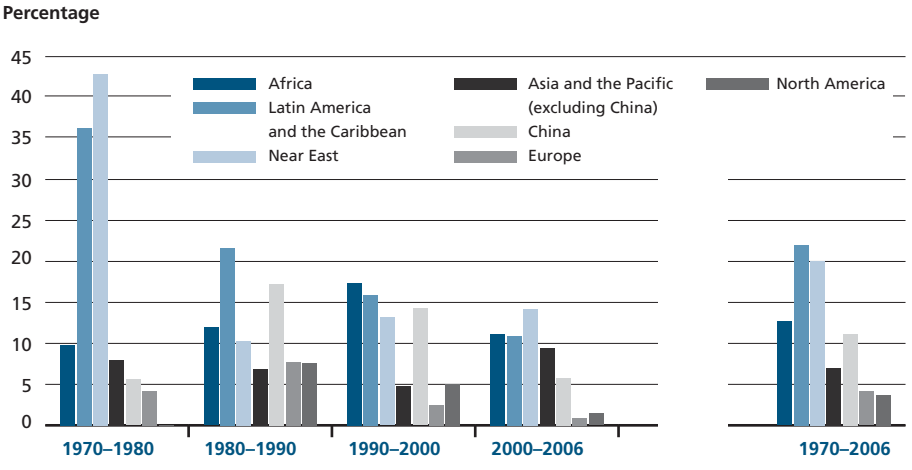
Aquaculture production by region in 2006



Note: Data exclude aquatic plants.

Figure 11

World aquaculture production: change in growth by region since 1970



Note: Data exclude aquatic plants.

Table 4
Top ten aquaculture producers of food fish supply: quantity and growth

	Top ten producers in terms of quantity, 2006				Top ten producers in terms of growth, 2004–06[1]		
	2004	2006	APR		2004	2006	APR
	(Tonnes)		(Percentage)		(Tonnes)		(Percentage)
China	30 614 968	34 429 122	6.05	Uganda	5 539	32 392	141.83
India	2 794 636	3 123 135	5.71	Guatemala	4 908	16 293	82.20
Viet Nam	1 198 617	1 657 727	17.60	Mozambique	446	1 174	62.24
Thailand	1 259 983	1 385 801	4.87	Malawi	733	1 500	43.05
Indonesia	1 045 051	1 292 899	11.23	Togo	1 525	3 020	40.72
Bangladesh	914 752	892 049	–1.25	Nigeria	43 950	84 578	38.72
Chile	665 421	802 410	9.81	Cambodia	20 675	34 200	28.61
Japan	776 421	733 891	–2.78	Pakistan	76 653	121 825	26.07
Norway	636 802	708 780	5.50	Singapore	5 406	8 573	25.93
Philippines	512 220	623 369	10.32	Mexico	104 354	158 642	23.30

Notes: Data exclude aquatic plants. APR refers to the average annual percentage growth rate for 2004–2006.
[1] For top countries in terms of growth, only countries with more than 1 000 tonnes production in 2006 were taken into account.

The growth in production of the major species groups continues, although the increases seen in the past decade have been smaller than those of the 1980s and 1990s (Figure 13). The period 2000–06 witnessed strong growth in the production of crustaceans in particular, and in marine fish. Production growth for other species groups has begun to slow, and the overall rate of growth, while still substantial, is not of the order seen in the previous two decades. Figure 14 presents aquaculture production by major species group.

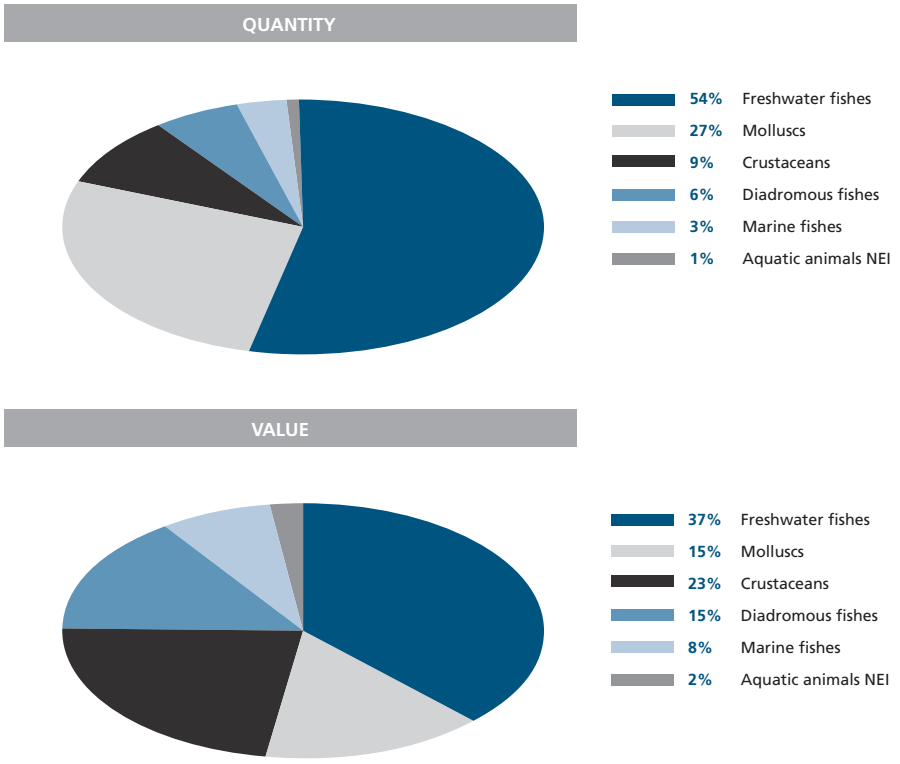
Aquaculture now accounts for 76 percent of global freshwater finfish production and 65 percent of mollusc and diadromous fish production (Figure 15). Its contribution to world supplies of crustaceans has grown rapidly in the last decade, reaching 42 percent of world production in 2006 and, in the same year, it accounted for as much as 70 percent of shrimps and prawns (penaeids) produced worldwide. Most cultured marine species are of relatively high commercial value, sometimes because wild stocks are small or declining. While the overall share of farmed fish in marine finfish production has stayed quite low, for the species that are farmed, aquaculture frequently dominates the market. This is the case for species such as the Japanese seabass, gilthead seabream, red drum and bastard halibut. In fact, for species such as these, the amounts now produced by aquaculture are often substantially higher than the past highest catch recorded by capture fisheries.

Production continues to differ much from region to region. In the Asia and the Pacific region, aquaculture production from China, South Asia and most of Southeast Asia consists primarily of cyprinids, while production from the rest of East Asia consists of high-value marine fish. In Latin America and the Caribbean, in the last decade, salmonids have overtaken shrimp as the top aquaculture species group as a result of outbreaks of disease in major shrimp-producing areas and the rapid growth in salmon production in Chile. In North America, channel catfish is the top aquaculture species in the United States of America, while Atlantic and Pacific salmon dominate in Canada.

Relative to other regions, SSA continues to produce little despite its natural potential. Nigeria leads in the region, with reported production of 85 000 tonnes of catfish, tilapia and other freshwater fishes. There are some encouraging signs in the continent. Black tiger shrimp (*Penaeus monodon*) in Madagascar and *Eucheuma* seaweed in the United Republic of Tanzania are thriving, and production of niche species such as abalone (*Haliotis* spp.) in South Africa is increasing. In North Africa, Egypt is by far the dominant country in terms of production (99 percent of the regional

Figure 12

World acquaculture production: major species groups in 2006



Note: NEI = not elsewhere included.

Figure 13

Trends in world aquaculture production:
average annual growth rate for major species groups 1970–2006

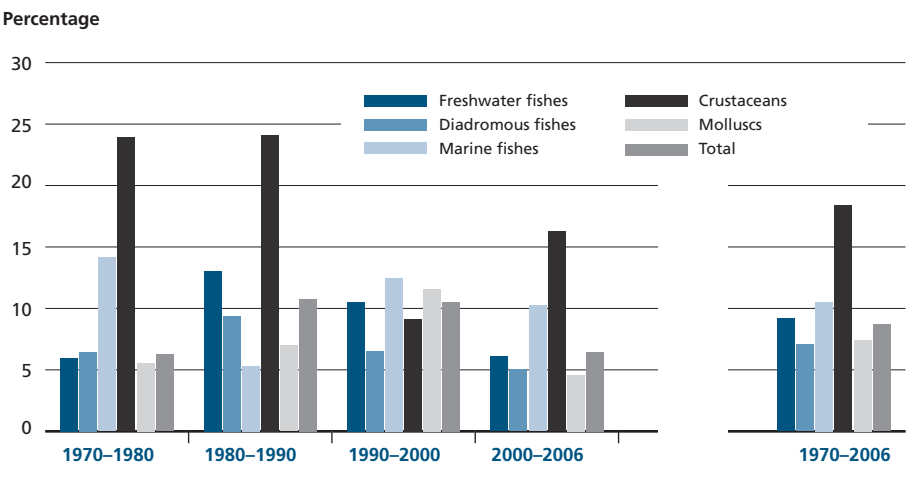
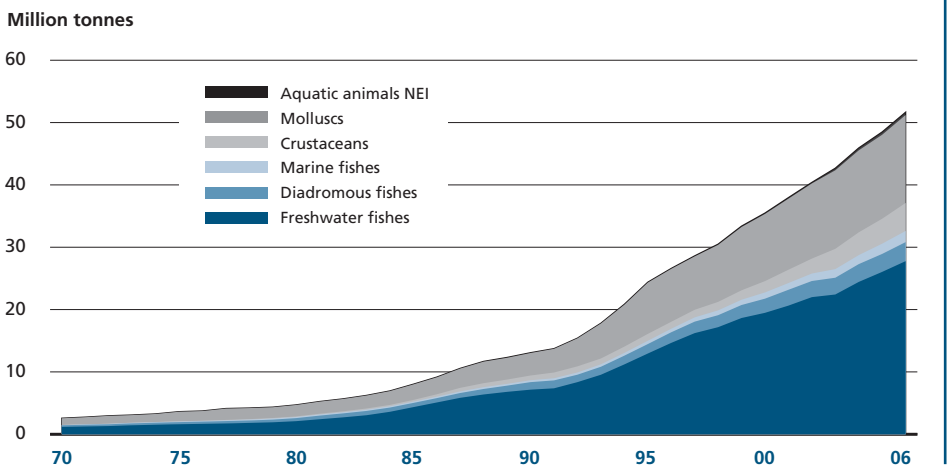


Figure 14

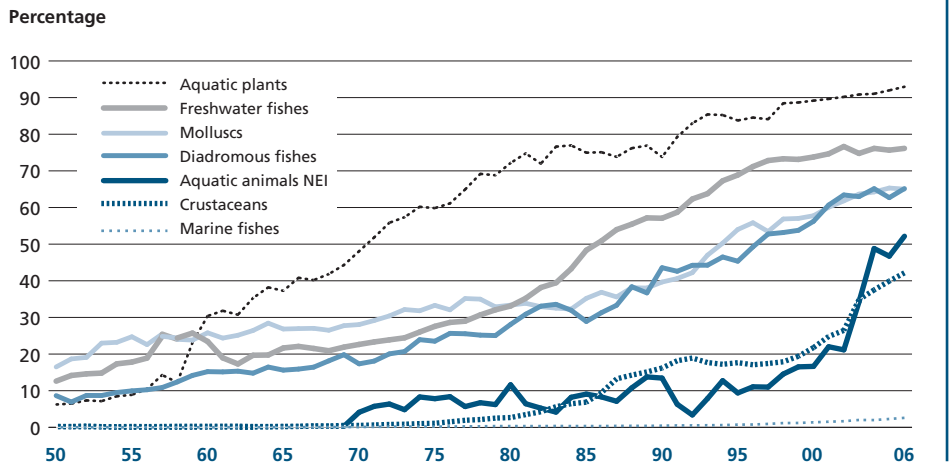
Trends in world aquaculture production: major species groups



Note: NEI = not elsewhere included.

Figure 15

Contribution of aquaculture to global production: major species groups



Note: NEI = not elsewhere included.

total) and, in fact, is now the second largest producer of tilapia after China and the world's top producer of mullets. In the Near East, Iran (Islamic Republic of) and Turkey are two leading countries in the region, each producing about 130 000 tonnes of trouts, carps and Indian white prawn.

However, in global terms, a few countries still dominate production of major species groups. China produces 77 percent of all carp (cyprinids) and 82 percent of the global supply of oysters (ostreids). The Asia and Pacific region accounts for 98 percent of carp and 95 percent of oyster production. Eighty-eight percent of shrimps and prawns (penaeids) also come from this region, with the top five producers (China, Thailand, Viet Nam, Indonesia and India) accounting for 81 percent. Meanwhile Norway and Chile are the world's leading producers of cultured salmons (salmonids), accounting for 33 and 31 percent of world production, respectively. Other European producers supply another 19 percent.

World aquatic plant production[6] by aquaculture was 15.1 million tonnes (US$7.2 billion) in 2006. The culture of aquatic plants has increased consistently, with an average annual growth rate of 8.0 percent since 1970. In 2006, it contributed 93 percent of the world's total supply of aquatic plants. Some 72 percent originated in China, with 10.9 million tonnes (US$5.2 billion). Virtually all of the remaining production also came from Asia: the Philippines (1.5 million tonnes), Indonesia (0.91 million tonnes), the Republic of Korea (0.77 million tonnes) and Japan (0.49 million tonnes). Japan is the second-most important aquatic-plant-producing country in terms of value (US$1.1 billion), owing to its high-priced Nori production. Japanese kelp (*Laminaria japonica* – 4.9 million tonnes) showed the highest production, followed by Wakame (*Undaria pinnatifida* – 2.4 million tonnes) and Nori (*Porphya tenera* – 1.5 million tonnes).

Integrated multitrophic aquaculture (incorporation of species from different trophic/nutritional levels in the same system) is on the rise. By converting solid and soluble nutrients from fed organisms and their feed into harvestable crops and/or extractive organisms (thereby reducing the potential for eutrophication) and by increasing economic diversification, integrated multitrophic aquaculture promotes economic and environmental sustainability. As the waste of one species becomes the nutritional input to another, the potential for contamination is a food safety and quality concern. However, as the practice is new, research is needed in this area to ensure that fish so produced do not present a danger to consumers.

Organic aquaculture has also attracted the attention of consumers, environmental advocates and entrepreneurial innovators. Some argue that it reduces overall exposure to toxic chemicals from pesticides that can accumulate in the ground, air, water and food supply, thereby lessening health risks for consumers. Some of its other merits include curbing topsoil erosion, improving soil fertility, protecting groundwater and saving energy. Moreover, organic standards prohibit the use of genetic engineering in production, which again reassures consumers. The growing interest in organic aquaculture has prompted governments to regulate the sector. Standards and certification procedures are being developed and tested – they are necessary tools to promote investment. In the absence of international standards, interested parties are developing their own specific organic aquaculture standards and accreditation bodies. These standards often vary significantly from place to place, certifier to certifier, and species to species.

GMOs continue to be a controversial issue also in aquaculture. Supporters claim that GMOs enhance the performance and profitability of farmed aquatic resources and, hence, improve food security. Opponents argue that they pose significant risks to the environment and, possibly, to human health. While there is universal consensus that GMOs should be regulated, there are disagreements as to what the regulations should contain. Some groups advocate a complete ban on GMOs, others call for mandatory labelling of genetically modified food and other products in order to alert consumers to potential health effects. However, GMO products from aquaculture have not yet appeared on the market.

Linked to, but distinct from, consumers' demand for fish quality standards is the public perception that aquaculture harms the environment. This public mistrust of aquaculture has occurred in some places leading to legal challenges, pressure on moratoria, and even vandalism. In some instances, attitudes towards aquaculture have influenced decision-makers, pressuring them to regulate and often to halt the expansion of aquaculture. A recent global FAO study on constraints facing aquaculture found that respondents in all regions except Africa and Eastern Europe expect such opposition to be a threat to its future development.[7] In some regions, the cause of the opposition is considered to be misinformation; in others, it is particular attributes of aquaculture. Aware of the need to address these issues, FAO and its partners have drafted guidelines for aquaculture certification (see page 103). These guidelines cover animal health and welfare, food safety and quality, environmental integrity and social responsibility associated with aquaculture. They provide guidance

on the development, organization and implementation of credible aquaculture certification schemes. The aims are: (i) to reassure producers, buyers, consumers and civil society regarding the quality and safety of aquaculture products; and (ii) to provide a further tool to support responsible and sustainable aquaculture.

FISHERS AND FISH FARMERS

Fisheries and aquaculture play, either directly or indirectly, an essential role in the livelihoods of millions of people around the world. In 2006, 43.5 million people were directly engaged, part time or full time, in primary production of fish, either by fishing or in aquaculture (Table 5). They accounted for 3.2 percent of the 1.37 billion people economically active in agriculture worldwide. In the last three decades, employment in the primary fisheries sector has grown faster than the world's population and employment in traditional agriculture. Eighty-six percent of the fishers and fish farmers worldwide are located in Asia, with China having the most (8.1 million fishers and 4.5 million fish farmers, see Table 6). Fishery employment in China experienced strong increases in the 1980s and 1990s to peak at 13.7 million people in 2001. The number of fishers and fish farmers then declined by 8 percent in the period 2001–06, mainly in the number of people engaged in capture fisheries. In 2006, other countries with a significant number of fishers and fish farmers were India, Indonesia, the Philippines and Viet Nam. Most fishers are small-scale, artisanal fishers, operating on coastal and inland fishery resources.

In recent decades, major increases in the total number of people engaged in fisheries and aquaculture have come from the development of aquaculture activities. Aquaculture can provide an important source of livelihood for the rural poor, generating income through direct sales of aquatic products, in processing and by providing ancillary services. In 2006, the estimated number of fish farmers was nearly 9 million people, with 94 percent operating in Asia. This figure is indicative only, as

Table 5
World fishers and fish farmers by continent

	1990	1995	2000	2005	2006
			(Thousands)		
Africa	1 773	1 896	3 631	3 589	3 637
North and Central America	760	777	891	1 034	1 038
South America	730	704	706	702	708
Asia	23 766	28 118	34 781	36 650	37 338
Europe	654	498	812	734	725
Oceania	55	52	49	54	55
World	**27 737**	**32 045**	**40 871**	**42 763**	**43 502**
Of which fish farmers[1]					
Africa	3	13	107	111	108
North and Central America	3	6	75	300	301
South America	66	93	71	69	69
Asia	3 738	5 986	7 369	8 078	8 107
Europe	20	26	44	71	73
Oceania	1	1	5	4	4
World	**3 832**	**6 124**	**7 672**	**8 632**	**8 663**

[1] Data for 1990 and 1995 were reported by only a limited number of countries and, therefore, are not comparable with those for later years.

Table 6
Number of fishers and fish farmers in selected countries

Country	Fishery		1990	1995	2000	2005	2006
WORLD	FI + AQ	(number)	**27 737 435**	**32 045 098**	**40 870 574**	**42 763 421**	**43 501 700**
		(index)	***68***	***78***	***100***	***105***	***106***
	FI	(number)	23 905 853	25 921 448	33 199 024	34 131 239	34 839 084
		(index)	*72*	*78*	*100*	*103*	*105*
	AQ	(number)	3 831 582	6 123 650	7 671 550	8 632 182	8 662 616
		(index)	*50*	*80*	*100*	*113*	*113*
China	FI + AQ	(number)	11 173 463	11 428 655	12 935 689	12 902 777	12 594 654
		(index)	*86*	*88*	*100*	*100*	*97*
	FI	(number)	9 432 464	8 759 162	9 213 340	8 389 161	8 091 864
		(index)	*102*	*95*	*100*	*91*	*88*
	AQ	(number)	1 740 999	2 669 493	3 722 349	4 513 616	4 502 790
		(index)	*47*	*72*	*100*	*121*	*121*
Indonesia	FI + AQ	(number)	3 323 135	4 177 286	4 776 713	4 486 776	4 496 680
		(index)	*70*	*87*	*100*	*94*	*94*
	FI	(number)	1 700 839	2 072 464	2 633 954	2 212 776	2 221 680
		(index)	*65*	*79*	*100*	*84*	*84*
	AQ[1]	(number)	1 622 296	2 104 822	2 142 759	2 274 000	2 275 000
		(index)	*76*	*98*	*100*	*106*	*106*
Iceland	FI + AQ	(number)	6 951	7 165	6 265	5 165	4 465
		(index)	*111*	*114*	*100*	*82*	*71*
Japan	FI + AQ	(number)	393 600	324 440	304 686	262 196	212 470
		(index)	*129*	*106*	*100*	*86*	*70*
Norway	FI + AQ	(number)	24 979	21 776	18 589	18 848	18 336
		(index)	*134*	*117*	*100*	*101*	*99*
	FI	(number)	20 475	17 160	14 262	14 626	13 932
		(index)	*144*	*120*	*100*	*103*	*98*
	AQ	(number)	4 504	4 616	4 327	4 222	4 404
		(index)	*104*	*107*	*100*	*98*	*102*
Peru	FI + AQ	(number)	56 550	62 930	66 361	70 036	72 260
		(index)	*85*	*95*	*100*	*106*	*109*
	FI	(number)	...	60 030	63 798	66 395	68 555
		(index)	...	*94*	*100*	*104*	*107*
	AQ	(number)	...	2 900	2 563	3 641	3 705
		(index)	...	*113*	*100*	*142*	*145*

Note: FI = fishing, AQ = aquaculture; index: 2000 = 100; ... = data not available.
[1] Data for 2005 and 2006 are FAO estimates.

some countries do not collect employment data separately for the two sectors, and some other countries' national systems do not yet account for fish farming.

Table 7 compares fish production by continent with the number of people employed in the primary sector. It illustrates the numbers of people involved and the different scales of operations. The highest concentration of people employed is in

Table 7
Fishery production per fisher and per fish farmer in 2006

	Production (capture + aquaculture)[1]	Percentage of production	Number of fishers and fish farmers	Percentage of persons	Production per person
	(Tonnes)	*(%)*	*(No.)*	*(%)*	*(Tonnes/year)*
Africa	7 684 068	5.3	3 637 316	8.4	2.1
Asia	94 300 307	65.6	37 337 594	85.8	2.5
Europe	15 552 606	10.8	725 498	1.7	21.4
North America	6 778 441	4.7	344 071	0.8	19.7
Latin America	17 832 018	12.4	1 401 764	3.2	12.7
Oceania	1 393 129	1.0	55 457	0.1	25.1
Total	**143 647 650**	**100.0**	**43 501 700**	**100.0**	**3.3**

[1] Production excludes aquatic plants. Data for total production also include 107 081 tonnes of "others not elsewhere specified".

Asia, but average production per person there is only 2.5 tonnes per year, whereas it is more than 21 tonnes in Europe and nearly 20 tonnes in North America. The high figure for Oceania in part reflects the incomplete reporting by many countries of this continent. The figures on production per person indicate the degree of industrialization of fishing activities, and also the key role played by small-scale fisheries in Africa and Asia.

While the number of people employed in fisheries and aquaculture has been growing steadily in most low-income and middle-income countries, employment in the sector has fallen or remained stationary in most industrialized economies. In Japan and Norway, the numbers of fishers have more than halved since 1970, down 61 and 42 percent, respectively. In many industrialized countries, the decline has occurred mainly in capture fisheries, while the number of fish farmers has increased. In 2006, the estimated number of fishers in industrialized countries was about 860 000, representing a decline of 24 percent compared with 1990. In recent decades, growing investment in onboard equipment, resulting in higher operational efficiencies and less need for seagoing personnel, has led to a significant decline in the number of people employed at sea. This has led to a rapid decline in recruitment in capture fisheries.

In industrialized countries, younger workers seem reluctant to go to sea on fishing vessels. For many young people, neither the salaries nor the quality of life aboard fishing vessels compares favourably with those of land-based industries. Moreover, widespread concerns about the status of stocks may contribute to the view that capture fisheries have an uncertain future. As a result, fishing firms in industrialized countries have begun to look elsewhere when recruiting personnel. In Europe, fishers from the economies in transition or from developing countries are starting to replace local fishers. In Japan, foreign workers have been allowed to work on Japanese distant-water fishing vessels under the "maru-ship system".[8]

A characteristic feature of employment in the fishing industry is the prevalence of occasional or part-time employment, peaking in the months of the year when riverine, coastal and offshore resources are more abundant or available, but leaving time in seasonal lows for other occupations. This is especially true in fisheries for migratory species and those subject to seasonal weather variations. In fact, in the past three decades, the number of full-time fishers has declined while the number of part-time fishers has grown quite rapidly. This trend has been particularly marked in Asia.

In 2006, in addition to the estimated 43.5 million part-time and full-time fishers, about 4 million occasional fishers and fish farmers were reported to FAO (2.5 million from India).

The fisheries sector, including aquaculture, is an important source of employment and income. However, employment in fishing and fish farming cannot be taken as the only indication of the importance of fisheries to a national economy. In addition to fishers and fish farmers involved in direct primary production of fish, there are people involved in other ancillary activities, such as processing, net and gear making, ice production and supply, boat construction and maintenance, manufacturing of fish-processing equipment, packaging, marketing and distribution. Others are involved in research, development and administration connected with the fishery sector. No official data exist on the estimated numbers of people involved in these other activities. Some estimations indicate that, for each person employed in capture fisheries and aquaculture production, there are about four jobs produced in the secondary activities, including post-harvest, for a total of more than 170 million jobs in the whole fishery industry. However, each jobholder on average provides for three dependants or family members. Thus, fishers, aquaculturists and those supplying services and goods to them assure the livelihoods of a total of about 520 million people, 7.9 percent of the world population.

Women play an important role both as workers in the fisheries sector and in ensuring household food security. Generally, they possess an in-depth understanding and knowledge of the natural environment and its resources. Millions of women around the world, especially in developing countries, work in the fisheries sector. Women participate as entrepreneurs and by providing labour before, during and after the catch in both artisanal and commercial fisheries. Their labour often consists of making and mending nets, baskets and pots, and baiting hooks. In fishing, women are rarely engaged in commercial offshore and deep-sea waters, but more commonly involved in fishing from small boats and canoes in coastal or inland waters – harvesting bivalves, molluscs and pearls, collecting seaweed and setting nets or traps. Women also play an important role in aquaculture, where they attend to fish ponds, feed and harvest fish, and collect prawn larvae and fish fingerlings. However, their most important role in both artisanal and industrial fisheries is at the processing and marketing stages. In some countries, women have become important entrepreneurs in fish processing; in fact, most fish processing is performed by women, either in their own cottage-level industries or as wage labourers in the large-scale processing industry. However, as much of this work remains invisible in available statistics, it goes unrecognized, and it is not possible to obtain a comprehensive picture of the role of women in the fisheries sector. This prevents them from obtaining due recognition in public efforts to develop the sector.

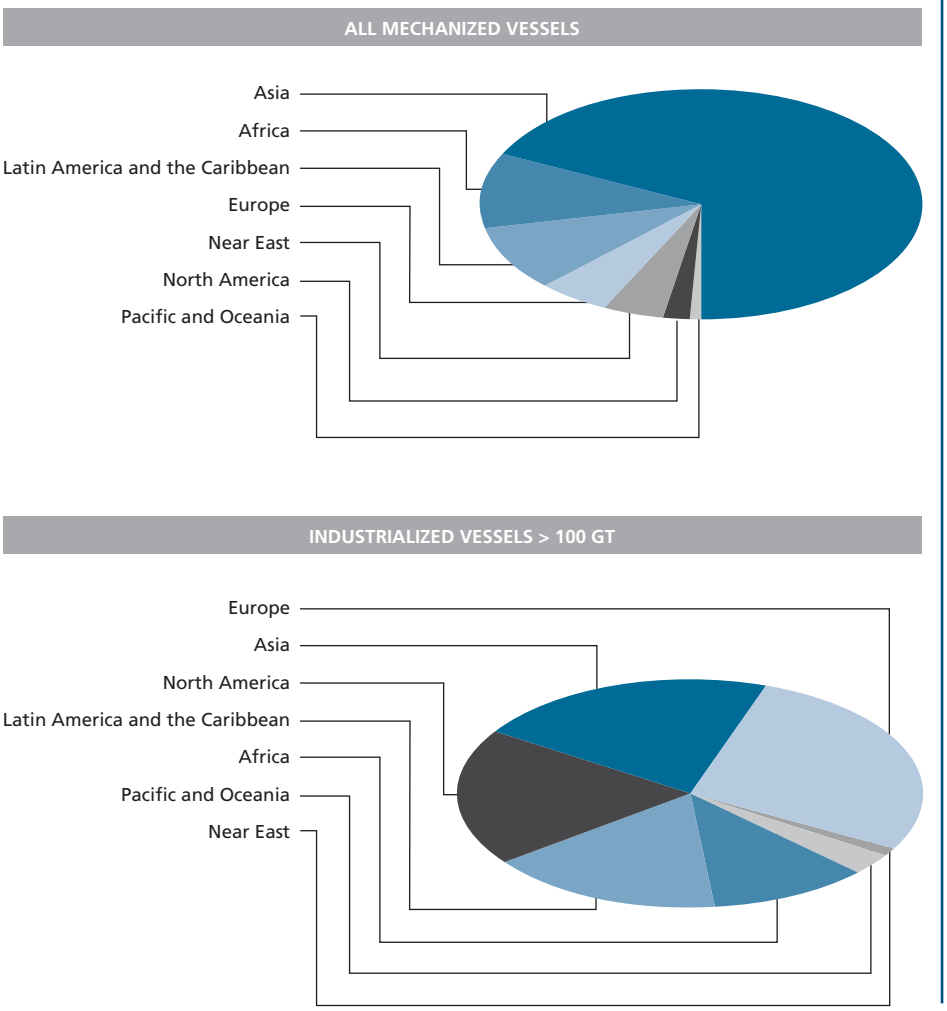
THE STATUS OF THE FISHING FLEET

In 2007, FAO obtained data on national fishing fleets from 97 countries (slightly fewer than half of those catching fish) either through direct reporting or through disseminated statistics. The quality of the data varies widely from quite fragmented records to consistent and continuous statistics over several years. Some data reported to FAO are based on national registers and/or other administrative records. However, these registers often do not cover small boats, especially those used in inland waters. Such craft are often not subject to compulsory registration. Even if they are, where the registers concerned are managed by provincial or municipal authorities, they are easily overlooked in reporting at the national level. In addition, registers and administrative records often include non-operational units. Taking these factors into consideration, the currently available information has only limited value for monitoring and detecting global trends in fishing capacity, and the figures reported in this section should only be considered indicative where they represent global trends.

Quite a large number of non-motorized boats are engaged in fishing operations, usually inshore or on inland waters. For the reasons already described, information about this category of vessel is generally lacking. In the past two years, very little information has been received about the non-motorized fleets. Therefore, there has

Figure 16

Distribution of fishing vessels by region in 2006

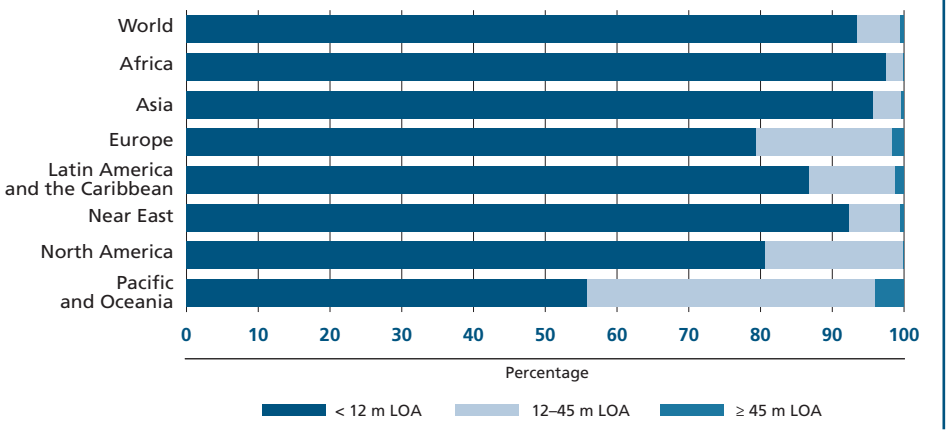


been no attempt to update the estimate made when preparing *The State of World Fisheries and Aquaculture 2006*.

The number of engine-powered fishing vessels is estimated to have been about 2.1 million in 2006, with almost 70 percent of them in Asia (Figure 16). Of the remaining vessels, most were reported to be fishing in Africa, followed by Europe, the Near East, and Latin America and the Caribbean. As almost 90 percent of the motorized fishing vessels in the world are less than 12 m in length, such vessels dominate everywhere, particularly in Africa, Asia and the Near East. The fishing fleets in the Pacific region and in Oceania, Europe and North America tend to consist of vessels that are, on average, slightly larger. This characteristic is confirmed by the distribution of industrialized fleets (vessels of more than 100 GT, roughly more than 24 m in length, extracted from the Lloyd's Fairplay database), which shows them as being rather evenly distributed among Asia, Europe, Latin America and the Caribbean, and North America (Figure 17). Correspondingly, there is a higher proportion of vessels of more than 100 GT in the Europe, Latin America and the Caribbean, and North America regions than in the Africa and Asia regions. This situation is reflected in the estimated average annual catches per vessel, which are lower in the Asia and Africa regions than elsewhere.

Figure 17

Size distribution of mechanized fishing vessels



Note: LOA = length overall.

Lloyd's database indicated that about 23 000 industrialized fishing vessels (for a total of 9.9 million GT) and 740 fish carriers (for a total of slightly less than 1.0 million GT) were operational at the end of 2007. The number of industrialized fishing vessels under the flag of the United States of America, about 3 300, was larger than that reported by any other nation. However, vessels under the flag of the Russian Federation accounted for the largest fleet in terms of gross tonnage, at 1.5 million tonnes (16 percent of the world total). The differences between these two fleets probably reflect the historical development of fishing capacity in the two countries. In the 1980s, the Soviet Union, of which the Russian Federation was then a part, had a centrally planned economy. On a production line basis, it built a fleet of large fishing vessels and fishery support vessels with the ability to operate in distant waters. The United States of America developed a fleet owned and built by individual entrepreneurs to their own specifications with an emphasis on the capacity to harvest local coastal stocks. Despite the changes brought about by the United Nations Convention on the Law of the Sea with regard to fisheries jurisdictions in the early 1980s, a similar pattern of vessel construction continued for a decade into the early 1990s. Some East European countries, e.g. Romania and Ukraine, also employ large vessels. The largest average size – 2 400 GT – was reported for the Belize-flagged fleet. Up to 8.5 percent of the vessels (8.9 percent in terms of total gross tonnage) in the database were recorded as having an "unknown" flag. This is a fleet larger than all national fleets with the exception of that of the United States of America. This "unknown" category has expanded quickly in recent years in spite of global efforts to eliminate IUU fishing activities. The database shows what a vessel's flag was before it became "unknown". In order of frequency, flags included in this category are those of Belize, the Russian Federation, Japan, Panama and Honduras. Correspondingly, Belize, the Russian Federation and Japan have reported a substantial reduction in their industrial fishing fleets since 2001. The vessels in the "unknown" category show a relatively high average age (31.4 years), so some of those vessels that have left the national registers – and are now classified as of "unknown" flag – might no longer be in operational condition.

The Russian Federation and China account for the largest share (35 percent) of fish carriers with 140 and 120 vessels, respectively. However, in tonnage terms, Panama, the Russian Federation and Belize dominate. Vessels flying one of these three flags account for more than 60 percent of the world's gross tonnage of fish carriers. Carriers under the flags of Belize, Cyprus or Panama are large; the average fish carrier in these fleets is 7 000–11 000 GT.

Figure 18

Relative changes in numbers and GT of industrialized fishing vessels and fish carriers > 100 GT

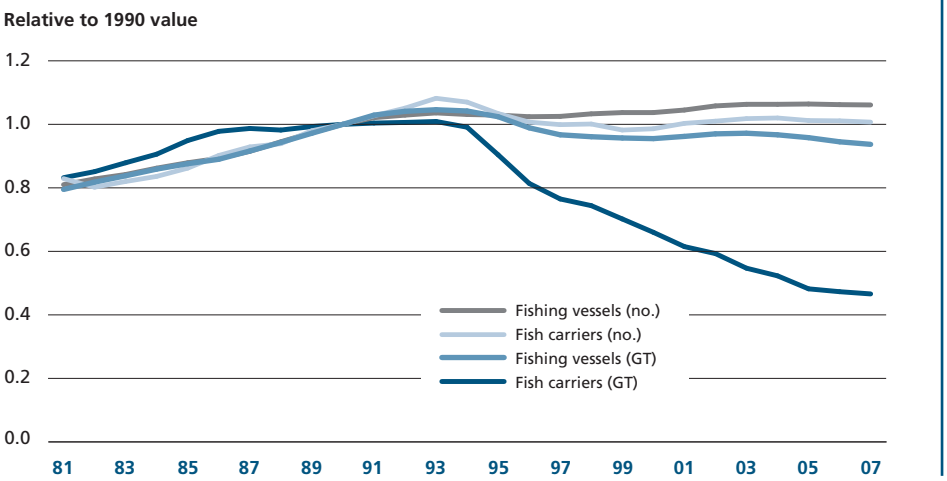


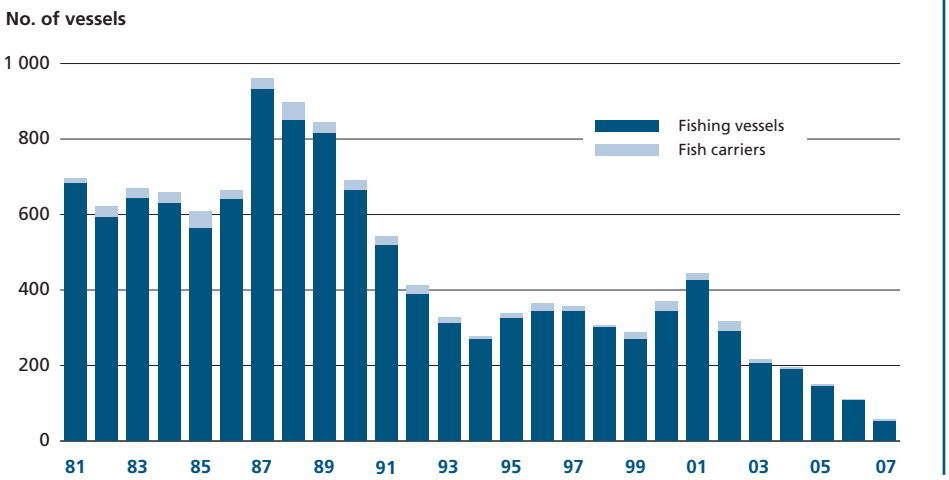
Figure 18 shows changes in the numbers and GT of industrialized fishing vessels and fish carriers of more than 100 GT relative to the 1990 levels extracted from the Lloyd's database. The numbers of both fishing vessels and fish carriers have stayed around the same level in the last ten years. While the size of the fishing fleet has declined slightly in terms of GT, the fleet of fish carriers in 2006 had fallen to less than half that of 1990. This implies that recently built fish carriers have been much smaller than their predecessors. In addition, scrapped vessels have on the whole been much larger (fishing vessels at 1 100 GT and fish carriers at 5 000 GT) than those built to replace them. These new vessels have averaged about 540 GT for fishing vessels and 590 GT for fish carriers. The average size of newly built vessels has remained relatively stable with some fluctuations in the last ten years. There have been suggestions that the recent rapid rise in fuel prices will increase the use of fish carriers in an attempt to cut overall fuel costs by reducing the time fishing vessels spend travelling to and from the fishing grounds. However, the recent change in the fleet size of fish carriers does not seem to support this view. The number of new fishing vessels being built declined substantially in the late 1980s, when it fell to about half of the previous level. It stayed at about this level until 2001 but has since declined substantially (Figure 19). Currently, the average age of operational fishing vessels is 27.4 years, and that for fish carriers is 22.9 years.

The issues of overcapacity in fishing fleets and their reduction to the levels that should be in balance with long-term sustainable exploitation of resources have received global attention in the past two decades. Many countries have adopted policies to limit the growth of national fishing capacity in order to protect aquatic resources and make fishing economically viable for the harvesting enterprises.

The State of World Fisheries and Aquaculture 2006 reported on attempts by China and the European Union (EU) to limit and control the capacity of their fishing fleets. The "Entry-Exit" scheme, briefly described in that edition, remains in force for EU members. The European Economic Area (EEA) reported declining fleets for EU members in the three years following its introduction in 2003. However, for EEA 18,[9] the rates of decline in number of vessels – about 3.2 percent annually – seem unaffected by the "Entry-Exit" scheme. However, a decline in GT terms has occurred. The annual rate of decline increased from 0.8 percent in the period 1998–2003 to about 2.1 percent thereafter. The enlargement of the EU by ten countries[10] in 2004 made a larger number of fishing vessels subject to the "Entry-Exit" scheme. The fishing fleets of these new members have shown a faster fall in fishing capacity than those of the original

Figure 19

Changes in number of newly built vessels



15 members.[11] The combined fleet shrank by 3.1 percent annually in terms of numbers of vessels and by 3.5 percent annually in GT terms in the period 2004–06.

China's five-year programme to de-license and scrap 30 000 fishing vessels ended at the beginning of 2008. It is unclear how many vessels were scrapped under the programme. Whatever its achievements, it appears that the fleet of commercial vessels in China continues to expand. Official data record an annual increase in vessel numbers of about 3.5 percent for the period 2002–06.

THE STATUS OF FISHERY RESOURCES

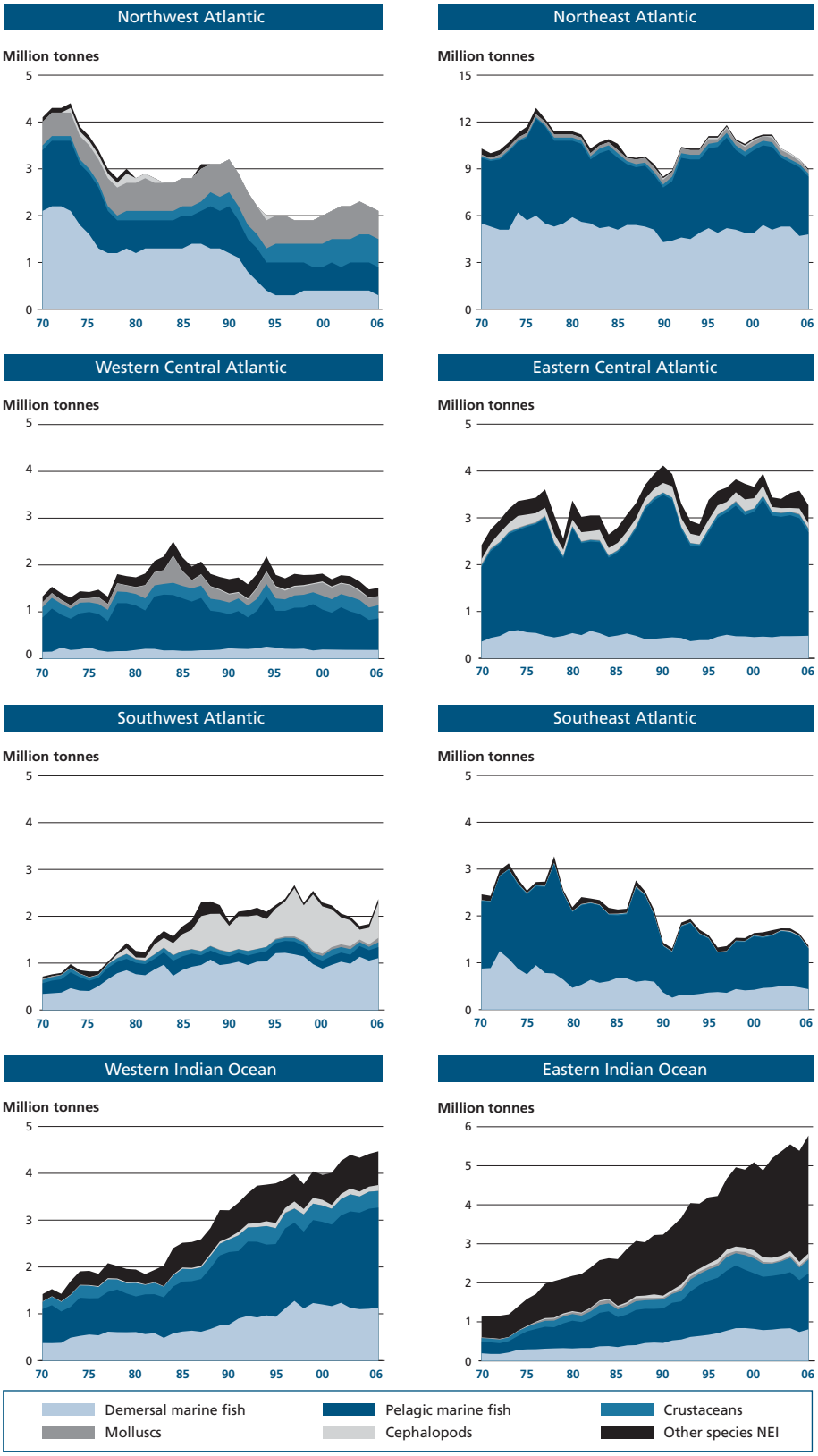
Marine fisheries

The global state of exploitation of the world marine fishery resources has tended to vary, with some trends in the observed exploitation categories (Figure 20). While the proportion of underexploited or moderately exploited stocks declined linearly from 40 percent in the mid-1970s to 20 percent in 2007, the proportion of fully exploited stocks remained steady at about 50 percent. The proportion of overexploited, depleted or recovering stocks appears to have stabilized at between 25 and 30 percent since the mid-1990s (Figure 21). The overall examination of the state of stocks and groups of stocks for which information is available confirms that the proportions of overexploited, depleted and recovering stocks have remained relatively stable in the last 10–15 years, after the noticeable increasing trends observed in the 1970s and 1980s. It is estimated that, in 2007, about one-fifth of the stock groups monitored by FAO were underexploited (2 percent) or moderately exploited (18 percent) and could perhaps produce more. Slightly more than half of the stocks (52 percent) were fully exploited and, therefore, producing catches at or close to their maximum sustainable limits, with no room for further expansion. The other 28 percent were either overexploited (19 percent), depleted (8 percent) or recovering from depletion (1 percent) and, thus, yielding less than their maximum potential owing to excess fishing pressure in the past, with no possibilities in the short or medium term of further expansion and with an increased risk of further declines and a need for rebuilding.

Most of the stocks of the top ten species, which account in total for about 30 percent of the world marine capture fisheries production in terms of quantity (Figure 6 on page 12), are fully exploited or overexploited and, therefore, cannot be expected to produce major increases in catches. This is the case for: anchoveta (*Engraulis ringens*), with two main stocks in the Southeast Pacific that are fully exploited and overexploited; Alaska pollock (*Theragra chalcogramma*), which is fully exploited in the North Pacific; blue whiting (*Micromesistius poutassou*), which is fully exploited in the Northeast

Figure 20

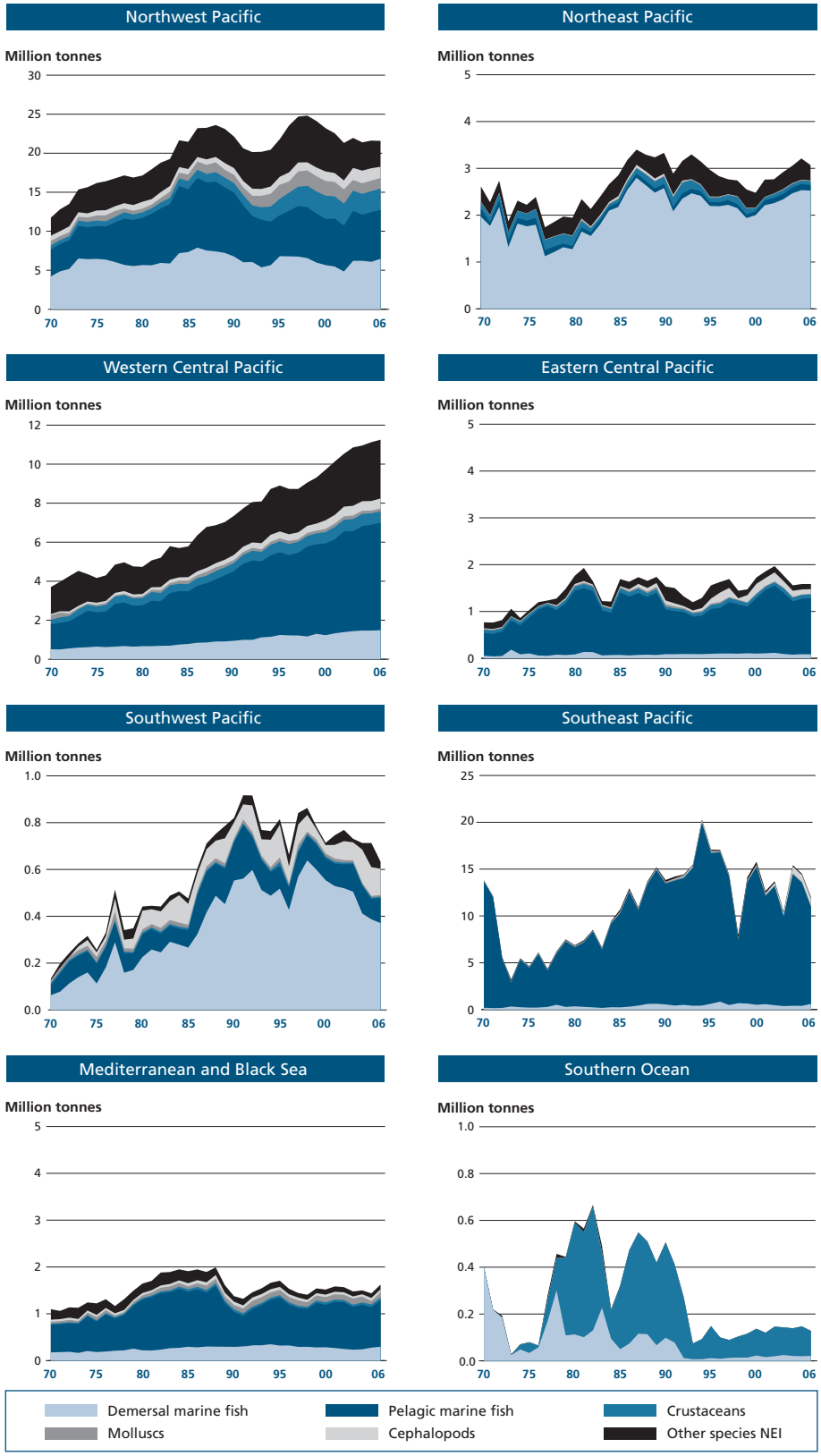
Capture fisheries production in marine areas



(Continued)

Figure 20 *(cont.)*

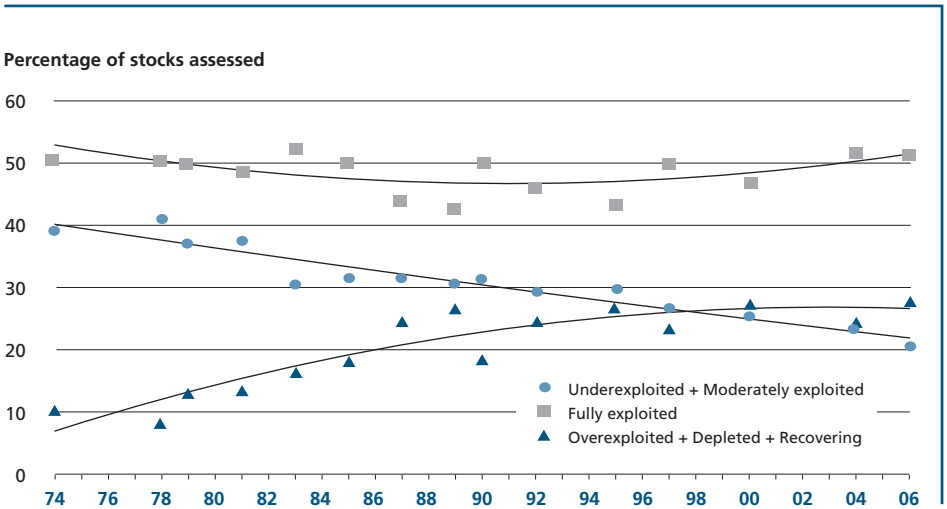
Capture fisheries production in marine areas



Note: NEI = not elsewhere included.

Figure 21

Global trends in the state of world marine stocks since 1974



Atlantic; Atlantic herring (*Clupea harengus*), with several stocks that are fully exploited, some that are depleted and some that are underexploited because of market conditions; Japanese anchovy (*Engraulis japonicus*), which is fully exploited in the Northeast Pacific; Chilean jack mackerel (*Trachurus murphyi*), which is fully exploited and overexploited in the Southeast Pacific; and yellowfin tuna (*Thunnus albacares*), which is fully exploited in the Atlantic and Pacific Oceans and probably moderately to fully exploited in the Indian Ocean. Some stocks of skipjack tuna (*Katsuwonus pelamis*) are fully exploited while some are still reported as moderately exploited, particularly in the Pacific and Indian Oceans, where they could offer some limited possibilities for further expansion of fisheries production. However, this may not be desirable as it is nearly impossible to increase skipjack catches without negatively affecting bigeye and yellowfin tunas. Some limited possibilities for expansion are also offered by a few stocks of chub mackerel (*Scomber japonicus*), which are moderately exploited in the Eastern Pacific, while other stocks are already fully exploited. The largehead hairtail (*Trichiurus lepturus*) is considered overexploited in the main fishing area in the Northwest Pacific, but its state of exploitation is unknown elsewhere.

The percentage of stocks fully exploited, overexploited or depleted varies greatly by area. The major fishing areas with the highest proportions (71–80 percent) of fully exploited stocks are the Northeast Atlantic, Western Indian Ocean and Northwest Pacific. The proportion of overexploited, depleted and recovering stocks varies between 20 and 52 percent in all areas except in the Northwest Pacific, Western Central Pacific and Eastern Central Pacific, where it is 10 percent or less. Relatively high proportions (20 percent or more) of underexploited or moderately exploited stocks can be found in the Eastern Indian Ocean, Western Central Pacific, Eastern Central Pacific, Southwest Pacific and Southern Ocean, and for some species of tunas.

Four FAO major fishing areas account for more than 10 percent each and collectively produced about 66 percent of the world marine catches in 2006. The Northwest Pacific is the most productive, with a total catch of 21.6 million tonnes (26 percent of total marine catches), followed by the Southeast Pacific, with a total catch of 12.0 million tonnes (15 percent), the Western Central Pacific with 11.2 million tonnes (14 percent) and the Northeast Atlantic, with 9.1 million tonnes (11 percent).

In the Northwest Pacific, small pelagics are the most abundant category, with the Japanese anchovy providing large catches, although there were signs of decline in 2005 and 2006 as compared with catches of more than 2 million tonnes in 2003. Other important contributors to the total catch are the largehead hairtail, considered overexploited, and the Alaska pollock and chub mackerel, both considered

fully exploited. Squids, cuttlefish and octopuses are important species yielding 1.4 million tonnes.

In the Southeast Pacific, total catches have oscillated around 12 million tonnes in the last five years. There has been no major change in the status of stocks since 2004. The stock of anchoveta has recovered from the severe El Niño event of 1997–98 and is considered fully exploited in most of the area. Two other important pelagic stocks, the Chilean jack mackerel and in particular the South American pilchard, remain in a decadal cycle of natural low abundance, producing a fraction of the record catches observed between the mid-1980s and mid-1990s. The stocks of South Pacific hake remain under heavy fishing pressure with no sign of recovery.

The Western Central Pacific is the most productive fishing area of the tropical regions, with total catches up about 3 percent on 2004. Tunas and tuna-like species make up about 24 percent of the total for this fishing area, with most species assessed as either fully exploited or moderately to fully exploited. The status of other species groups is highly uncertain. This region is highly diverse, its fisheries are mostly multispecies, and detailed data for reliable assessments are usually not available for most stocks. Analysis of survey information for some countries in the region (Malaysia, the Philippines, Thailand and Viet Nam) have shown considerable degradation and overfishing of coastal stocks, most dramatically in the Gulf of Thailand and along the east coast of Malaysia.

In the Northeast Atlantic, catches of blue whiting have stabilized at about 2 million tonnes per year since 2003, and the stock is considered fully exploited. Fishing mortality has been reduced in cod, sole and plaice. Cod remains depleted in the North Sea and in the Faeroes, but other stocks are healthier and considered fully exploited. Several stocks of haddock have shown spectacular increases in biomass since 2000, fisheries have grown and most stocks are now considered fully exploited. Saithe stocks have also increased since 2000. Some sand eel and capelin stocks have become depleted, while fishing for shrimp seems to have ceased in some areas.

A record high has been reached in total landings in the Eastern Indian Ocean, with a total of 5.8 million tonnes, a 5-percent increase compared with 2004. The category "marine fishes non-identified", representing 50 percent of the total catches in the area, accounts for most of this increase. "Miscellaneous pelagic fishes" (including Indian mackerels and various carangids) made up 11 percent of the catches and "miscellaneous coastal fishes" (croakers, ponyfishes, sea catfishes, etc.) 10 percent. Tuna catches in 2006 were slightly below the six-year (2000–05) average of 450 000 tonnes. While catches of most groups show either a rising trend or are fluctuating slightly with no clear trend, there are indications that parts of this fishing area could be overfished, with the situation being aggravated by increasing stress from pollution, sedimentation, modified river runoffs and intensive coastal aquaculture.

There have been several changes in the status of the stocks in the Southeast Atlantic since the last full assessment made in 2004. The important hake resources remain fully exploited to overexploited although there are signs of some recovery in the deepwater hake stock (*Merluccius paradoxus*) off South Africa. The status of the coastal fishes remains fully exploited or depleted. A significant change concerns the Southern African pilchard, which was at a very high biomass and estimated to be fully exploited in 2004, but which now, under unfavourable environmental conditions, has declined considerably in abundance and is overexploited throughout the region. In contrast, the status of Southern African anchovy has improved from fully exploited to fully to moderately exploited, and Whitehead's round herring is underexploited to moderately exploited. The condition of Cape horse mackerel has deteriorated, particularly off Namibia, where it is currently overexploited. The condition of the Perlemoen abalone stock has deteriorated, driven heavily by illegal fishing, and it is currently overfished and probably depleted.

Overall, 80 percent of the 523 selected world fish stocks for which assessment information is available are reported as fully exploited or overexploited (or depleted and recovering from depletion). It should be noted that the status of fully exploited is

not undesirable provided it is the result of an effective and precautionary management approach. Nevertheless, the combined percentage reinforces earlier observations that the maximum wild capture fisheries potential from the world's oceans has probably been reached. Therefore, a more cautious and closely controlled approach to development and management of world fisheries is still required (Box 2). As reported in *The State of World Fisheries and Aquaculture 2006*, the situation seems more critical for some highly migratory, straddling and other fishery resources that are exploited solely or partially in the high seas. An example highlighted in that earlier edition included the state of highly migratory oceanic sharks, with more than half of the stocks for which information is available being listed as overexploited or depleted. In the case of straddling stocks and of other high seas fishery resources, nearly two-thirds of the stocks for which the state of exploitation can be determined were classified as overexploited or depleted. These high seas fishery resources constitute only a small fraction of the world fishery resources, but they can be considered key indicators of the state of a major part of the ocean ecosystem. The United Nations Fish Stocks Agreement entered into force in 2001. It is providing a legal basis for management measures that are now being introduced and that are expected to benefit species fished on the high seas in the medium to long term. However, further rapid progress in implementation is necessary if the ocean ecosystem is to be safeguarded.

Inland fisheries

By landing more than 10 million tonnes in 2006, inland fisheries contributed 11 percent of global capture fisheries production. Although the amount may be small in comparison with marine fisheries, fish and other aquatic animals from inland waters remain essential and irreplaceable elements in the diets of both rural and urban people in much of the world, especially in developing countries. However, for demographic and cultural reasons, there are significant differences in the level of exploitation among the major geographical regions. Although global landings from inland fisheries have grown continuously, there are few examples of collapsing fisheries and a number of fish stocks, especially in Latin America, remain lightly exploited. Therefore, adopting a precautionary approach, the fisheries could be developed further.

Although statistics are improving in some countries, collecting accurate information on inland fisheries can be extremely costly. Moreover, many public administrations still do not collect such information or make assessments of the status of inland fishery resources. The very nature of inland fisheries makes assessment of their status extremely difficult. In addition, inland fisheries practised for sustenance or gain often take place in remote areas and are carried out by the poorer sectors of society. Catches are frequently not recorded by species or not recorded at all. Catch statistics are generally inadequate for use as a measure of stock status. Therefore, providing accurate statements on the status of inland fishery resources on a global or even regional level remains a challenge. Noting this and in order to enhance knowledge and awareness of the sector, FAO invited case studies of a number of inland fisheries in various parts of the world.[12] These studies were also meant to highlight some of the most crucial issues in ensuring the sustainability of such fisheries.

The five case studies presented below all confirm that inland fisheries are highly complex, and that, where ecosystem processes remain largely undisturbed, stock dynamics are basically controlled by environmental processes and factors external to the fisheries, such as natural fluctuations in climate or flood patterns. Often, the yields track intra-annual and interannual variations in nutrient inputs (whether natural or resulting from pollution), although response times depend on the life cycle of the fish. Therefore, the perception that fishing pressure is the only or main driver is mistaken; and fish stock assessments based on steady-state assumptions can be highly misleading, both in the interpretation of trends and in the use of fishery assessment models.

However, anthropogenic ecosystem impacts in the form of species introductions, pollution, habitat fragmentation and changes in the flood cycle reduce the resilience of fish stocks to fishing pressure, and the fisheries should be managed with this in mind.

Box 2

Reconciling conservation with fisheries

Is there a future for capture fisheries if we are to conserve aquatic ecosystems? Conversely, is there a future for capture fisheries if we do *not* conserve ecosystems? Can the social and economic goals of fishing be reconciled with the goal of conserving aquatic ecosystems? While in some arenas, fisheries and conservation may be seen as incompatible activities, it is widely recognized that both are fundamental elements of sustainable development. Capture fisheries are responsible for a significant share of the food supply for human consumption. They provide jobs and income for millions of people worldwide and have an important role in the economies of many countries (see Part 1 of this publication). Ensuring that the species and ecosystems that support these fisheries are maintained in healthy and productive states – in other words, that they are conserved – is essential if such benefits are to be sustained into the future.

Despite its social and economic importance, attempts to manage fisheries sustainably have been unsuccessful in many parts of the world due to several factors.[1] These management failures have given rise to widespread concerns, often accompanied by high-profile media reports, about the negative impacts of fisheries on marine ecosystems. In the eyes of many environmentalists and of public opinion in general, the overfishing of stocks, habitat modification resulting from destructive fishing practices, the incidental capture of endangered species and other impacts have made fisheries a primary culprit in an ecological crisis of global dimensions. While some of the claims have been exaggerated and some misleading, the underlying crisis is real and an urgent response is required at global level. However, in responding, there is a danger that the pendulum will swing too far in the opposite direction and, from an overemphasis on short-term social and economic goals, the long-term goals of conservation will become the only driving forces in the management of human impacts on aquatic ecosystems.

Many solutions to the ecological crisis have been proposed, including among them the banning of certain fishing practices, control of access to fisheries by global implementation of systems of access rights, greater use of positive incentives, regulation of trade in endangered species (e.g. through the Convention on International Trade in Endangered Species of Wild Fauna

That said, there are considerable opportunities to safeguard and enhance existing inland fisheries that provide food security for millions of people and to realize the potential for developing underexploited stocks. It is crucial that inland fisheries be integrated in natural resources management plans that cover all stakeholders who affect the quality or quantity of the water resources throughout the catchment basin concerned. Inland fisheries management needs an ecosystem approach, and this is particularly important in large catchment areas for large lakes and river systems. The values and benefits of inland fisheries would be increased and strengthened if these fisheries were recognized and protected through better governance and political will.

Africa – Lake Victoria

Lake Victoria, shared between Kenya, Uganda and the United Republic of Tanzania, is the second-largest lake in the world, covering an area of 68 000 km^2. In the mid-1980s, the lake's fish community and fishery changed drastically from being dominated by more than 200 endemic haplochromine species to a catch of basically three species:

and Flora, known as CITES) and the establishment of marine protected areas. All of these have roles to play in reconciling fisheries and conservation, but none of them would provide *the* solution if used in isolation. There is now broad agreement at the international policy level that the ecosystem approach to fisheries (EAF) is the appropriate and necessary framework for fisheries management. The EAF, which flows from and is consistent with the FAO Code of Conduct for Responsible Fisheries, is defined as an approach that "strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties of biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries". It addresses both human and ecological well-being and merges two paradigms – that of protecting and conserving ecosystems and that of fisheries management, which focuses on providing food, income and livelihoods in a sustainable manner.

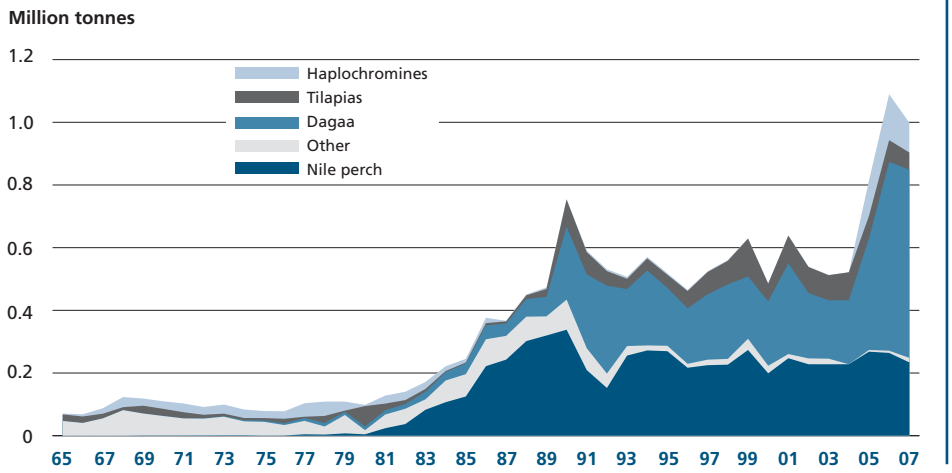
If, as is now widely recognized, the unsustainable use of aquatic ecosystems has its roots in ill-functioning institutions and communities, it is only to be expected that any solution to conservation will have to be: (i) socially acceptable and just; (ii) effective from both biodiversity and livelihood perspectives; and (iii) based on strengthened institutions at local and international levels. Therefore, the expanded objectives of the EAF will almost invariably require a diverse and comprehensive set of management tools in order to achieve the reconciled set of often conflicting goals. A common understanding of the concept is developing, and good progress has been made in incorporating the principles of EAF in policies at international and national levels. However, there is still much to do to make these principles operational in the practical management of fisheries.

[1] FAO. 2002. *Report and documentation of the international workshop on factors contributing to unsustainability and overexploitation in fisheries. Bangkok, Thailand, 4–8 February 2002*, edited by D. Greboval. FAO Fisheries Report No. 672. Rome.

the introduced Nile perch (*Lates niloticus*) and dagaa/omena (*Rastrineobola argentea*) in the open waters; and the introduced Nile tilapia (*Oreochromis niloticus*) along the shores (Figure 22). The endemic cichlids (haplochromines), that vanished almost completely as the fish community changed, have been reappearing in catches since 2000 and are probably recovering slowly. The inshore demersal species, originally mainly endemic tilapias (*Oreochromis esculentus, O. leucosticus* and *O. variabilis*), Nile catfish (*Bagrus docmac*), lungfish (*Protopterus aethiopicus*), the elephant-snout fish (*Mormyrus kanume*), and the ningu (*Labeo victorianus*), are all depleted, except the lungfish. Today, the Nile tilapia dominates, its abundance is increasing in surveys and it is considered moderately exploited. Dagaa stocks and catches have been increasing steadily. Since 2005, it has been the most important fishery in the lake by weight, but there are no signs of overexploitation. The economically most important Nile perch fishery supports an export industry worth some US$250 million per year. The status of this stock is controversial, but while many believe it is overfished, there are no objective data to support this claim.

Figure 22

Total annual catches in Lake Victoria 1965–2007 grouped into five main groups



Sources: J. Kolding, P. van Zwieten, O. Mkumbo, G. Silsbe and R. Hecky. 2008. Are the Lake Victoria fisheries threatened by exploitation or eutrophication? Towards an ecosystem based approach to management. *In* G. Bianchi and H.R. Skjoldal, eds. *The ecosystem approach to fisheries.* (in press). CABI Publishing; and Lake Victoria Fisheries Organization (unpublished data).

A recent analysis[13] has shown that the dynamics of fish production in Lake Victoria are, to a large extent, environmentally driven. Changes in land-use practices have led to an increased input of nutrients, resulting in a doubling in primary production since 1969, and providing the basis for the observed increase in fish production. However, eutrophication has also led to increases in fish kills and loss of habitat owing to deoxygenation. This poses a serious threat to the entire ecosystem.

Central Asia – Kyrgyzstan

The disintegration of the Soviet Union had a profound impact on the fisheries sector throughout Central Asia. Kyrgyzstan was one of the countries most severely affected. In 2004–06, its capture fisheries yield had dropped to only 3 percent of the level recorded in the early 1990s (Figure 23). All exploited fish stocks are in serious decline. In 2005, the naked osman (*Gymnodiptychus dybowskii*) and Issyk Kul marinka (*Schizothorax pseudoaksaiensis issykkuli*), two species that constituted an important part of the catch in the past, were recommended for inclusion in the Red Book of Kyrgyzstan.

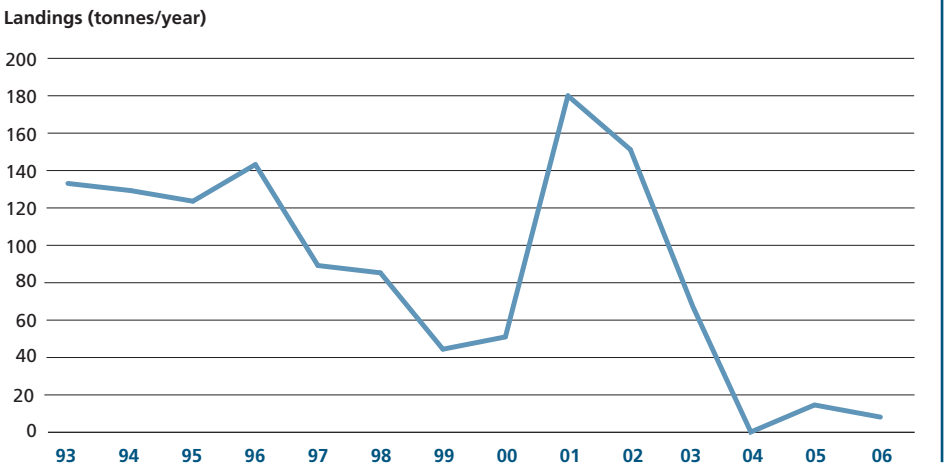
Most lakes in the country are oligotrophic with low fisheries yields. Therefore, since the 1930s, in an attempt to boost productivity, most lakes in the country have been intensively stocked with mainly exotic species, including also several predators. This has placed indigenous species under stress. In addition, illegal fishing is a serious problem – illegal catches are estimated to be several times higher than official catches. Fishing concessions have now been leased out to private entities, but short-term lease contracts have discouraged sustainable management of the resources. The authorities are addressing the issue, and the collapse of the fishery has led to a moratorium on fishing in the country's two largest lakes. However, recovery in the fish stocks is a long-term process and will depend on the implementation of new management measures.

Europe – Lake Constance

Lake Constance, shared by Austria, Germany and Switzerland, serves as a reservoir of potable water for more than 4 million people but also has an active fishery. Catch statistics have been collected on commercial fisheries since 1910, and yield statistics on angling since 1996. In 2006, about 140 commercial fishers caught 617 tonnes, of which

Figure 23

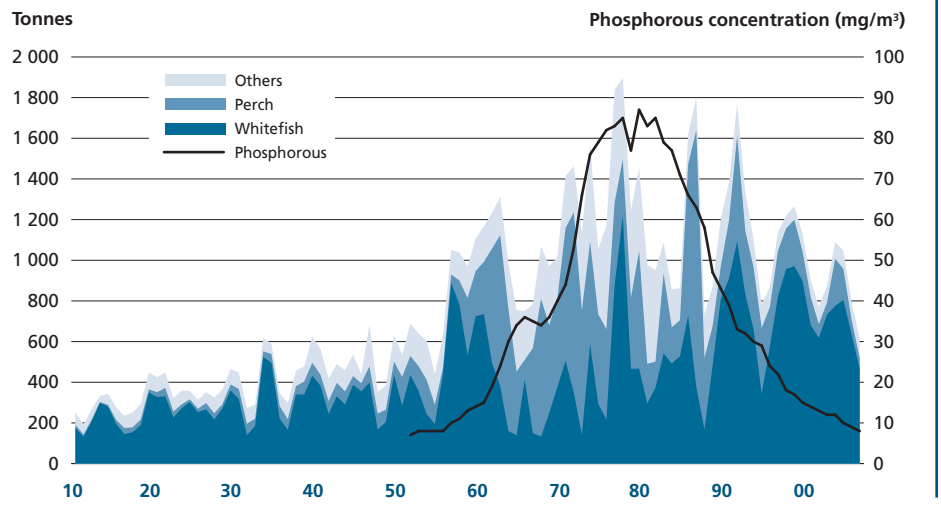
Landings from lakes in Kyrgyzstan 1993–2006



Source: FAO. 2008. *Capture fisheries and aquaculture in the Kyrgyz Republic: current status and planning,* by M. Sarieva, M. Alpiev, R. Van Anrooy, J. Jørgensen, A. Thorpe and A. Mena Millar. FAO Fisheries Circular No. 1030. Rome.

Figure 24

Landings from Lake Constance 1910–2006



Note: The line refers to phosphorous concentration in the water column.

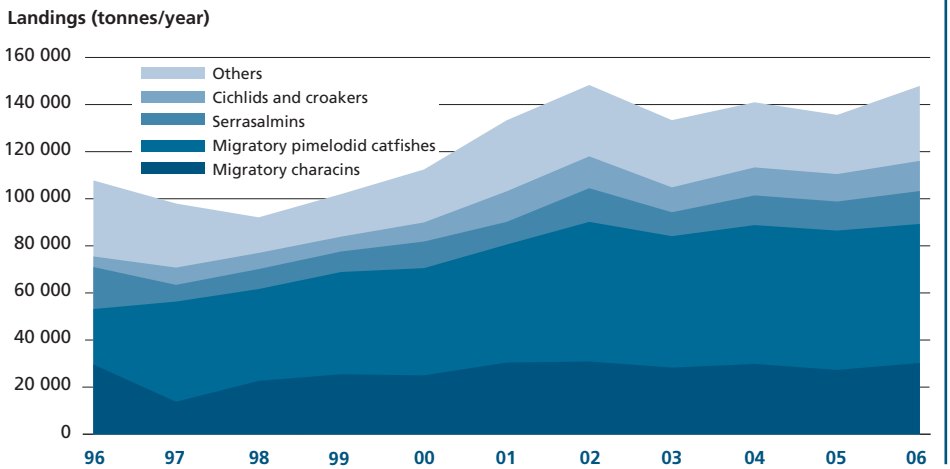
about 80 percent was whitefish (*Coregonus lavaretus*). Some 5 000 anglers caught 68 tonnes, mainly perch (*Perca fluviatilis*).

Until the 1960s, the oligotrophic lake supported a whitefish-dominated fishery. However, increasing eutrophication led to higher fish production but also changed catch composition. There was a drastic decline in whitefish yields, down to 20–30 percent of the total catch, while perch yields increased to about 50 percent at the time when the lake was most eutrophied (Figure 24).

In the last 30 years, intensive measures to reduce eutrophication have re-instated the lake's former oligotrophic state, reducing the total catch to the level before eutrophication while restoring the whitefish fishery, which again contributes about 80 percent of the annual yield.

Figure 25

Landings from commercial fisheries in the Brazilian Amazon 1996–2006



At present, whitefish and perch populations are fully exploited. Nearly all the individuals that can be caught by the gillnets allowed are taken. All other target species are only moderately exploited. Fishery management will need to adjust to lower yields, and the number of professional fishers may have to decrease further to ensure catches that will provide fishers with sufficient income.

Latin America – Amazon

The Amazon Basin covers 6.8 million km^2 and is shared by Bolivia, Brazil, Colombia Ecuador, Guyana, Peru and Venezuela (Bolivarian Republic of). The commercial capture fisheries in the Brazilian part of the basin are the most significant, contributing up to 17 percent[14] of total annual aquatic animal production in Brazil between 1996 and 2006. In that decade, the yield from these fisheries increased by 37 percent (Figure 25).

Most fish stocks (60 percent) are considered to be underexploited, while 30 percent are overexploited or recovering, including several large, slow-growing species such as tambaqui (*Colossoma macropomum*) and surubim (*Pseudoplatystoma* spp.) (Figure 26). Several medium-sized species including jaraqui (*Semaprochilodus* spp.) and curimatã (*Prochilodus nigricans*) are also showing signs of overfishing. The data on exploitation levels need to be interpreted with caution because environmental factors such as flood intensity overshadow the impact of the fishery, particularly for species with opportunistic life strategies and short life spans. High fishing pressure in combination with weak recruitment caused by unfavourable environmental conditions may lead to collapse. On the positive side, stocks of pirarucu (*Arapaima gigas*) and the large migratory catfish piramutaba (*Brachyplatystoma vailantii*) are now recovering. In the case of pirarucu, which became commercially extinct in the 1970s and completely disappeared in some areas, recovery can be related to the introduction of new community-based management practices.

Southeast Asia – Tonle Sap

The Mekong River Basin, shared by Cambodia, China, the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam, sustains the largest inland fisheries in the world, with an estimated annual catch of 2.6 million tonnes.[15] Contrary to popular belief, available data indicate that catches in the basin are larger than ever before. However, as the number of fishers is growing faster than the yield, the catch per fisher is declining.

The dai[16] fishery in the Tonle Sap River (a Cambodian tributary of the Mekong River) has been monitored since 1995. More than 200 species are known from the river, but this fishery is dominated by a small number of opportunistic cyprinids maturing at a small

Figure 26

Exploitation level of species in the commercial fisheries in the Brazilian Amazon, based on landing data 1996–2006

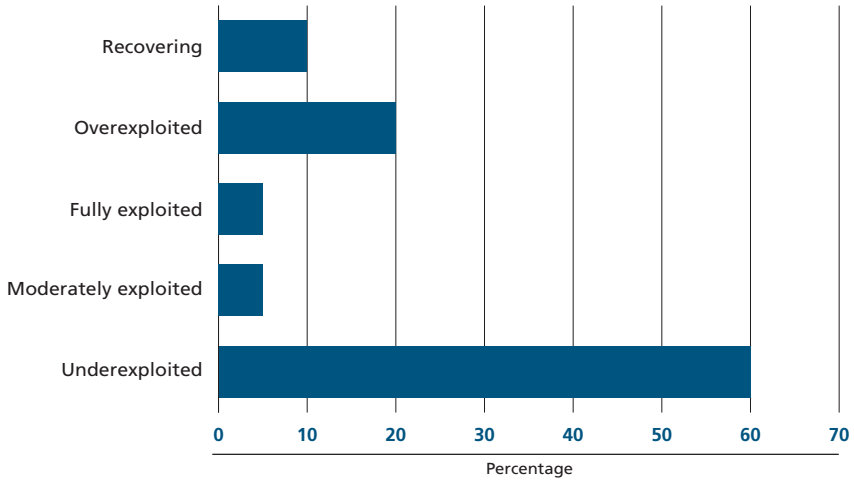
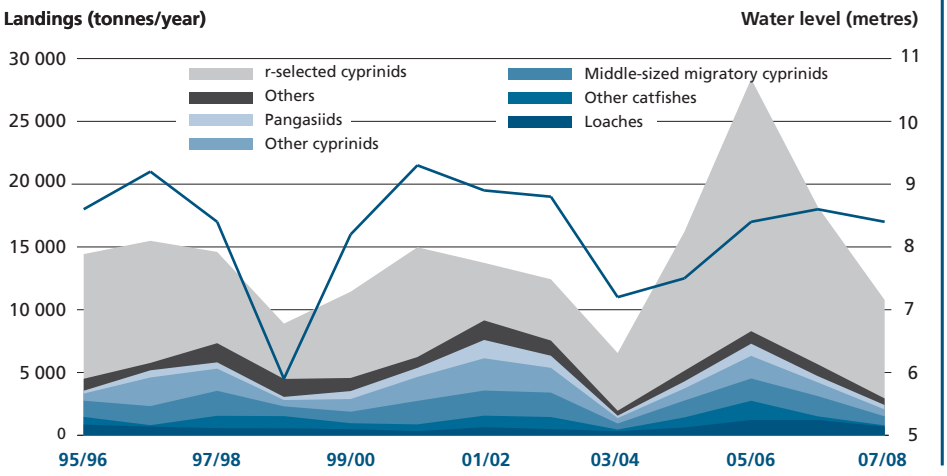


Figure 27

Landings from the dai fisheries of Tonle Sap by species groups 1995/96–2007/08



Note: The line refers to an index of the water level during peak flood.
Source: Data provided by Lieng Sopha and A. Halls, personal communication, 2008.

size (r-selected species), which in most years account for more than half of the catch (Figure 27). As these species are short-lived, they are recruited to the fisheries the year they hatch or the following year. When favourable conditions occur, which in general terms means a larger flood,[17] yield increases immediately. While the response time is longer for longer-living species, the same pattern can be seen for these, although they are also affected by other factors (including fishing mortality). While historical catch data indicate that larger and slower-growing species are less abundant than in the past, nothing in the available dataset points to any species being overexploited. Whether any population decline can be attributed to increased fishing pressure or a deteriorating environment (pollution, water abstraction, dam construction and flood protection) is debatable. However, habitat destruction and fragmentation as a consequence of dam construction are currently larger threats than fishing pressure to fish stocks.

Box 3

Fish utilization

An important feature of the fish-processing industry is that, while the operations are mostly small to medium scale, there is enormous diversity in the species of fish handled. For each type of processing, the fish can be prepared in several ways, from manual methods to fully automated operations, and then packaged in a wide variety of ways depending on the location and market demand. The various levels of progress and scales of operation available in the world increase the differences between species. What may be appropriate in an industrialized fishery is often not suitable for a small-scale artisanal fishery in a developing country. Furthermore, fish preservation and processing may vary according to species. Each of the many thousands of fish species has its own characteristic composition, size, shape and intrinsic chemistry. Fish is very perishable and several chemical and biological changes take place immediately after capture. Fish requires careful handling and preservation, special facilities such as cold storage and refrigerated transport, and rapid delivery to consumers. Therefore, the research and development of post-harvest systems for handling raw material are important to developing appropriate measures to: (i) increase its shelf-life; (ii) reduce physical, organoleptic (sensory) and nutritional losses; and (iii) preserve the quality and safety of the finished products. This is important for ecological, social and economic reasons – to safeguard consumer health and food security and to ensure the sustainability of the industry.

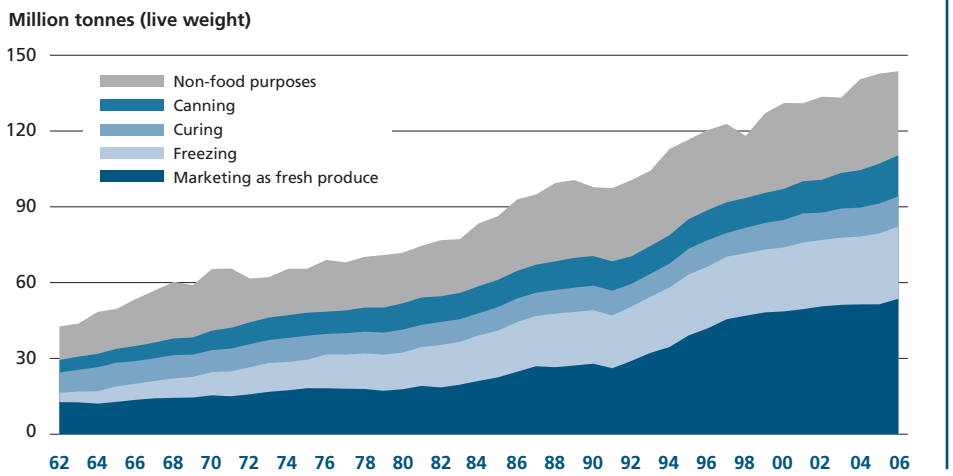
FISH UTILIZATION

In 2006, more than 110 million tonnes (77 percent) of world fish production was used for direct human consumption. Almost all of the remaining 33 million tonnes was destined for non-food products, in particular the manufacture of fishmeal and fish oil (see Table 1 on page 3). If China is excluded, the quantities were 72 million tonnes and 20 million tonnes, respectively (see Table 2 on page 4 and Figure 2 on page 5). In 2006, more than three-quarters of China's reported fish production was destined for human consumption, with the remaining amount (an estimated 13 million tonnes) reduced to fishmeal and allocated to other non-food uses, including direct feed for aquaculture. In China, aquatic products are traditionally most commonly distributed to the domestic market in live and fresh form. However, in recent years, processing has seen significant growth. For example, in 1996, total processed aquatic products for human consumption accounted for 20 percent of total domestic aquatic production, while in 2006 this share reached 33 percent. In the last few years, more value-added products have been made in China, including retail packs. China processes not only domestic production but also imported fish into an array of fish products, including salted, dried, smoked and various preserved fish products for both domestic and export markets. The Chinese reprocessing industry is labour-intensive and traditionally works on low margins, which have recently tended to narrow further with escalating costs for raw materials.

In 2006, 48.5 percent of the fish destined for human consumption was in live and fresh form, which is often the most preferred and highly priced product form. Fifty-four percent (77 million tonnes) of the world's fish production underwent some form of processing. Seventy-four percent (57 million tonnes) of this processed fish was used for manufacturing products for direct human consumption in frozen, cured and prepared or preserved form, and the rest for non-food uses (Box 3). Freezing is the main method

Figure 28

Utilization of world fisheries production (breakdown by quantity), 1962–2006



of processing fish for food use, accounting for 50 percent of total processed fish for human consumption in 2006, followed by prepared and preserved (29 percent) and cured fish (21 percent) (Figure 28).

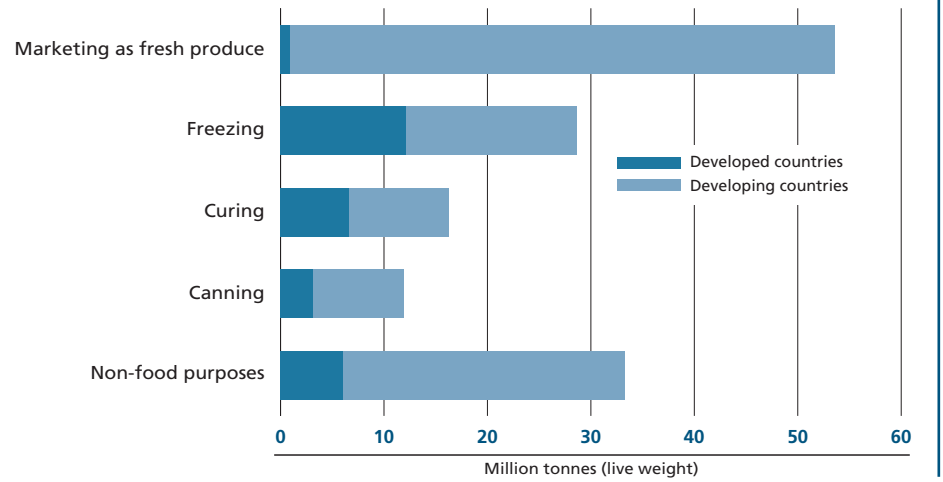
Fish is one of the most versatile food commodities and can be utilized in a great variety of ways and product forms. It is generally distributed as either live, fresh, chilled, frozen, heat-treated, fermented, dried, smoked, salted, pickled, boiled, fried, freeze-dried, minced, powdered or canned, or as a combination of two or more of these forms. However, fish can also be preserved by many other methods. The trade in live fish is special. In some parts of Southeast Asia, and particularly in China, the trade is not formally regulated but based on tradition. However, in markets such as the EU, the trade in live fish has to comply with requirements *inter alia* concerning animal welfare during transportation.

In many developing countries with tropical ambient temperatures, quality deterioration and significant post-harvest losses occur because of inadequate use of ice, long supply chains, poor access to roads and electricity, and inadequate infrastructure and services in physical markets. Market infrastructure and facilities are often limited and congested, increasing the difficulty of marketing perishable goods. Owing to these deficiencies, together with well-established consumer habits, fish production is utilized in such countries mainly in live/fresh form (representing 60.1 percent of fish destined for human consumption in 2006) or processed by smoking or fermentation (10.0 percent in 2006). However, in the last few years, there has been a slight increase in the share of frozen products in developing countries (19 percent in 2006, up 7.3 percent since 1996), with a more significant rise in prepared or preserved forms (11.1 percent in 2006, up 41 percent since 1996). In developed countries, the bulk of fish used for human consumption is in frozen and prepared or preserved forms. Freezing is still prominent as the primary form of production, with a proportion that has been constantly increasing, and it accounted for 42 percent of total production in 2006 (Figure 29). Processors of traditional products, in particular of canned products, have been losing market shares to suppliers of fresh and frozen products as a result of long-term shifts in consumer preferences.

The utilization and processing of fish production have diversified significantly in the last two decades, particularly into high-value fresh and processed products, fuelled by changing consumer tastes and advances in technology, packaging, logistics and transport. These changes include improvements in storage and processing capacity, together with major innovations in refrigeration, ice-making, and food-packaging and fish-processing equipment. Vessels incorporating these improved facilities and able to

Figure 29

Utilization of world fisheries production (breakdown by quantity), 2006



stay at sea for extended periods have been built. This has permitted the distribution of more fish in live or fresh form. Moreover, improved processing technology enables higher yields and results in a more lucrative product from the available raw material.

In developed countries, value-added innovation is mainly focused on increased convenience foods and a wider variety of high value-added products, mainly in fresh, frozen, breaded, smoked or canned form. These necessitate sophisticated production equipment and methods and, hence, access to capital. The resulting fish products are commercialized as ready and/or portion-controlled, uniform-quality meals.

In developing countries, and supported by a pool of cheaper labour, processing is still focused on less sophisticated methods of transformation, such as filleting, salting, canning, drying and fermentation. These traditional, labour-intensive fish-processing methods are a means for providing livelihood support for large numbers of people in coastal areas in many developing countries. For this reason, they are likely to continue to be important components in rural economies structured to promote rural development and poverty alleviation.

However, in many developing countries, fish processing is evolving. There is a trend towards increased processing. This may range from simple gutting, heading or slicing to more advanced value-addition, such as breading, cooking and individual quick-freezing, depending on the commodity and market value. Some of these developments are driven by demand in the domestic retail industry or by a shift in cultured species, for example, the introduction of *Penaeus vannamei* in Asia. These changes reflect the increasing globalization of the fisheries value chain, with the growth of international distribution channels controlled by large retailers. More and more producers in developing countries are being linked with, and coordinated by, firms located abroad. The increasing practice of outsourcing processing at regional and world levels is very significant, its extent depending on the species, product form, and cost of labour and transportation. For example, whole fish from European and North American markets are sent to Asia (China in particular, but also India and Viet Nam) for filleting and packaging, and then re-imported. In Europe, smoked and marinated products are being processed in Central and Eastern Europe, in particular in Poland and in the Baltic countries. The further outsourcing of production to developing countries is restricted specifically by sanitary and hygiene requirements that can be difficult to meet. At the same time, processors are frequently becoming more integrated with producers, especially for groundfish where large processors in Asia, in part, rely on their own fleet of fishing vessels. In aquaculture, large producers of farmed salmon, catfish and shrimp have established

advanced centralized processing plants to improve the product mix, obtain better yields and respond to evolving quality and safety requirements in importing countries. In many developed countries, processors are often facing reduced margins owing to increased competition from low-cost processors in developing countries. They are also experiencing increasing problems linked to the scarcity of domestic raw material because of declining stocks and the need to import fish for their business.

Fish plays an important role not only in terms of its use for direct human consumption but also in the production of animal feeds, particularly fishmeal. About one-quarter of world fish production is destined for non-food products, with the bulk being converted into fishmeal and fish oil. The remainder, mainly consisting of low-value fish, is largely utilized as direct feed in aquaculture and livestock. In 2006, the quantity of fish used as raw material for fishmeal was about 20.2 million tonnes, down 14 percent on 2005 and still well below the peak levels of more than 30 million tonnes recorded in 1994. The decrease in fishmeal production in the past decade has been irregular, its considerable fluctuations mainly reflecting annual variations in catches of small pelagics, especially anchoveta.

Another emerging application of fish, crustaceans and other marine organisms is as a source of bioactive molecules for the pharmaceutical industry. Chitin from shrimp and crab shells is already being used in the pharmaceutical industry. Chitin and chitosan have wide-ranging applications in many areas such as water treatment, cosmetics and toiletries, food and beverages, agrochemicals and pharmaceuticals. Japan is the largest market (20 000 tonnes) for chitin-derived products. Biomedical products from wastes derived from the fish-processing industry (e.g. skin, bones and fins) are attracting considerable attention from industry. Fish skin as a source of gelatine has attracted interest after bovine spongiform encephalopathy (BSE) and some religious requirements prompted a search for alternatives to mammalian sources of gelatine. It is estimated that about 2 500 tonnes of fish gelatine was produced in 2006. Similarly, fish collagen has advantages over bovine collagen in the pharmaceutical industry. Carotenoids and astaxanthins are pigments that can be extracted from crustacean wastes, and the pharmaceutical industry is now showing interest in seafood processing waste as a source of these important molecules. Fish silage and fish protein hydrolysates obtained from fish viscera are finding applications in the pet feed and the fish feed industries. A number of anticancer molecules have been discovered following research on marine sponges, bryozoans and cnidarians. However, following their discovery, for reasons of sustainability, these molecules are not extracted from marine organisms directly, but are chemically synthesized. Another approach being researched is aquaculture of some sponge species.

FISH TRADE AND COMMODITIES

In addition to its contribution to economic activity, employment and in generating foreign exchange, trade in fish and fishery products plays an important role in improving food security and contributes to fish products meeting nutritional needs. Fish and fishery products are highly traded with more than 37 percent (live weight equivalent) of total production entering international trade as various food and feed products (Figure 30). A specific feature of the trade in fish is the wide range of product types and participants. In 2006, 194 countries reported exports of fish and fishery products. World exports of fish and fishery products reached US$85.9 billion in 2006. This represented an increase of 9.6 percent on 2005 and of 62.7 percent on 1996 (Figure 31). Export value expanded at an average annual rate of 5 percent in the period 1996–2006. In real terms (adjusted for inflation), exports of fish and fishery products increased by 32.1 percent in the period 2000–06, by 26.6 percent in 1996–2006 and by 103.9 percent between 1986 and 2006. In terms of quantity (live weight equivalent), exports peaked at 56 million tonnes in 2005, with a growth of 28 percent since 1995 and of 104 percent since 1985. In 2006, exports decreased by 4 percent to 54 million tonnes. However, this decrease was due to reduced production and trade in fishmeal. In fact, exports of fish for human consumption rose a further

Figure 30

World fisheries production and quantities destined for export

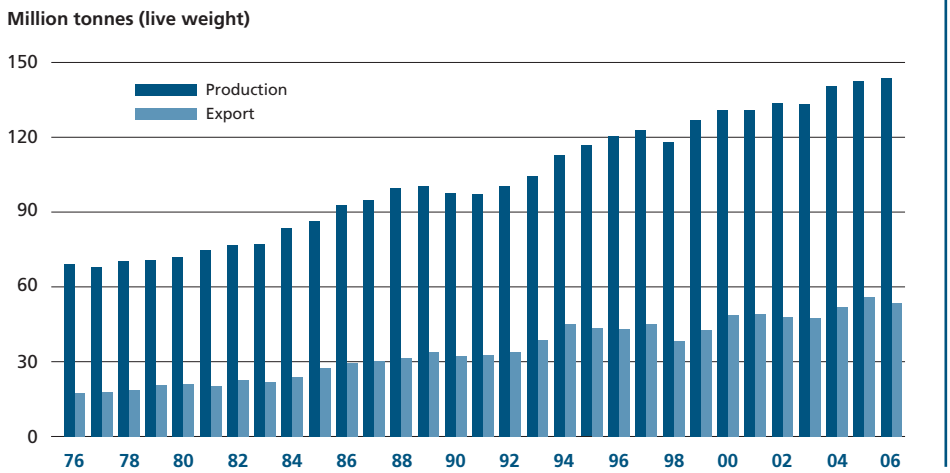
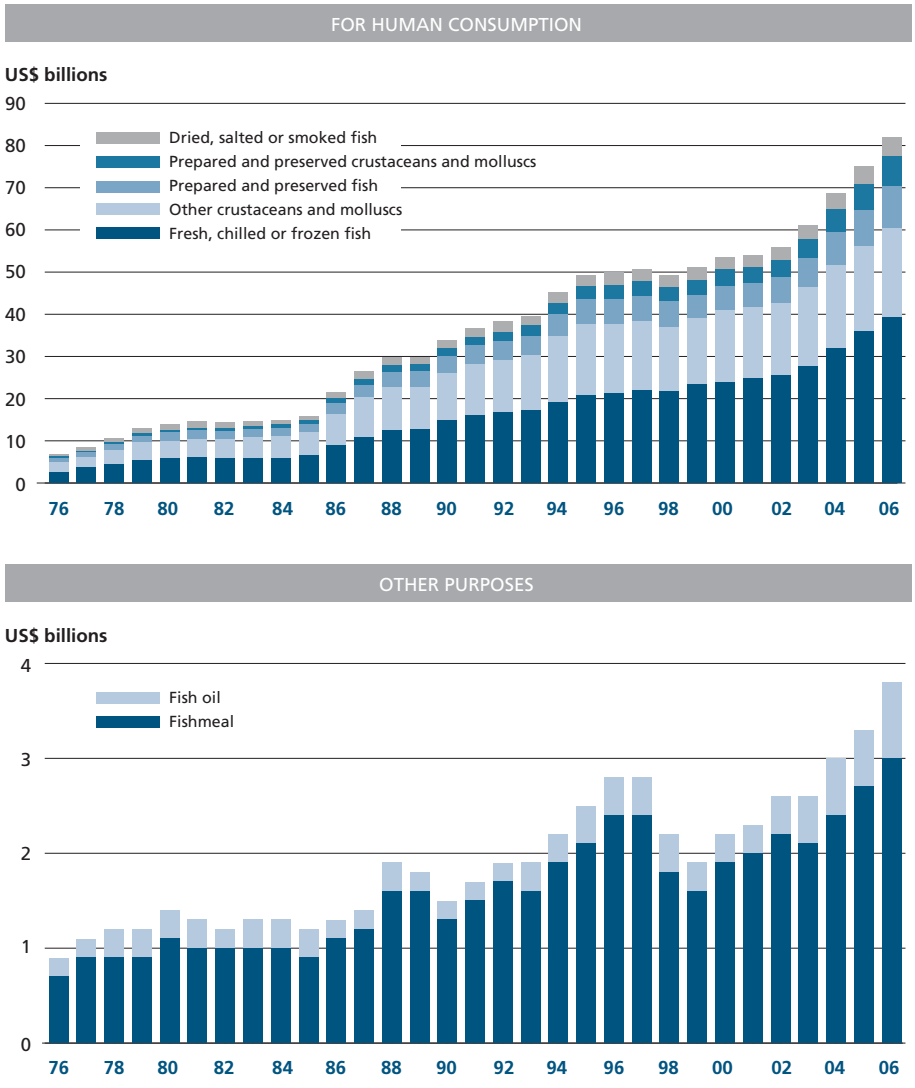


Figure 31

World fishery exports by major commodity groups



5 percent compared with the previous year and have increased by 57 percent since 1996. Available data for 2007 indicate further strong growth to about US$92 billion. However, some weakening in demand was registered in late 2007 and early 2008 as turmoil in the financial sector started to affect consumer confidence in major markets. This is expected to influence discretionary spending and sales of higher-value items in the short term. However, the long-term trend for trade in fish is positive, with a rising share of production from both developed and developing countries reaching international markets.

The growing exports of the last few years reflect the increase in consumption of fish and fishery products not only in the EU and the United States of America but in many other regions of the world, including Asia (with the notable exception of Japan). Furthermore, progress in processing, packaging, handling and transportation has enabled more rapid and efficient trade. Rising trade quantities (except for fishmeal) and values reflect the increasing globalization of the fisheries value chain, with the outsourcing of processing to other countries. At the same time, the growth of international and global distribution channels through large retailers has furthered this development.

In 2006, increased fishery exports coincided with an impressive global trade expansion, caused mainly by the increase in global economic activity. In its *World Trade Report 2007*, WTO indicated that all major regions recorded gross domestic product (GDP) growth outpacing population growth and that global GDP growth had accelerated to 3.7 percent, the second-best performance since 2000.[18] According to the UN Comtrade database, real merchandise export growth grew by 13.4 percent in 2006 compared with 2005, and well above the average annual rate of 8.7 percent in 1996–2006. An important factor was also the influence exerted by price movements and exchange rates on trade flows, in particular as a consequence of the weaker US dollar (which is used to denominate many commodity prices) and the marked appreciation of several currencies (especially European ones) against it. Since 2004, prices of various agricultural commodities (particularly of basic foods) have rebounded after a prolonged period of decline. They rose sharply in 2006, and some have been rising at an even faster pace since then. High feed prices have also raised costs for animal production and resulted in an increase in livestock prices. A series of long- and short-term factors have contributed to this growth. They include the tightening in own supplies, the intertwining of global markets, exchange rates, rising crude oil prices and freight rates. Prices of fishery products followed the general upward trend of all food prices in the course of 2007 and early 2008. This is the first time in decades that real prices of fish have been rising. Prices for species from capture fisheries are increasing more than those of farmed species because of the larger impact from higher energy prices on fishing vessel operations than on farmed species. However, aquaculture is also experiencing higher costs, in particular for feed. For more information on this issue, see Box 14 (page 160).

Table 8 shows the top ten exporters and importers of fish and fishery products in 1996 and 2006. Since 2002, China has been the world's largest exporter of fish and fishery products. In the last few years, it has further consolidated its leading position. In 2006, its exports reached US$9.0 billion, and they grew further to US$9.3 billion in 2007. Despite this, fishery exports represented only 1 percent of its total merchandise exports in 2006 and 2007. China's fishery exports have increased remarkably since the early 1990s. This increase is linked to its growing fishery production, as well as the expansion of its fish-processing industry, reflecting competitive labour and production costs. In addition to exports from domestic fisheries production, China also exports reprocessed imported raw material, adding considerable value in the process. China has experienced a significant increase in its fishery imports in the past decade. In 2006, it was the sixth-largest importer with US$4.1 billion, and imports reached US$4.5 billion in 2007. This growth has been particularly noticeable since the country's accession to the WTO in late 2001, as a consequence of which it lowered import duties, including those on fish and fishery products. The growth in imports is partly a result of the above-mentioned imports by China's processors of raw material for reprocessing and export. However, it also reflects China's growing domestic consumption of species, mainly of high value, that are not available from local sources.

Table 8
Top ten exporters and importers of fish and fishery products

	1996	2006	APR
	(US$ millions)		(Percentage)
EXPORTERS			
China	2 857	8 968	12.1
Norway	3 416	5 503	4.9
Thailand	4 118	5 236	2.4
United States of America	3 148	4 143	2.8
Denmark	2 699	3 987	4.0
Canada	2 291	3 660	4.8
Chile	1 698	3 557	7.7
Viet Nam	504	3 358	20.9
Spain	1 447	2 849	7.0
Netherlands	1 470	2 812	6.7
TOP TEN SUBTOTAL	23 648	44 072	6.4
REST OF WORLD TOTAL	29 139	41 818	3.7
WORLD TOTAL	**52 787**	**85 891**	**5.0**
IMPORTERS			
Japan	17 024	13 971	–2.0
United States of America	7 080	13 271	6.5
Spain	3 135	6 359	7.3
France	3 194	5 069	4.7
Italy	2 591	4 717	6.2
China	1 184	4 126	13.3
Germany	2 543	3 739	3.9
United Kingdom	2 065	3 714	6.0
Denmark	1 619	2 838	5.8
Republic of Korea	1 054	2 729	10.0
TOP TEN SUBTOTAL	41 489	60 534	3.8
REST OF WORLD TOTAL	11 297	25 357	8.4
WORLD TOTAL	**52 787**	**85 891**	**5.0**

Note: APR refers to the average annual percentage growth rate for 1996–2006.

In addition to China, other developing countries play a major role in the fishery industry. In 2006, 79 percent of world fishery production took place in developing countries. Their exports represented 49 percent (US$42.5 billion) of world exports of fish and fishery products in value terms and 59 percent (31.6 million tonnes in live weight equivalent) in terms of quantity. An important share of their exports consisted of fishmeal (35 percent by quantity, but only 5 percent by value). In 2006, in terms of quantity, developing countries contributed 70 percent of world non-food fishery exports. Developing countries have also significantly increased their share of the quantity of fish exports destined for human consumption, from 43 percent in 1996 to 53 percent in 2006. The fishery industries of developing countries rely heavily on the markets of developed countries, not only as outlets for their exports, but also as suppliers of their imports for local consumption (mainly low-priced, small pelagics as well as high-value fishery species for emerging economies) or for their processing industries. In 2006, in value terms, 40 percent of the imports of fish and fishery products by developing countries originated from developed countries. In fact, owing to the above-mentioned phenomenon of outsourcing, several developing countries are

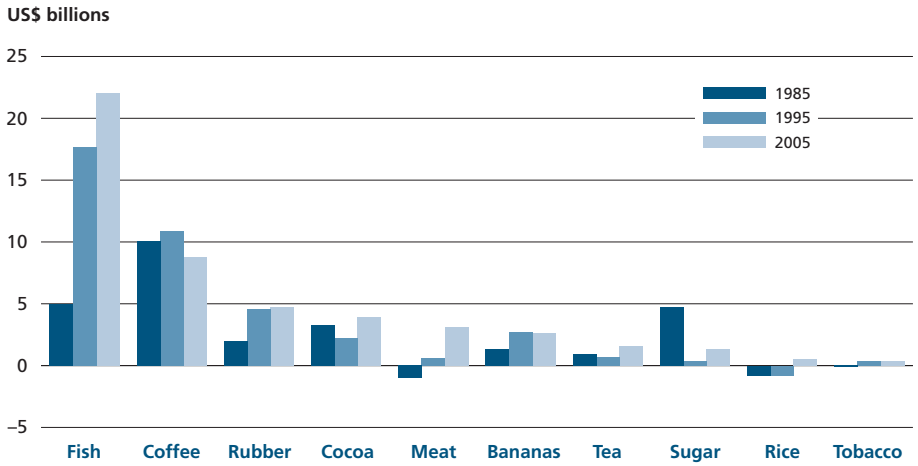
importing an increasing quantity of raw material for further processing and re-export to developed countries. Fishery exports of developing countries are gradually evolving from raw material for the processing industry in developed countries to value-added products and also high-value live fish. In 2006, in value terms, 75 percent of the fishery exports of developing countries were destined for developed countries. A share of these exports consisted of processed fishery products prepared using imported fish. Fishmeal was the only product for which exports from developing countries to other developing countries (58 percent of the total) were more important than exports to developed countries. This is mainly due to the significant aquaculture production in many developing countries and the resulting need for feed.

Fishery net exports (i.e. the total value of their exports less the total value of their imports) continue to be of vital importance to the economies of many developing countries (Figure 32). They have increased significantly in recent decades, growing from US$1.8 billion in 1976 to US$7.2 billion in 1984, to US$16.7 billion in 1996 and reaching US$24.6 billion in 2006. The low-income food-deficit countries (LIFDCs) play an active and growing role in the trade in fish and fishery products. In 1976, their exports accounted for 10 percent of the total value of fishery exports. This share expanded to 12 percent in 1986, 17 percent in 1996 and 20 percent in 2006, when their fishery exports were US$17.2billion and their fishery net export revenues were an estimated US$10.7 billion.

In 2006, world fish imports[19] reached a new record high of US$89.6 billion, an increase of 10 percent on the previous year, and of 57 percent since 1996. Preliminary data suggest that world imports of fish and fishery products totalled about US$96 billion in 2007. All major importing markets, except Japan, further increased the value of their imports of fish and fishery products, with the EU experiencing a significant 12-percent rise. Japan, the United States of America and the EU are the major markets, with a total share of 72 percent of the total import value in 2006. In total, developed countries accounted for 80 percent of imports in terms of value but only 62 percent in terms of quantity (live weight equivalent), indicating the higher unit value of products imported by developed countries. With stagnant domestic fishery production and growing demand, developed markets have to rely on imports and/or on aquaculture to cover a growing share of internal consumption. This is also the main reason why import tariffs in developed countries are so low and, albeit with a few exceptions (such as for some value-added products), do not represent any significant barrier to increased trade. As a result, in recent decades, fishery products from

Figure 32

Net exports of selected agricultural commodities by developing countries



developing countries have been able to gain increased access to developed-country markets without facing prohibitive custom duties. In 2006, about 50 percent of the import value of developed countries originated from developing countries. At present, rather than import tariffs, the principal barrier to increased exports from developing countries (beyond the physical availability of product) is the lack of ability to adhere to quality- and safety-related import requirements. Furthermore, they are also hindered by importing countries' increasing requirements that production processes respect animal health, environmental standards and social concerns. Not only is the emerging dominance of large retail and restaurant chains in seafood distribution and sales shifting negotiating power towards the final stages in the value chain, retailers are also increasingly imposing private- or market-based standards and labels on developing-country exports. This is making it more difficult for small-scale fish producers to enter international markets and distribution channels.

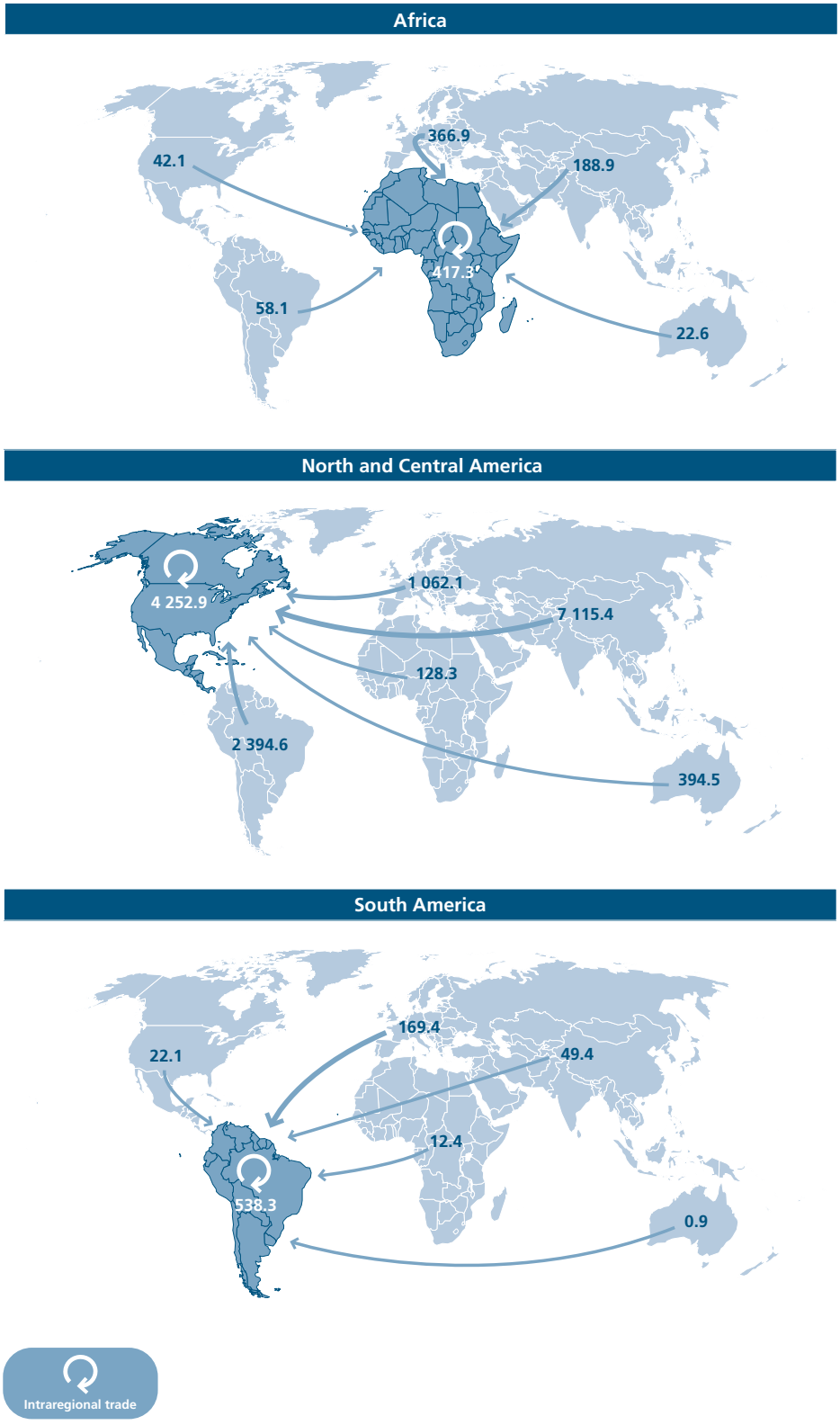
The maps in Figure 33 indicate trade flows of fish and fishery products by continent for the period 2004–06. However, the overall picture presented by these maps is not complete as information is not available for all countries. For example, about one-third of African countries did not report their trade in fishery products by country of origin or destination. However, the quantity of data available is sufficient to establish general trends. The Latin America and the Caribbean region holds a strong positive net fishery exporter position, as do the Oceania regions and the developing countries of Asia. Africa has been a net exporter since 1985, when the factory ships of the Soviet Union and Eastern Europe either stopped fishing or ceased landing massive quantities of inexpensive frozen pelagic fish in West Africa. Europe, Japan and North America are characterized by a fishery trade deficit (Figure 34).

In 2006, 97 countries were net exporters of fish and fishery products. In recent decades, there has been a tendency towards increased intensity of fishery trade within regions. Most developed countries trade more with other developed countries than with developing countries despite a growing share of fish consumption being covered by imports from developing countries. In 2006, some 85 percent (in value terms) of fishery exports from developed countries were destined to other developed countries, and about 50 percent of developed-country fishery imports originated in other developed countries. Intra-EU trade is particularly significant, with more than 84 percent of EU exports going to, and about 45 percent of imports coming from, other EU countries in 2006 and 2007. Trade in fish and fishery products among the more developed economies consists mainly of demersal species, herring, mackerel and salmon but also bivalves. In general, a significant share of trade among developed countries is of farmed origin.

The trade in fish between developing countries represents only 25 percent of the value of their fishery exports. This trade should increase in the future, partly as a result of the emergence of more liberal and effectively implemented regional trade agreements, and partly driven by the demographic, social and economic trends that are transforming food markets in developing countries. However, such trade is hampered by the fact that the majority of developing countries apply, in general terms, much higher import tariffs for all imported products than do developed countries. This is mostly to generate much-needed government revenue. Over time, the trade in fish and fish products between developing countries is likely to improve subsequent to a gradual trade liberalization and a reduction in import tariffs following the expanding membership of the WTO and the entry into force of a number of bilateral trade agreements with strong relevance to the trade in fish. With the accession of China and Viet Nam to the WTO (in 2001 and 2007, respectively), all the major fish producing, importing and exporting countries are now members of the organization, with the exception of the Russian Federation. The latter is a WTO observer and is involved in access negotiations, with the aim of becoming a full member within this decade. In addition to the member countries' individual commitments on import tariffs, the most important elements of the WTO agreements for trade in fish are those concerning subsidies, antidumping, technical barriers to trade (TBT), sanitary and phytosanitary standards, and dispute resolution.

Figure 33

Trade flows by continent (total imports in US$ millions, c.i.f.; averages for 2004–06)



(Continued)

Figure 33 *(cont.)*

Trade flows by continent (total imports in US$ millions, c.i.f.; averages for 2004–06)

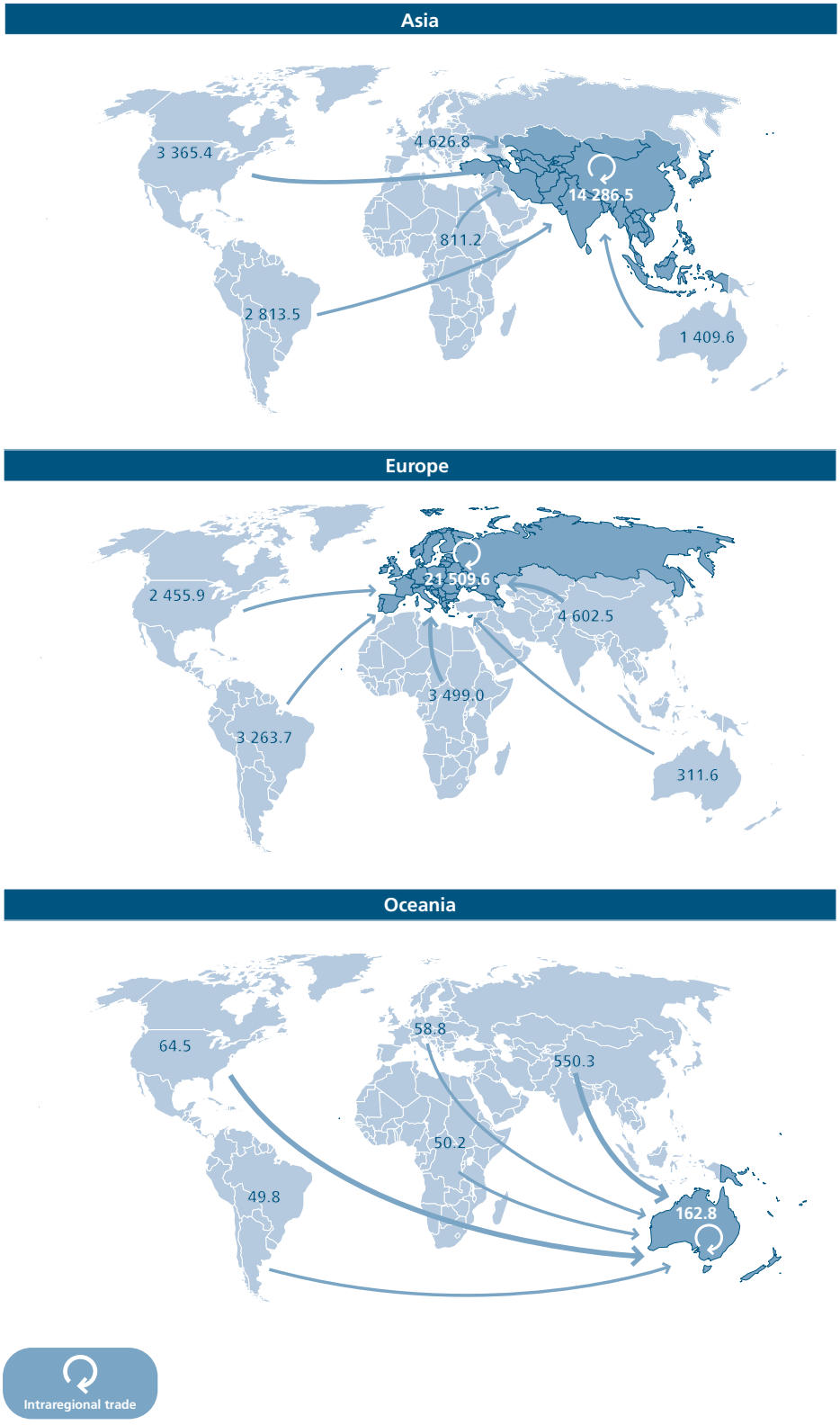
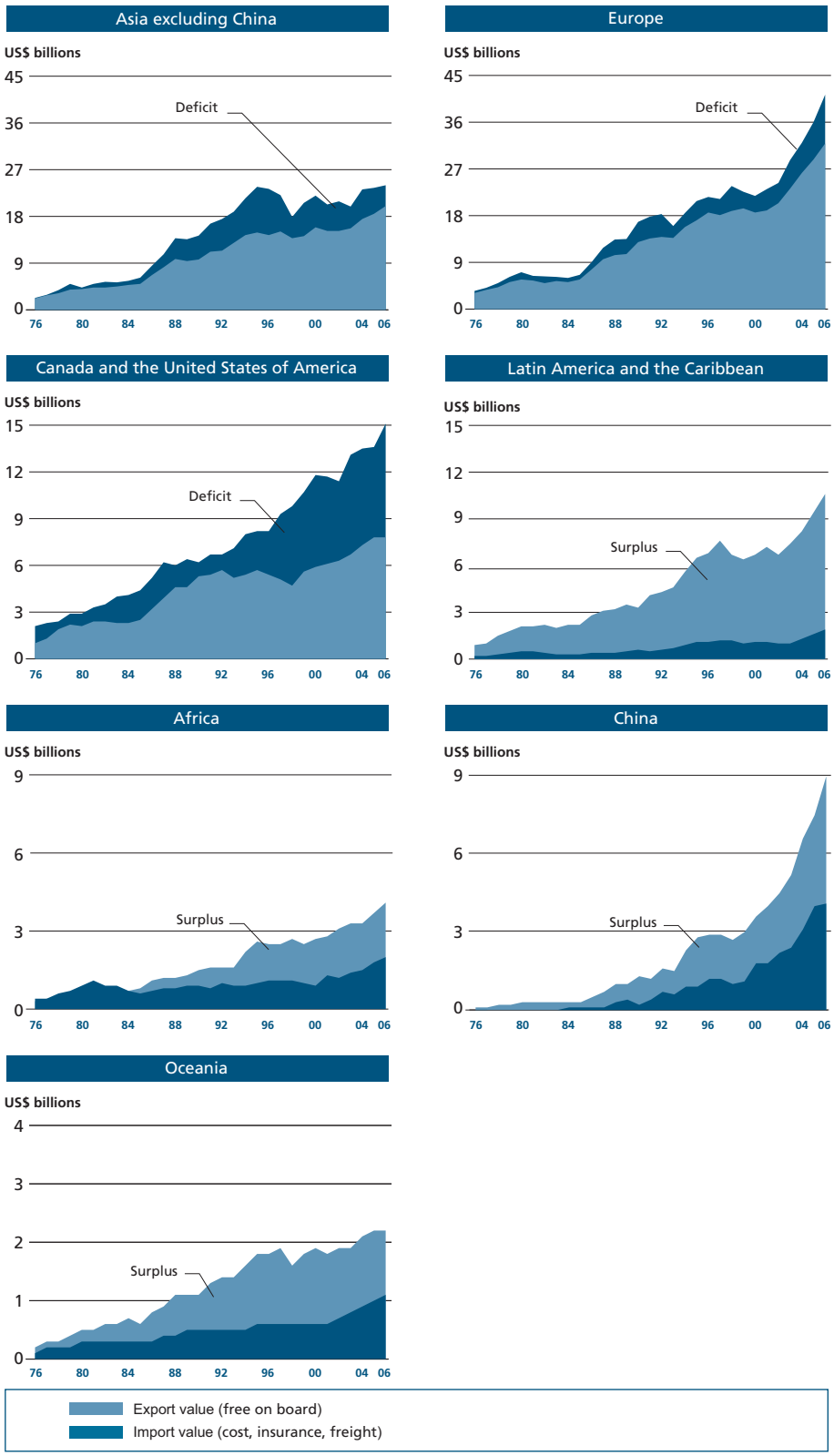


Figure 34

Imports and exports of fish and fishery products for different regions, indicating net deficit or surplus



Some of the major recent issues concerning international trade in fishery products have been:

- introduction by buyers and international retailers of private standards for food safety and quality, animal health, environmental sustainability and social purposes;
- continuation of trade disputes related to shrimp and salmon exports;
- the growing concern of the general public and the retail sector about overexploitation of certain fish stocks;
- the uptake of ecolabels by major retailers;
- certification of aquaculture in general and of shrimp in particular;
- the multilateral trade negotiations in the WTO;
- expansion of regional trade areas, and regional and bilateral trade agreements;
- the negotiations on economic partnership agreements between the African, Caribbean and Pacific Group of States and the EU;
- global warming and its impact on the fisheries sector;
- rising energy prices and their impact on fisheries;
- rising commodity prices in general and their impact on producers as well as consumers.

Commodities

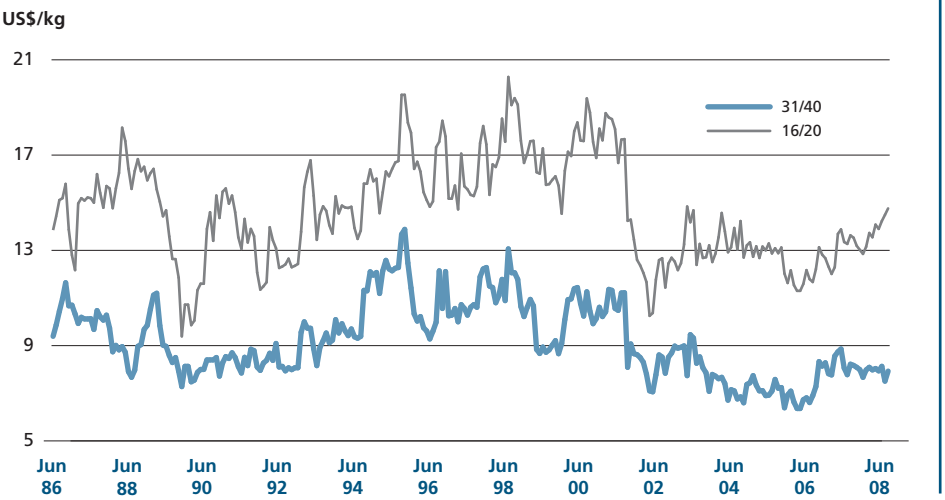
In world markets, the trade focus is mainly on high-value species, such as shrimp, salmon, tuna, gadiformes,[20] bass and bream. However, a number of high-volume but relatively low-value species are also traded in large quantities not only nationally and within major producing areas (such as Asia and South America) but also at the international level. Many of these species are farmed. With the tremendous growth in aquaculture production of the last few decades, the absolute and relative contribution of farmed products to international trade has also grown considerably. Many of the species that have registered the highest growth rates in the last few years are mostly destined for export. Export growth rates for species such as catfish and tilapia currently exceed 50 percent per year. These species are entering new markets where, only a few years ago, they were practically unknown. This highlights the potential for further growth in the production, trade and consumption of species and products that respond to consumers' needs for moderately-priced white-meat fillets and that, for the most part, are sold through the supermarket or food service channels. Many species, such as salmon, tuna and tilapia, trade increasingly in processed form (fillets or loins). However, trade in many aquaculture products is not yet well documented as the classification used internationally to record trade statistics for fish does not distinguish species between wild and those of farmed origin.

Owing to the high perishability of fish and fishery products, more than 90 percent of the quantity of international trade of fish and fishery products is conducted in processed form, albeit to varying degrees. In 2006, the share of live, fresh or chilled fish was 10 percent by quantity, but more than 18 percent by value. Live and fresh fish are valuable but difficult to trade and transport, and they are often subject to stringent health regulations and quality standards. Nonetheless, trade in live fish has increased in recent years as a result of technological developments, improved logistics and increased demand. International statistics on trade in live fish also include trade in ornamental fish, which is high in value terms but almost negligible in terms of quantity traded.

Exports of frozen fish have increased in the past decade, from 31 percent of the total quantity of fish exports in 1996 to 39 percent in 2006. Exports of prepared and preserved fish totalled 9.3 million tonnes (live weight equivalent) in 2006, representing 17 percent of total exports (10 percent in 1996). Exports of cured fish accounted for 5 percent of total exports in 2006, remaining rather stable in the last decade. In 2006, exports of non-food fishery products represented 29 percent of total fish exports in terms of quantity, a large proportion of which originated from South American countries.

Figure 35

Shrimp prices in Japan



Note: 16/20 = 16–20 pieces per pound; 31/40 = 31–40 pieces per pound.
Data refer to wholesale prices for black tiger, headless, shell-on shrimps. Origin: Indonesia.

Shrimp

Shrimp continues to be the largest single commodity in value terms, accounting for 17 percent of the total value of internationally-traded fishery products (2006). Despite growing export volumes, its share has been declining, with average prices showing a downward trend. In value terms, the major exporting countries are Thailand, China and Viet Nam. In 2007, shrimp imports were weaker in both the United States of America (the main shrimp importer) and Japan, whereas the EU consolidated its position as the leading shrimp market in the world. Apart from the United Kingdom, all major European countries experienced a stable or increasing trend for shrimp imports. Prices for cultured shrimp fell owing to softer demand, while prices for wild shrimp rose in early 2008 (Figure 35). With prices and margins under pressure, many producers of farmed shrimp are now looking into diversification and value-addition strategies in order to counter the price weakness, including cut-backs in output in order to stabilize prices.

Salmon

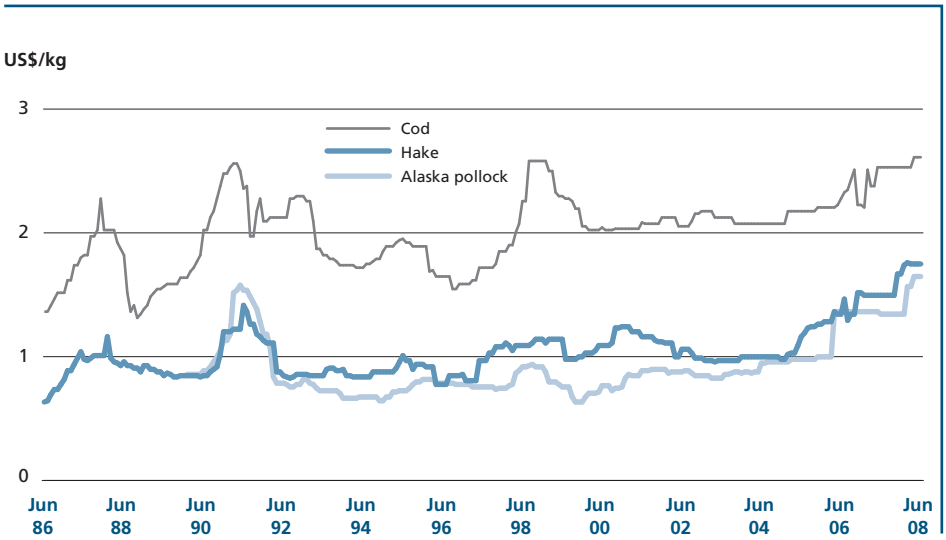
The share of salmon (including trout) in world trade has increased strongly in recent decades and now stands at 11 percent. This has been driven mainly by the strong growth in salmon and trout aquaculture in Northern Europe and in North and South America. Prices have oscillated in line with sudden shifts in supply, reaching record levels in 2006 but returning to more normal levels in 2007 and 2008. Industry concentration is enabling producers to benefit from economies of scale, in particular in the use of feed, but also in the handling of disease, a problem that has affected some of the larger companies. Demand for farmed salmon is firm, increasing steadily year by year, with new markets opening up in both developed, transition and developing countries. The increase in demand for farmed salmon is facilitated by the expansion of modern retail channels and the steady availability of product throughout the year.

Groundfish

Groundfish represented 10 percent of total fish exports (by value) in 2006. Globalization in the groundfish sector is evident with products processed in China and Viet Nam continuing to supply world markets. China consolidated its position in the cod and pollock fillet markets. In the United States of America, groundfish imports fell

Figure 36

Groundfish prices in the United States of America



Note: Data refer to c&f (cost and freight) prices for fillets.

as exporters preferred the "Euro area" (given the weak US dollar). Dollar weakness contributed to stable prices in local currency terms in key European frozen-fillet markets in 2007 (Figure 36). The relatively stable price situation was also helped by steady Alaska pollock supplies. Hake provisions from some origins (notably Argentina) were weaker than in 2006, influenced by buoyant regional demand in South America itself. The groundfish market is characterized by a high degree of substitution among the different groundfish species as well as with other species. Increasingly, the market for fillets is being supplied by freshwater species, such as tilapia, catfish and Nile perch. Annual farmed production of the first two species exceeds 2 million and 1 million tonnes, respectively. Tilapia has found a ready market in the United States of America, whereas catfish imports are growing rapidly in the EU, the Russian Federation, and the United States of America. Despite smaller quotas for a number of wild traditional groundfish species, the ample supply of ready substitutes from farmed sources has prevented prices from rising beyond certain levels.

Tuna

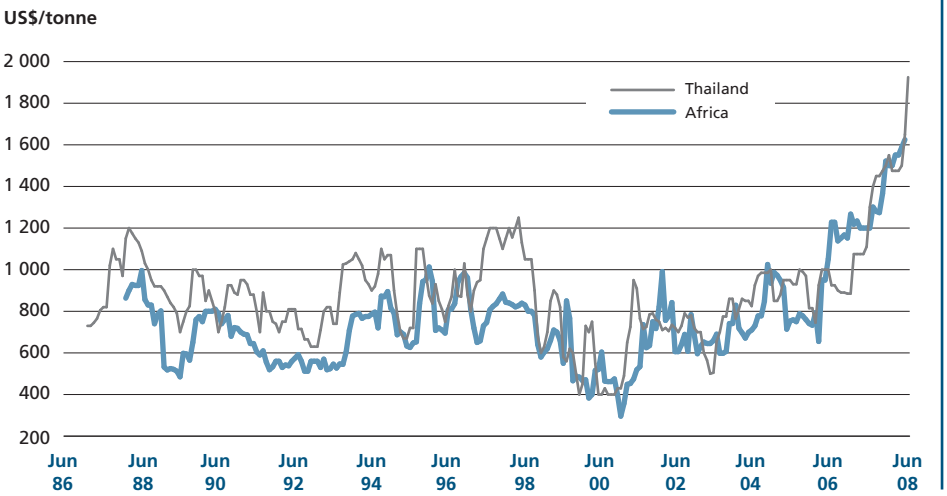
The share of tuna in total fish exports in 2006 was 8 percent. Tuna markets were rather unstable owing to large fluctuations in catch levels, and they declined in 2007. The main reason for this decline was the increased fuel price, which made long fishing trips uneconomical for the world tuna fleet. Prices increased in all main markets (Figure 37), and canned tuna prices soared for the first time in 20 years. Japan, the largest market for imported tuna, saw falling quantities in all categories. Import tariffs on tuna remain an important issue for both importers and exporters, as does the impact of preferential access for products from specific countries.

Cephalopods

The share of cephalopods in world trade in fish was 4.2 percent in 2006. Thailand is the largest exporter of squid and cuttlefish, followed by Spain, China and Argentina. Morocco is the principal octopus exporter. Spain, Italy and Japan are the largest importers of this species. Total annual catches of cephalopods are fairly stable at about 3.6–3.8 million tonnes. Squid prices plummeted in 2007 as traders in Argentina sold at prices much below those of the previous season. On the other hand, octopus production and trade declined in 2007 as a result of limited catches by the Mauritanian

Figure 37

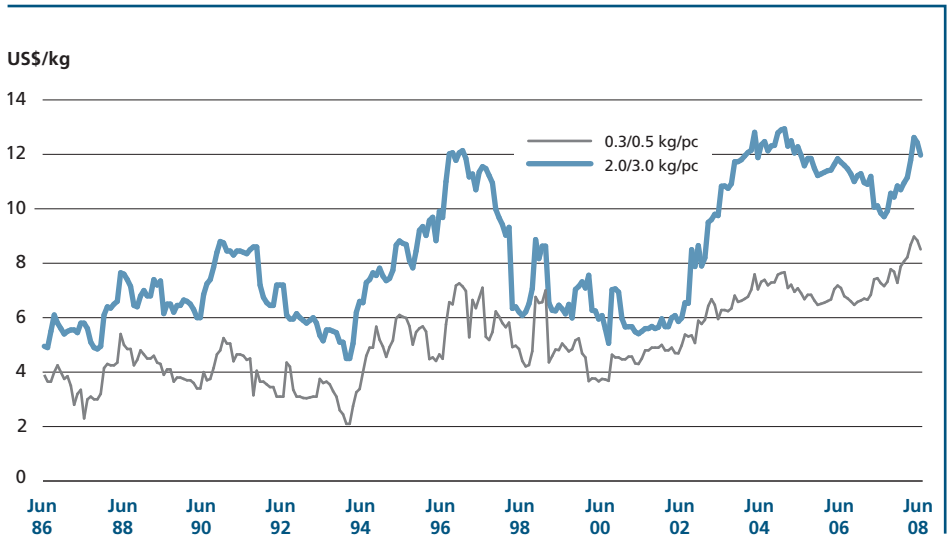
Skipjack tuna prices in Africa and Thailand



Note: Data refer to c&f (cost and freight) prices for 4.5–7.0 pounds of fish.
For Africa: ex-vessel Abidjan, Côte d'Ivoire.

Figure 38

Octopus prices in Japan



Note: kg/pc = kilograms per piece. Data refer to wholesale prices. Whole, 8 kg/block.

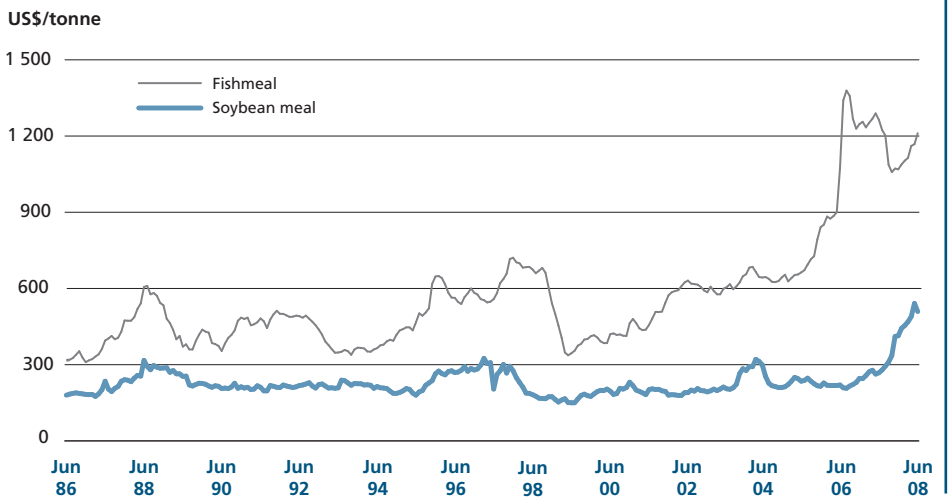
fleet. Demand for octopus in Japan improved, and lower imports resulted in an important price hike of US$2.00 per kilogram in the course of 2007 (Figure 38).

Fishmeal

In recent decades, fishmeal production has been remarkably stable at about 6 million tonnes (product weight), fluctuating between 5 million and 7 million tonnes depending on catch levels of anchovy off South America. Total fishmeal production of the main fishmeal exporters for 2007 reached 2.7 million tonnes, slightly below that of 2006. A significant reduction in anchovy catches off Peru in 2006 led to sharply higher

Figure 39

Fishmeal and soybean meal prices in Germany and the Netherlands



Note: Data refer to c.i.f. prices.
Fishmeal: all origins, 64–65 percent, Hamburg, Germany.
Soybean meal: 44 percent, Rotterdam, Netherlands.

Source: Oil World; FAO GLOBEFISH.

fishmeal prices in that year, but prices were rather stable in the course of 2007. In early 2008, fishmeal prices moved upwards again, and are likely to remain high, also in view of high vegetable meal prices (Figure 39). Of note is the large share of fishmeal now consumed by the aquaculture industry, estimated at 60 percent, with strong demand particularly in China. At the same time, the poultry industry has drastically reduced its fishmeal use.

Fish oil

Production of fish oil was relatively high in 2007. This resulted from the high fat content of the fish processed. In early 2008, fish-oil prices soared to an all-time record of US$1 700/tonne, compared with US$915/tonne one year earlier. Demand for fish oil for direct human use is boosting prices (Figure 40). For fish oil, the role of aquaculture is even greater than for fishmeal, with close to 85 percent of production consumed by the sector, and with salmonids responsible for more than 55 percent of the sector's share.

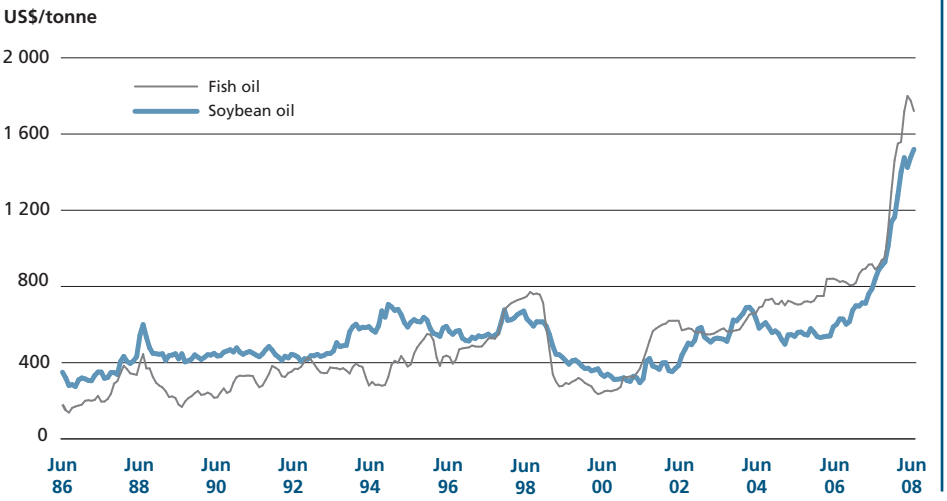
FISH CONSUMPTION[21]

Fish[22] consumption has undergone major changes in the past four decades. World apparent per capita fish consumption has been increasing steadily, from an average of 9.9 kg in the 1960s to 11.5 kg in the 1970s, 12.5 kg in the 1980s, 14.4 kg in the 1990s and reaching 16.4 kg in 2005. However, this increase has not been uniform across regions. In the last three decades, per capita fish supply has remained almost static in SSA. In contrast, it has risen dramatically in East Asia (mainly in China) and in the Near East/North Africa region. China has accounted for most of the world growth; its estimated share of world fish production increased from 21 percent in 1994 to 35 percent in 2005, when Chinese per capita fish supply was about 26.1 kg. If China is excluded, per capita fish supply is about 14.0 kg, slightly higher than the average values of the mid-1990s, and lower than the maximum levels registered in the 1980s (14.6 kg). Preliminary estimates for 2006 indicate a slight increase in global per capita fish supply to about 16.7 kg.

The global increase in fish consumption tallies with trends in food consumption in general. Per capita food consumption has been rising in the last few decades. Nutritional standards have shown positive long-term trends, with worldwide increases

Figure 40

Fish oil and soybean oil prices in the Netherlands



Note: Data refer to c.i.f. prices.
Origin: South America; Rotterdam, Netherlands.

Source: Oil World; FAO GLOBEFISH.

in the average global calorie supply per person and in the quantity of proteins per person. However, many countries continue to face food shortages and nutrient inadequacies, and major inequalities exist in access to food, mainly owing to very weak economic growth and rapid population expansion (Box 4). The majority of undernourished people in the world live in Asia and the Pacific, with the highest prevalence of undernourishment found in SSA.

There are large variations across countries and regions of the world in the amount of total fish supply for human consumption, reflecting different eating habits and traditions, availability of fish and other foods, prices, socio-economic levels, and seasons (Figure 41). Per capita apparent fish consumption can vary from less than 1 kg per capita in one country to more than 100 kg in another. Differences are also evident within countries, with consumption usually higher in coastal areas.

Of the 107 million tonnes available for human consumption in 2005 (Table 9), consumption was lowest in Africa (7.6 million tonnes, with 8.3 kg per capita), while Asia accounted for two-thirds of total consumption, of which 36.9 million tonnes were consumed outside China (13.9 kg per capita), with 33.6 million tonnes in China alone (26.1 kg per capita). The corresponding per capita consumption figures for Oceania, North America, Europe, Central America and the Caribbean, and South America were 24.5, 24.1, 20.8, 9.5 and 8.4 kg, respectively.

There are significant differences in fish consumption between the industrialized and the less-developed countries. In 2005, apparent fish consumption in industrialized countries reached 27.5 million tonnes (live weight equivalent), 14.2 million tonnes more than in 1961, for a growth in annual per capita consumption from 20.0 to 29.3 kg in the same period. The share of fish in total protein intake was 7.9 percent in 2005, back at the levels prevailing in the mid-1980s. The contribution of fish to total protein intake grew significantly in the period 1961–89 (between 6.5 and 8.6 percent), before gradually decreasing following the growth in consumption of other animal proteins. Since the early 1990s, the consumption of fish protein has remained relatively stable at about 8.2–8.6 g per capita per day, while the intake of other animal proteins has continued to grow.

In 2005, the average per capita apparent fish supply in developing countries was 14.5 kg, and 13.8 kg in LIFDCs. If China is excluded, these data become 10.6 and 8.3 kg,

Box 4

Fish and nutrition

Fish contributes to food security in many regions of the world, providing a valuable supplement for diversified and nutritious diets. Fish is highly nutritious. It provides not only high-value protein, but also represents an important source of a wide range of essential micronutrients, minerals and fatty acids. On average, fish provides about 20–30 kilocalories per person per day. It provides higher levels, up to 180 kilocalories per person per day, only in a few countries where there is a lack of alternative foods, and where a preference for fish has been developed and maintained (for example in Iceland, Japan and some small island developing states). The dietary contribution of fish is more significant in terms of animal proteins, which are a crucial component in some densely populated countries where total protein intake levels may be low. In fact, many populations, those in developing countries more than those in developed ones, depend on fish as part of their daily diets. For them, fish and fishery products often represent an affordable source of animal protein that may not only be cheaper than other animal protein sources, but preferred and part of local and traditional recipes. While the average per capita fish consumption may be low, even in small quantities fish can have a significant positive nutritional impact by providing essential amino acids that are often present only in low quantities in vegetable-based diets.

Table 9

Total and per capita food fish supply by continent and economic grouping in 2005

	Total food supply *(Million tonnes live weight equivalent)*	Per capita food supply *(kg/year)*
World	**107.0**	**16.4**
World excluding China	**73.4**	**14.0**
Africa	7.6	8.3
North and Central America	9.8	18.9
South America	3.1	8.4
China	33.6	26.1
Asia	70.5	17.9
Asia (excluding China)	36.9	13.9
Europe	15.2	20.8
Oceania	0.8	24.5
Industrialized countries	27.5	29.3
Economies in transition	4.1	12.3
LIFDCs (excluding China)	23.8	8.3
Developing countries excluding LIFDCs	17.6	16.2

respectively. Although consumption in LIFDCs excluding China has increased in the last four decades, and especially since the mid-1990s (+1.5 percent per year since 1995), the per capita fish intake is only half that of industrialized countries. Despite this relatively low level of fish consumption, the contribution of fish to total animal protein intake in 2005 was significant at about 20 percent. It may be higher than indicated by official statistics in view of the unrecorded contribution of subsistence fisheries. However, since 1975, when it peaked at 23.4 percent, this share has declined slightly notwithstanding the continued growth in fish protein consumption (from 2.0 to 2.5 g per capita per day in the period 1975–2005); this decline in relative share reflects the increased consumption of other animal proteins.

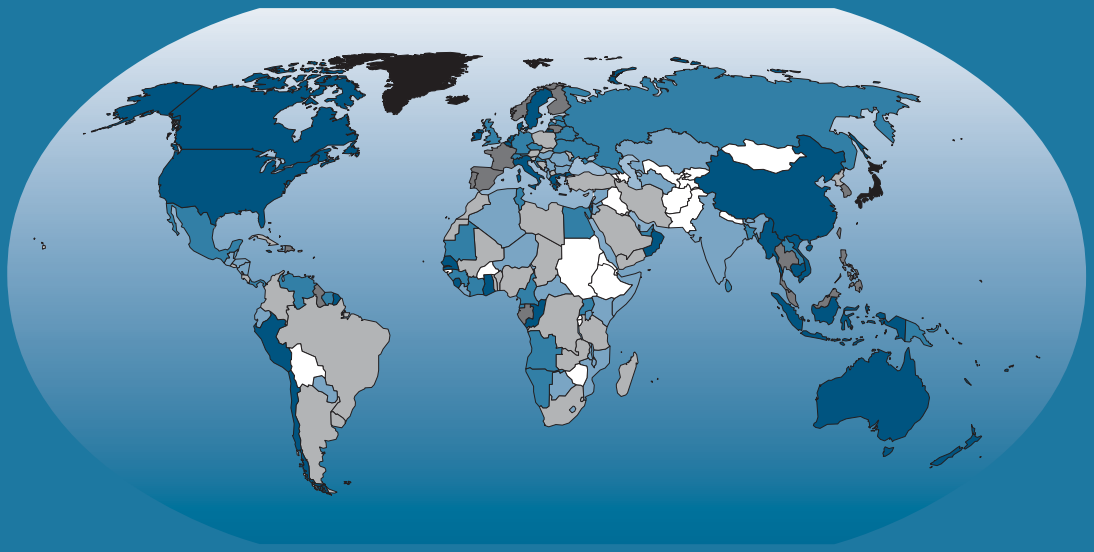
It is estimated that fish contributes to at least 50 percent of total animal protein intake in some small island developing states, as well as in Bangladesh, Cambodia, Equatorial Guinea, French Guiana, the Gambia, Ghana, Indonesia and Sierra Leone (Figure 42). The contribution of fish proteins to total world animal protein supplies rose from 13.7 percent in 1961 to a peak of 16.0 percent in 1996, before declining to 15.3 percent in 2005. Corresponding figures for the world, excluding China, show an increase from 12.9 percent in 1961 to 15.4 percent in 1989, then declining slightly to 14.7 percent in 2005. Figures for 2005 indicate that fish provided about 7.6 percent of animal protein in North and Central America and more than 11 percent in Europe. In Africa, it supplied about 19 percent, in Asia nearly 21 percent, in the LIFDCs including China about 19 percent and in the LIFDCs excluding China 20 percent. Globally, fish provides more than 1.5 billion people with almost 20 percent of their average per capita intake of animal protein, and nearly 3.0 billion people with 15 percent of such protein. Figure 43 presents the contributions of major food groups to total protein supplies.

Aquaculture production is playing an increasing role in satisfying demand for human consumption of fish and fishery products. In the past few years, major increases in the quantity of fish consumed have originated from aquaculture. The average contribution of aquaculture to per capita fish available for human consumption rose from 14 percent in 1986, to 30 percent in 1996 and to 47 percent in 2006, and it can be expected to reach 50 percent in the next few years. China is mainly responsible for this increase. In 2006, overall per capita fish supply from aquaculture was estimated at 7.8 kg, but it was 26.5 kg in China and only 3.3 kg for the world excluding China (Figure 44). However, the share of fish from aquaculture has increased steadily in the world excluding China, rising from 9 percent in 1986, to 15 percent in 1996 and 24 percent in 2006. Further growth in the availability of fish for human consumption is expected to come mainly from aquaculture. Aquaculture production has pushed the demand for and consumption of several freshwater species, such as tilapia and catfish (including *Pangasius* species) as well as for high-value species, such as shrimps, salmon and bivalves. Since the mid-1980s, these species have shifted from being primarily wild-caught to being primarily aquaculture-produced, with a decrease in their prices and a strong increase in their commercialization. Aquaculture has also had a major role in terms of food security in several developing countries, particularly in Asia, with significant production of some low-value freshwater species, which are mainly destined for domestic consumption.

Fish consumption differs among countries, and within countries it differs among segments of society. These differences reflect *inter alia* consumer preferences, availability, product developments, prices and levels of disposable income. Demersal fish are among the main species preferred by consumers in Northern Europe and in North America, whereas cephalopods are mainly consumed in Mediterranean and Asian countries. The consumption of crustaceans, being high-priced commodities, is concentrated mainly in affluent economies. However, as a result of the increased production of shrimps and prawns from aquaculture and the consistent decrease in their price, per capita availability of crustaceans increased more than threefold, from 0.4 to 1.6 kg between 1961 and 2005. The same reasons hold for molluscs (excluding cephalopods), whose availability increased from 0.6 to 2.0 kg per capita. The other

Figure 41

Fish as food: per capita supply (average 2003–2005)

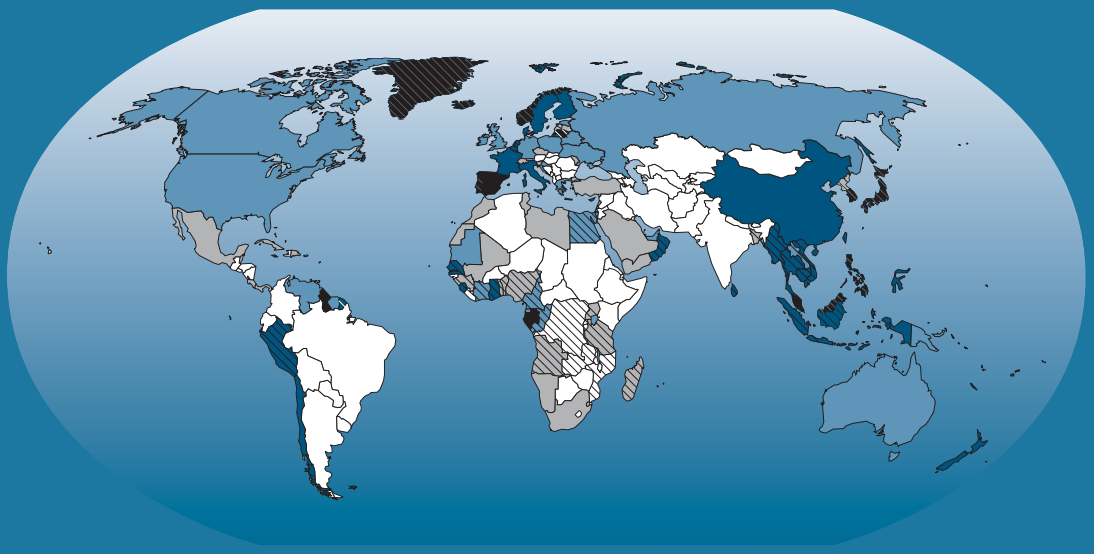


Average per capita fish supply (in live weight equivalent)

0–2 kg/year
2–5 kg/year
5–10 kg/year
10–20 kg/year
20–30 kg/year
30–60 kg/year
> 60 kg/year

Figure 42

Contribution of fish to animal protein supply (average 2003–2005)



Fish proteins (per capita per day)

< 2 g
2–4 g
4–6 g
6–10 g
> 10 g

Contribution of fish to animal protein supply

> 20%

Figure 43

Total protein supply by continent and major food group (2003–05 average)

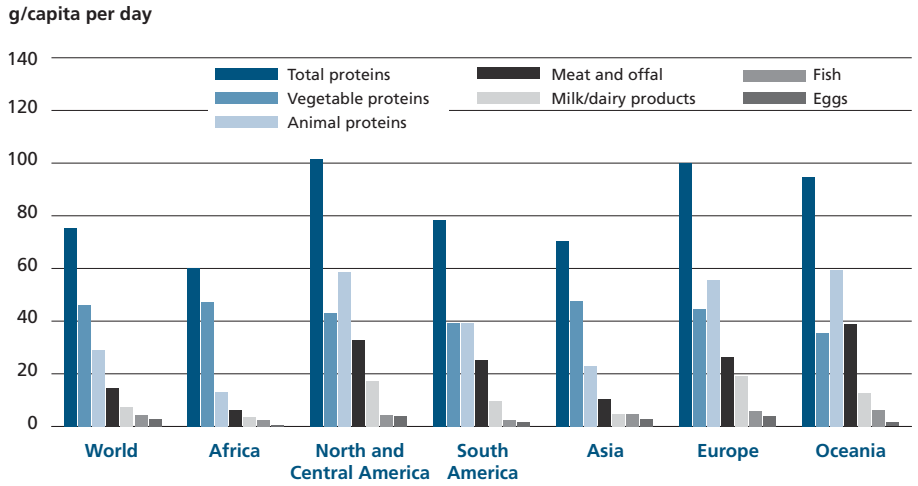
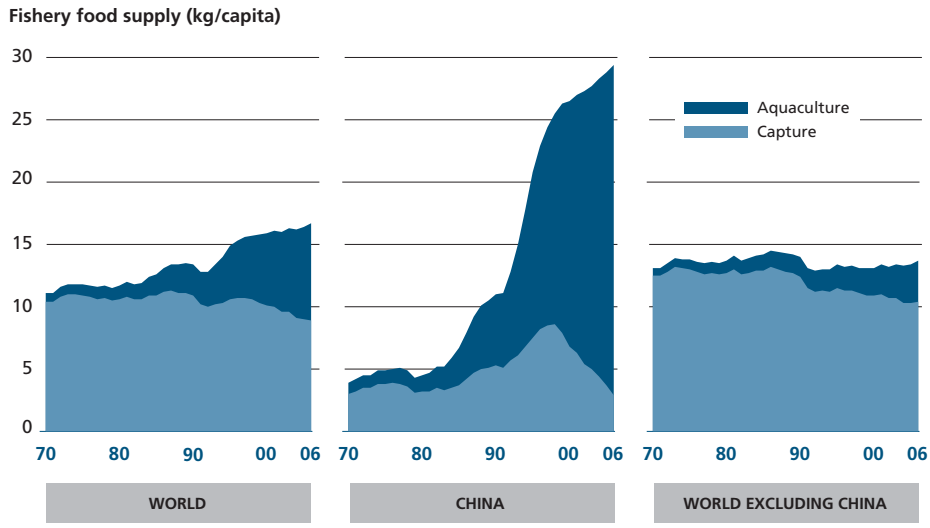


Figure 44

Relative contribution of aquaculture and capture fisheries to food fish consumption



broader groups did not show dramatic changes in their share in average world consumption, with demersal and pelagic fish species stable at about 3.0 kg per capita. Of the 16.4 kg of fish per capita available for consumption in 2005, about 74 percent came from finfish. Shellfish supplied 26 percent (or about 4.1 kg per capita), subdivided into 1.6 kg of crustaceans, 0.5 kg of cephalopods and 2.0 kg of other molluscs. Freshwater and diadromous species accounted for about 32 million tonnes of the total supply (about 4.9 kg per capita). Marine finfish species provided more than 47 million tonnes, of which 20.0 million tonnes were demersal fish, 19.9 million tonnes were pelagic species and 7.6 million tonnes were unidentified marine fish. The remaining share of the total food supply consisted of shellfish, of which 10.5 million tonnes were crustaceans, 3.5 million tonnes cephalopods and 12.9 million tonnes other molluscs.

Significant changes in fish and overall food consumption have taken place in both developed and developing countries. In developed countries, where incomes are generally high and basic dietary needs have long been more than satisfied, leading consumers often look for more variety in their diets. At the same time, the average consumer, particularly in European countries, Japan and the United States of America, is increasingly requiring high standards on different fronts, such as food safety, freshness, diversity and convenience. Furthermore, consumption in these countries will be increasingly determined by quality assurances, such as traceability, packing requirements and processing controls, that reinforce an underlying preference for premium-quality fish. Among other factors that are increasingly influencing consumption decisions are health and well-being. The populations of many industrialized countries are becoming older, richer, more educated and more health conscious. The demand for food that promotes health and well-being has increased in recent years. Fish has a particular prominence in this respect, following mounting evidence confirming the health benefits of eating fish. More stringent demands for assurance concerning safety is another high-profile issue that has emerged in recent years. It is considered very important to earn and maintain consumer confidence in the safety of fish. Consumers are increasingly requesting product attributes that depend on the production process. They now demand guarantees that their food has been produced, handled and commercialized in a way that is not dangerous to their health, respects the environment and addresses various other ethical and social concerns. Customers as well as major distributors are increasingly concerned about the sustainability and risk of depletion of marine stocks.

There are increasing calls for transparency in traceability systems – in order to trace the source, the quality, and the environmental and social impacts of food production and distribution. At the same time, consumers also want convenience and palatability. The response of the food industry has been to produce appealing and healthy fish products. Furthermore, societal changes, such as rising incomes, urbanization and greater female participation in the workforce, and media pressure are driving the demand for product diversification, higher-value products, semi-processed and processed products, and products that are ready to eat or require little preparation before serving. Markets have become more flexible, and new products and species have found market niches. Another trend is the increasing importance of fresh fish. Unlike many other food products, fish is still more favourably received on the market when it is fresh rather than processed. However, historically, fresh fish has been of little importance in international trade owing to its perishable nature and limited shelf-life. Improvements in packaging, reduced air-freight prices, and more efficient and reliable transport have created additional sales outlets for fresh fish. Food chains and department stores are also taking an increasing share of the fresh seafood sector. Many of them now provide fresh seafood counters with an extensive variety of fish and freshly prepared fish dishes or salads next to their frozen-food counters. Demand for products that cater to specific consumer tastes puts pressure on the whole value chain, especially on processors as well as on producers who need to provide what processors and consumers require. These developments involve fish originating from both capture fisheries and aquaculture. Aquaculture may have a potential advantage in providing raw material for higher-value processed products.

Per capita fish consumption in higher-income countries is expected to continue growing, but at a slower pace than in recent decades. New markets are emerging worldwide. Rising incomes and the ensuing diversification of diets are leading to a shift towards significantly higher fish consumption in developing countries. In emerging countries, especially in East and Southeast Asia, an expanding middle class is leading to increased fish consumption, in particular of high-quality and high-value products as purchasing power rises. In the last few decades, the increase in food consumption has been caused by growing consumption of red meat, fish, milk and eggs, at the expense of basic cereals. Protein availability has grown in both the developed and developing world, but the increase has not been equally distributed.

There has been a remarkable increase in the consumption of animal products in countries such as Brazil and China and in other less developed countries. However, the supply of animal protein remains significantly higher in industrialized countries than in developing countries.

The driving force behind the enormous surge in the consumption of animal products is a combination of population growth, rising incomes and increasing urbanization. Economic development and rising incomes usually lead to advances in the availability and quality of food, better overall nutritional status and the elimination of food shortages. This is normally accompanied by improvements in the supply chain of food, that is, in production, processing and marketing. Food distribution has undergone dramatic changes. Several developing countries, especially in Asia and Latin America, have experienced a rapid expansion in the number of supermarkets, which are not only targeting higher-income consumers but also lower- and middle-income consumers. Thus, they are emerging as a major force in developing countries, offering consumers a wider choice, reduced seasonality and lower prices for food products – and often safer food. Urbanization is a major force in global food demand. Growing urbanization usually modifies dietary patterns, both quantitatively and qualitatively, and changes the lifestyles of individuals. There is an increasing trend towards a global uniformity of urban consumer behaviour. Compared with the less-diversified diets of rural communities, city dwellers tend to have a more varied diet, richer in higher-energy foods, with more proteins from meat, poultry, fish and milk and fewer carbohydrates and fibres. Furthermore, urbanization stimulates development in infrastructure, including cold chains (which enable trade in perishable goods). In its 2007 Revision of World Urbanization Prospects, the United Nations Population Division indicated that the world population would reach a landmark in 2008.[23] For the first time in history, the urban population would equal the rural population of the world and, from then on, the majority of the world population would be urban. Nevertheless, major parts of the world remain largely rural. In Africa and Asia, six out of ten people still live in rural areas. The world's urban population is expected to nearly double by 2050, increasing from 3.3 billion in 2007 to 6.4 billion in 2050, with virtually all of the growth being absorbed by the urban areas of the less-developed regions.

The above-mentioned trends in fish consumption are expected to continue for the foreseeable future. Population and income growth, together with urbanization and dietary diversification, are expected to create additional demand and to continue to shift the composition of food consumption towards a growing share of animal products in developing countries. In industrialized countries, food demand is expected to grow only moderately and, in determining demand for food products, issues such as safety, quality, environmental concerns and animal welfare will probably be more important than price and income changes.

GOVERNANCE AND POLICY

Marine fisheries: industrial

The world's oceans support economic activities on a vast scale, and the need to rehabilitate and protect their common wealth and productivity has led the international community to focus intensely on how oceans are used and governed. A critical component of that equation is sound fisheries governance, especially in terms of achieving long-term sustainable management of living marine resources, a precondition for maintaining their social and economic value (Box 5). Intrinsically linked to this goal is the need to ensure greater responsibility and accountability by all individuals and private companies involved in the harvesting, processing and marketing of fish. More broadly, and also taking account of the potential for endemic corruption in resource-based industries,[24] sustainable management outcomes (including poverty reduction and alleviation, improved food security, stronger economic development and growth, and greater access to public services) depend to a large extent on concurrent improvements in public governance.

Box 5

The potential economic benefits from effective management of global marine fisheries

The "Rent Drain" study, a joint project of the World Bank PROFISH Global Program on Fisheries and FAO, describes the economic status of the global marine fisheries. The study shows that the difference between the potential and actual net economic benefits from marine fisheries is in the order of US$50 billion per year. The cumulative economic loss to the global economy over the last three decades is estimated to be in the order of US$2 trillion. In many countries, the catching operations are buoyed up by subsidies, so that the global fishery economy to the point of landing (the harvest subsector) was in deficit in the study's base year (2004). Improved governance of marine fisheries could capture a substantial part of this US$50 billion annual economic loss.

The study argues that the focus on the declining biological health of the world's fisheries has tended to obscure the even more critical economic health of the fisheries. Economically, healthy fisheries are fundamental to achieving not only the restoration of fish stocks but other accepted objectives for the fisheries sector, such as improved livelihoods, exports, fish food security and economic growth.

The "Rent Drain" study, builds on previous estimates of the global rents loss, in particular studies by FAO[1] and by Garcia and Newton.[2] Many of the problems characterized in the Garcia and Newton study still remain prevalent in global fisheries a decade later. More fish stocks are overexploited, overcapacity in fishing fleets remains problematic, income levels of fishers remain depressed and fish prices have stabilized or even fallen while the costs of harvesting fish have increased. Labour and fleet productivity has declined even as fishing technology has advanced.

Global marine capture fisheries production is relatively stagnant, producing 85 million tonnes in 2004, about the same quantity as in 1992. Analysis of trends in the value and costs of production show that marine capture fisheries are loss-making at the global level. For example, available global data suggest stable or even declining real per unit export values since the mid-1990s. Increased fuel costs, growing numbers of vessels and declining catch rates have reduced the economic efficiency of global marine capture fisheries. Subsidies for fuel and investment in fishing capacity have contributed even further to the decline in catch-per-fisher and catch-per-vessel ratios.

The study considered the global marine fishery as a single bioeconomic unit. Available global datasets were used to generate parameters for the

Fisheries management poses challenges for all countries, especially those that are capacity poor. In some countries, improvements in resource management are proceeding hand-in-hand with public sector reform and measures to promote better governance. These outcomes are increasingly being incentive-linked to the provision of development assistance. However, despite positive developments, there has been only limited progress in the implementation of management measures in most of the world.

In this respect, a key fisheries management issue is the lack of progress in reducing fishing capacity[25] and related harmful subsidies, a fundamental consideration if the state of world fisheries is to be improved. The 2007 session of the FAO Committee on Fisheries (the Committee) referred to the lack of progress in this area, and to the need

classical Schaefer and Fox biological models and to make estimates of the difference between the current (2004) and potential economic rent in the global fishery using each model. The estimate of US$50 billion is a mean from the two models. The estimate has a 95-percent confidence interval of between US$26 billion and US$72 billion. The rent loss estimate may increase by US$10–20 billion per year if discards are assumed to have an economic value and if allowance is made for the recent increases in fuel and food prices. A series of developing country case studies also lend weight to the rent loss estimates.

The estimate refers only to the harvest sector, that is, the global fisheries economy to the point of landing. However, a more economically efficient harvest sector can generate substantial additional downstream benefits. The estimate also excludes consideration of the value of biodiversity losses and losses by recreational fisheries and marine tourism.

The real cumulative global resource rent loss from inefficient marine capture fisheries in the period from 1974 to 2007 was estimated at US$2.2 trillion. The rent loss of US$50 billion in 2004 was used as a base value to construct a time series of losses. The 1974–2007 period was used because FAO produced its first "state of the marine fisheries" report in 1974, the first of a series of 14 such reports. The changing proportion of global fish stocks reported as fully exploited or overexploited in this series was used to build the annual loss estimates.

Capturing resource rent could generate economic growth both in the marine economy and other sectors, finance fisheries management systems, and help ensure an economically efficient and socially and environmentally sustainable use of the resources.

[1] FAO. 1993. *Marine fisheries and the law of the sea: a decade of change. Special chapter (revised) of The State of Food and Agriculture 1992*. Rome.
[2] S.M. Garcia and C. Newton. 1997. Current situation, trends and prospects in world capture fisheries. *In* E.L. Pickitch, D.D. Huppert and M.P. Sissenwine, eds. *Global trends: fisheries management*, pp. 3–27. American Fisheries Society Symposium 20. Bethesda, United States of America.
Source: World Bank. 2008. *The sunken billions. The economic justification for fisheries reform*. Washington, DC.

to match fishing capacity with sustainable harvesting levels. In a similar vein, in 2007, United Nations General Assembly Resolution 62/177 deplored the fact that fish stocks in many parts of the world are overfished or subject to sparsely regulated and heavy fishing efforts. The relationship between excess capacity and IUU fishing was also highlighted by both the Committee and the UN General Assembly. These issues and the nexus between them need to be addressed in tandem. They are also being deliberated on in other regional and global fora.[26]

There has been only limited progress in the implementation of measures *inter alia* to mainstream precautionary and ecosystem approaches to fisheries, eliminate bycatches and discards, regulate bottom-trawl fisheries (Box 6), manage shark fisheries and deal with IUU fishing in a comprehensive manner. Each of these issues has social,

Box 6

The need for additional indicators of fishing capacity

There is growing concern over the impacts that fishing gear may have on environments including: (i) the amount of fuel/energy consumed to capture the target species; (ii) the physical damage to the marine environment; (iii) the capacity of lost or abandoned fishing gear to "ghost fish"; (iv) the quantity and number of bycatch species; and (v) the quantity of fish and other animals discarded when using a particular fishing gear. These concerns have been raised in relation to commercial fishing gear including purse seines, bottom trawls, dredges, pots, hooks and lines, lift nets, gillnets and entangling nets.

While size and power of the fishing fleet may be useful indicators of trends in fishing capacity, vessel indices are unable to provide measures of the social, economic or environmental impacts attributed to a particular fishing method. First, the majority of small fishing vessels (which constitute 90 percent of global vessels by number) are multipurpose and use different types of gear depending on time, season and opportunity. Second, although some fleet data by vessel type are linked with fishing gear, the existing vessel statistics and information do not necessarily reflect the operational activities of the vessels. Third, the measurements used for vessel size and power often have no direct linear relationship with the impacts of fishing gear. This indicates the need to establish effective effort indices for fishing gear (for example, the days, number and types of gear used) in order to quantify the impacts of fishing gear on fisheries and monitor their trends.

This type of indicator will be useful in quantifying the impacts associated with each type of fishing gear type, and in identifying problems that need to be mitigated or resolved. For example, it has been claimed that bottom trawling is associated with high fuel consumption, physical damage to marine habitat, and high bycatch and discards. At the same time, a crude estimate indicates that 23 percent of global capture production, about 20 million tonnes, is obtained from bottom trawling. When considering a shift from bottom trawling to an alternative capture method, a fishing-gear/effort indicator, if analysed together with capture production data and socio-economic data (such as fuel consumption by vessel type and employment), would enable: (i) evaluation of the social, economic and environmental consequences of such a change; (ii) quantification of the extent to which environmental-impact-mitigation objectives can be or have been met; and (iii) monitoring of progress after the implementation of the new policy. Decisions on which types of fishing gear to promote or restrict should be based on a clear understanding of their relative benefits and disadvantages as well as the impacts and consequences of the measures.

economic and political dimensions, and the implementation of measures to tackle them effectively requires adequately trained human resources, well-structured and resilient institutions, and financial support.

A sharp focus on capacity building for fisheries management is a priority for both developing and developed countries. In a globalizing fisheries world, there is increasing interdependence between developing and developed states.[27] With respect to the implementation of international fisheries instruments (e.g. the 1995 United Nations Fish Stocks Agreement), it is recognized that there is an element of self-interest in the

provision of development assistance. This is because the instruments face a reasonable probability of floundering if they are not embraced widely by countries and if there is not a degree of implementation equivalency among parties to agreements. Principally for these reasons, most of the instruments concluded since the 1992 United Nations Conference on Environment and Development contain capacity-building provisions.[28]

A further and important reason to promote capacity building exists where regional cooperation and collaboration underpin the implementation of agreements. In these cases, capacity-poor countries become the weak links in the implementation process. For example, the adoption of harmonized and minimum standards for monitoring, control and surveillance (MCS) and regional port state measures envisages that they be implemented by countries in unison and with a similar degree of vigour. A failure to achieve coordinated implementation creates implementation loopholes, thereby undermining regional cooperation and outcomes.

Regional fisheries management organizations

Regional fisheries management organizations (RFMOs), the cornerstones of international fisheries governance, are struggling to fulfil their mandates despite concerted efforts to improve their performance. This situation results partly from the frameworks within which they operate and from an apparent lack of political will by members to implement decisions in a timely manner. Moreover, the effectiveness of RFMOs is impaired by: the use of consensus decision-making; placing national interests ahead of good fisheries governance; an unwillingness of members to fund research in support of management; time-lagged implementation of management decisions; a focus on crisis management rather than everyday fisheries management; and the lack of a real connection between day-to-day fisheries management requirements and an annual meeting based on diplomatic practice. However, there is a growing consensus that these fundamental issues require resolution if RFMOs are to be reinvigorated and become truly effective vehicles for sustainable fisheries management.

In an effort to improve their effectiveness, many RFMOs are implementing performance reviews. Most have opted for a mixed-panel approach, where there is a combination of internal and external professionals. Such an approach has many advantages, combining an intimate knowledge of the organization's operations and challenges with independent expert knowledge and input. A highly successful review, undertaken in collaboration with FAO, of the North East Atlantic Fisheries Commission (NEAFC) was concluded in 2006. This initial review paved the way for reviews of other RFMOs. Nonetheless, the international community recognizes that there are many differences among RFMOs, and it is essential that a flexible approach be adopted so that differences can be accommodated fully.

The RFMOs slated for performance reviews in 2008 include the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Indian Ocean Tuna Commission (IOTC) and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).[29] The review of RFMOs responsible for the management of straddling fish stocks and highly migratory fish stocks established before the conclusion of the 1995 United Nations Fish Stocks Agreement (the Agreement) is especially important. This is to ensure that the Agreement's thrust and intent can be reflected in the revised mandates of these organizations. In 2007, the Northwest Atlantic Fisheries Organization completed an extensive review and amendment process in order to update its convention to bring it into line with the Agreement.

Despite pessimism in the international community about the lack of effectiveness of RFMOs and their inability or reluctance to take practical management decisions, steps have been taken, or are being taken, to establish new RFMOs where none existed previously. Once these have been established, nearly all of the world's major fish stocks will be covered by RFMOs, the major exception being straddling stocks in the Southwest Atlantic Ocean.

In 2006, following an initiative of the Ministerial Conference on Fisheries Cooperation among African States bordering the Atlantic Ocean,[30] FAO cooperated to establish the Fishery Committee for the West Central Gulf of Guinea. This organization complements two existing subregional organizations in adjacent areas (the Subregional Fisheries Commission and the Regional Fisheries Committee for the Gulf of Guinea). Each organization has fisheries management functions. Their goals are to support member countries in gathering information and developing plans as a means of contributing to improved fisheries management in West Africa.

Further initiatives to enhance fisheries governance are the negotiations in the Pacific Ocean to establish the South Pacific Regional Fisheries Management Organization (SPRFMO) and the Inter-governmental Meeting on Management of High Seas Bottom Fisheries in the North Western Pacific Ocean. Negotiations for both initiatives are based on principles of international law, the 1982 United Nations Convention on the Law of the Sea, and the 1995 United Nations Fish Stocks Agreement. The SPRFMO involves a large number of countries. Its goal is to establish an organization in which the precautionary and ecosystem approaches to fisheries management are applied in order to ensure the long-term conservation and sustainable use of fishery resources. The management focus is on non-tuna species, including discrete high seas stocks. The negotiations have been in train since 2006 and are expected to conclude in 2009. Consultations to establish the mechanism for the North Western Pacific Ocean commenced in 2006. The process involves four countries.[31] The nature and scope of the agreement for the proposed mechanism and the implementation of interim measures are under active discussion.

A major challenge for the international community is to bring agreements into force once negotiations have been concluded. In July 2006, the multilateral agreement to establish the South Indian Ocean Fisheries Agreement (SIOFA) was signed by six countries (Comoros, France, Kenya, Mozambique, New Zealand and Seychelles) and the European Community. Its purpose is to manage high seas fishing in the South Indian Ocean in order to ensure the long-term conservation and sustainable use of non-tuna resources. However, the SIOFA has not yet entered into force and it may not do so in the near future – there have been no ratifications, and no interim management measures for the target stocks have been agreed.

International cooperation is strengthened and many problems resolved through consultation and the timely exchange of information. For RFMOs, such exchanges are crucial in dealing with common issues such as IUU fishing and the harmonization of data formats. FAO and non-FAO RFBs have met biennially since 1999 to consider matters of common concern and to learn how different bodies handle and resolve similar problems. These meetings marked a watershed in cooperation among RFBs. In 2007, the nature and scope of cooperation was taken a step further with the First Meeting of Regional Fishery Body Secretariats Network. This meeting *inter alia* reviewed: decisions by the Committee on Fisheries (COFI) of relevance to RFBs (including their role); external factors affecting fisheries management; approaches to incorporate ecosystem considerations into RFB fisheries management programmes; the status of the Fisheries Resources Monitoring System (FIRMS);[32] and other relevant matters.

Independently of this FAO-led process for RFBs, the world's five tuna RFMOs have commenced an annual consultative process. They held their first meeting in Japan (Kobe, 26 January 2007) and their second meeting in the United States of America (San Francisco, 5–6 February 2008). Unlike the RFB grouping, all the tuna organizations have management functions, comparable management goals and similar challenges. In addition, most of the organizations have members in common, and often shared fleets. In at least one case, two RFMOs have overlapping mandates. Therefore, it is appropriate that they collaborate and seek to promote interregional harmonization on common issues including harmonized stock assessment, MCS, vessels monitoring systems (VMSs), vessel lists, trade and catch tracking systems, and transhipment controls. At the 2008 meeting, it was noted that all tuna organizations had taken

action to improve data sharing and strengthen MCS measures, primarily to deter IUU fishing.

At recent international fora, concern has been expressed that some RFMOs are failing to adopt management measures even where these are based on the best scientific advice available.[33] This failure is bringing the role and work of RFMOs into disrepute and jeopardizing their credibility. The 2008 report of the tuna RFMO meeting also referred to this issue. It noted that significant concern was shared among the RFMOs on the slow progress by some organizations in addressing matters such as the establishment of equitable and transparent allocation procedures, capacity control and management based on scientific advice. In fact, substantial concern was voiced regarding the consequences of RFMOs not adopting management measures consistent with the best available scientific advice. On this matter, there was criticism by Pacific Island parties and civil society in December 2007 concerning the failure of the Western and Central Pacific Fisheries Commission (WCPFC) to reach management decisions on bigeye and yellowfin stocks.[34] This situation has led to a souring of relations between Pacific Island countries and the distant-water fishing nations that are members of the WCPFC.

While RFMOs are the primary vehicles for promoting international cooperation for fisheries management, other organizations and mechanisms are also focusing increasingly on issues relating to fisheries and their long-term sustainability, the ecosystem, the environment and climate change, often in an integrated manner. The international community is encouraging broadening cooperation with these organizations and mechanisms, which include the White Water to Blue Water Partnership Initiative, the Association of Southeast Asian Nations (ASEAN), the Southern African Development Community (SADC), the MERCOSUR and the Regional Ministerial Meeting on Promoting Responsible Fishing Practices, including Combating Illegal, Unreported and Unregulated Fishing in the Region (Bali, Indonesia, 2007).[35]

Dealing with IUU fishing

The need to combat IUU fishing and related activities, now generally considered an environmental crime involving theft of resources,[36] is high on the international fisheries agenda. This is because IUU fishing constitutes a serious threat to: (i) fisheries, especially those of high-value that are already overfished (e.g. cod, tuna, redfish and swordfish); (ii) marine habitats, including vulnerable marine ecosystems; and (iii) food security and the economies of developing countries. The incidence of IUU fishing is also increasing in many areas,[37] undermining national and regional efforts to manage fisheries sustainably. There is international consensus that efforts to combat IUU fishing should focus on blocking fish from entering international trade, thereby depriving IUU fishers of financial reward. Hence, an increased burden is falling on the shoulders of port and market states, including both developed and developing states, to prevent the movement and laundering of IUU-caught fish through their ports and into their markets.

Countries acting as flag or port of non-compliance encourage IUU fishing, as they provide the flags for vessels to operate with few or no restrictions and the havens in which to base operations and to handle catches. A major initiative under way relates to the negotiation of a binding international instrument on port state measures (Box 7). It is being complemented by an innovative approach to flag state responsibility as the international community moves to develop criteria to assess flag state performance and to consider possible action against vessels flying the flags of states that fail to meet these criteria.[38] This approach changes the emphasis somewhat. While fishing vessels continue to be targeted, flag states will now be confronted directly, instead of indirectly as was generally past practice. This development should enable the international community to take more concrete action against irresponsible flag states.

The 2001 FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing calls on market states to implement

Box 7

Towards a legally binding agreement/instrument on port state measures

Illegal, unreported and unregulated (IUU) fishing undermines national and regional efforts to manage fisheries sustainably and inhibits progress towards improving ocean governance. The international community recognizes that it must be addressed in a comprehensive and multipronged manner, as evidenced by the approach taken to develop the 2001 FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU).

While not losing sight of the importance of the IPOA-IUU "toolbox" as a whole, international attention is focusing more intensely on the role of the port state in preventing IUU-caught fish entering international trade. If IUU fishers are unable to tranship or land IUU-caught product, or if the transaction costs associated with trying to launder it for sale through legitimate market channels are sufficiently high, the financial incentive to engage in IUU fishing will decline. This situation should, in turn, have a positive impact on the state of resources that have been targeted by IUU fishers.

The FAO Committee on Fisheries (the Committee) addressed the use of port state measures specifically to combat IUU fishing in 2005 and 2007. Initially, the Committee agreed that a lack of binding port state measures provided a loophole for IUU fishers. It endorsed the 2005 FAO Model Scheme on Port State Measures to Combat Illegal, Unreported and Unregulated Fishing (the Model Scheme) and encouraged countries to implement it. In 2007, the Committee further agreed that there was an urgent need to develop a new legally-binding instrument based on the IPOA-IUU and the Model Scheme.

Working to a tight timetable, in September 2007, FAO convened an Expert Consultation to Draft a Legally-binding Instrument on Port State Measures in Washington, DC, to elaborate an initial draft text for a legally-binding instrument. This meeting was followed in June 2008 by a technical consultation to negotiate a text for a binding international instrument. It will be forwarded to the Committee on Fisheries (COFI) in 2009 for review and consideration.

It is now clear that IUU fishing is fuelled and supported by IUU fishers transhipping, landing and laundering their illicit catches. By all accounts, IUU fishing continues to be a profitable activity. Profitability will not diminish until it becomes more difficult for IUU fishers to sell their catches.

Central to reducing the profitability of IUU fishing is the need to make the movement of IUU-caught product from the vessel to shore and on to the consumer's plate more onerous. Port states have a front-line role in ensuring that only legally harvested fish is landed and that opportunities and loopholes for laundering illegal catch are closed. States must ensure that effective port state controls are exercised, and that they do not permit IUU fishing vessels to use their ports for any purpose or for IUU-caught fish to be transhipped or landed. This situation could have an adverse impact on trade volumes in the short to medium terms. However, if unsustainable IUU fishing practices on stocks are not eradicated, fish supply levels may well decrease, leading to a decline in fish available for national consumption and international trade.

internationally-agreed market measures, consistent with WTO rules, to prevent the trade in IUU-caught fish.[39] Furthermore, several RFMOs have adopted catch and trade traceability schemes to ensure that only documented and legally-harvested product is offered for sale in member countries. The CCAMLR, CCSBT and Inter-American Tropical Tuna Commission (IATTC), for example, operate such schemes. The combination of national measures to block the importation of IUU-caught fish, RFMO traceability schemes, the implementation of flag state certification of catch schemes (e.g. such as those being implemented by the NEAFC and, shortly, by the EU) and enhanced port state measures should reinforce one another and reduce the opportunities for IUU products to enter international trade.

Underpinning efforts to address flag and vessel issues is FAO's work to consider the development of a comprehensive global record for fishing vessels, refrigerated transport vessels and supply vessels. It is seeking to develop a harmonized global list of fishing vessels, incorporating information from RFMO lists, national vessel registers and other sources that contain information on authorized vessels. An Expert Consultation on the Development of a Comprehensive Global Record of Fishing Vessels (FAO headquarters, Rome, 25–28 February 2008) addressed general concepts and policy considerations. It expressed the view that the global record would be an essential tool to ensure the effectiveness of port state measures. The Consultation also proposed a schedule of follow-up activities to be undertaken before COFI in 2009, where the matter will be considered further.

IUU fishing has severe impacts on developing countries. They are affected by IUU fishing, and often rampant IUU fishing (e.g. in West Africa), in their EEZs. In turn, because of a lack of capacity, they are handicapped in dealing with it. Furthermore, with the rise of catch and trade traceability schemes, many developing countries, at least initially, are likely to face the loss of market opportunities because of their inability to handle the technicalities associated with such schemes. This is a major concern for the international community and seen as an important reason for ensuring that capacity building to combat IUU fishing receives high priority in developing countries.

Given the serious harm caused by IUU fishing and the need to find more effective means of preventing the practice as soon as possible, a number of new ideas are being considered. An emerging proposal is whether RFMOs, in keeping with the philosophy of using financial incentives to influence IUU fishing, should levy charges on states issuing flags of non-compliance and whose vessels fish in a RFMO area.[40] The proponents of this approach argue that this compensation would be justified on the grounds that the members of these organizations incur higher participation fees because of IUU fishing (e.g. higher MCS costs that are paid for from members' contributions). In addition, as a result of IUU fishing, members are likely to have reduced fishing opportunities, with lower catches translating into lower incomes and profits.

In October 2007, the EU unveiled a new and forward-looking policy and legal framework on IUU fishing. It was introduced because the current EU framework could not guarantee that fisheries products imported from non-EU countries had been caught legally. The new framework hinges on reducing profit for IUU fishers and their collaborators. Two of its central tenets are to: (i) require flag states to certify that all imported fish has been harvested in a legal manner;[41] and (ii) impose sanctions on flag states that do not meet their international obligations. In addition, strict sanctions against EU nationals who engage in IUU fishing will be imposed, irrespective of whether they operate in the EU or abroad.

High seas fisheries

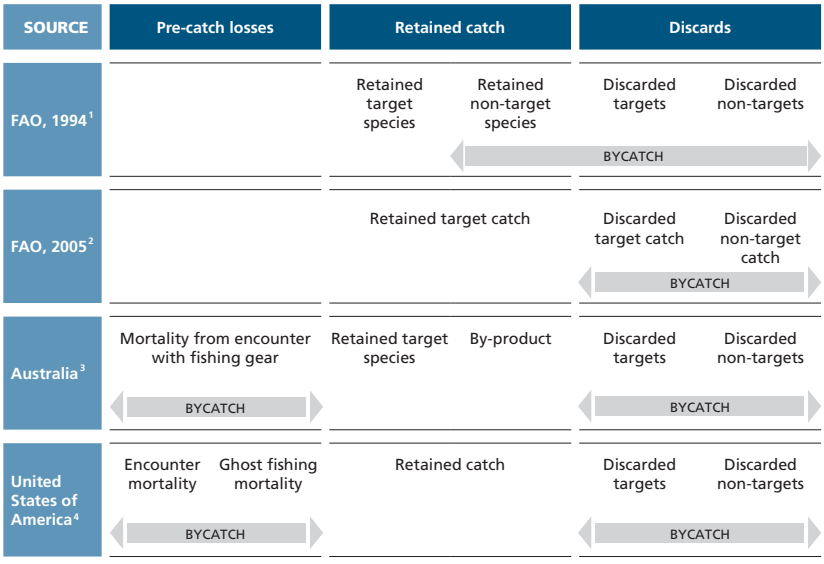
In line with international calls to address high seas fisheries governance and take account of the outcome of Deep Sea 2003 (an international conference on deep-sea fisheries held in Wellington, 27–29 November 2003), FAO embarked on work in 2006 to consider options for the management of deep-sea fisheries in the high seas. An initial

expert consultation (Bangkok, 21–23 November 2006) addressed key issues about these fisheries and proposed steps to: (i) enhance information exchange[42] in order to increase knowledge about these fisheries; and (ii) convene an FAO technical consultation to consider their management and to prepare guidelines and/or a code of conduct for management of these fisheries. In 2007, COFI considered the need for follow-up work and agreed that FAO should proceed with the elaboration of international guidelines (before 31 December 2008). A second expert consultation in 2007 (Bangkok, 11–14 September 2007) drafted guidelines that then formed the basis of negotiations at an FAO technical consultation (FAO headquarters, Rome, 4–8 February 2008). It was not possible to complete the work at that meeting, and the consultation was reconvened at FAO headquarters in August 2008. It is anticipated that international guidelines

Box 8

Replacing the bycatch concept in fisheries management?

In the last four decades, concern has been expressed by fishery managers and conservation/environmental groups that bycatch and discards may be contributing to biological overfishing and to altering the structure of marine ecosystems. In the last two decades, the search for solutions to the bycatch and discard problems has intensified, and bycatch has been reduced in several fisheries. However, in this period, the concept of what the term "bycatch" means to those both within and outside the fisheries sector has changed, and at this time there is no commonly accepted definition of the term.



[1] FAO. 1994. *A global assessment of fisheries bycatch and discards,* by D.L. Alverson, M.H. Freeberg, J.G. Pope and S.A. Murawski. FAO Fisheries Technical Paper No. 339. Rome.
[2] FAO. 2005. *Discards in the world's marine fisheries. An update,* by K. Kelleher. FAO Fisheries Technical Paper No. 470. Rome.
[3] Ministerial Council on Forestry, Fisheries and Aquaculture. 1999. *National Policy on Fisheries Bycatch.* Canberra, Department of Agriculture, Fisheries and Forestry.
[4] National Marine Fisheries Service. 2003. *Evaluating bycatch: a national approach to standardized bycatch monitoring programs.* Silver Spring, United States of America, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

endorsed by the consultation will be submitted to COFI in 2009 for consideration and approval.

Highly migratory species and straddling stocks

To promote participation in, and the implementation of, the 1995 United Nations Fish Stocks Agreement (the Agreement), and as a means of strengthening its position in customary international law, it is anticipated that the sixty-third session of the United Nations General Assembly in 2008 will agree to resume the Review Conference that was suspended in 2006. With a growing number of parties to the Agreement (68 parties in total as at March 2008), there is a consensus by both parties and non-parties that more intense dialogue is required to eliminate obstacles that are currently preventing non-

Already, in 1992, Murawski noted: "the use of the term bycatch adds considerable confusion to a topic that is already complex to both scientists and managers."[1] The term is relatively imprecise in that it constitutes a value judgment and may be inaccurate when used over any extended time to describe an element within a multi-species catch. In essence, "yesterday's bycatch may be today's target species."

The various components of recent key bycatch definitions are shown in the accompanying table. The definition used by FAO (2005) is the narrowest, and will lead to a lower estimate of bycatch than the other three, as it includes neither "retained non-target species" (referred to as incidental catch in FAO (1994) nor "unobserved mortalities". Therefore, in order to be useful for decision-makers and in public debates, any estimate of bycatch should be accompanied by a statement of which definition of bycatch has been used.

However, apart from being imprecise, the concept of bycatch has another weakness. It is not quite adequate for the modern fisheries manager. Given the present trend to move from single species to multispecies management and application of the ecosystem approach to fisheries, managers must manage more than catch and bycatch. They are expected to manage fisheries so that landings are sustainable, discarded catch minimized and pre-catch losses (unobserved mortality) reduced.

Fishers will probably always think in terms of catch and bycatch, but for scientists and managers these concepts are now too crude. Fishing is probably easer to manage if thought of in terms of pre-catch losses, landings and discarded catch. The term "catches", when used, then consists of landings and discarded catch.

[1] S.A. Murawski. 1992. The challenges of finding solutions in multispecies fisheries. *In* R.W. Schoning, R.W. Jacobson, D.L. Alverson, T.G. Gentle and J. Auyong, eds. *Proceedings of the National Industry Bycatch Workshop, February 4–6, 1992, Newport, Oregon*, pp. 35–45. Seattle, United States of America, Natural Resources Consultants, Inc.

parties from ratifying the Agreement. This development, which surfaced strongly at the seventh round of Informal Consultations of the States Parties to the Agreement (New York, United States of America, 11–12 March 2008), is seen as a highly positive one, reflecting good will by all participants to deepen implementation through increasing participation. A highly encouraging parallel development is the extent to which some non-parties are also taking steps to implement key aspects of the Agreement. Significantly, the 2008 seventh round of Informal Consultations of the States Parties to the Agreement identified a lack of capacity in developing countries as a barrier to its wider acceptance and implementation.

Bycatch and discards

In their various forms, bycatches can have significant consequences for populations, food webs and ecosystems. In recent decades, a broad-based public consensus has developed around the view that bycatch should be minimized to levels approaching insignificance (Box 8). This view, as reflected in worldwide legislation and agreements, demonstrates the widely-held belief that discarded portions of fishery catches represent an unacceptable waste of natural resources. Although no detailed estimate of bycatch is available, a crude estimate suggests that it could be more than 20 million tonnes globally (equivalent to 23 percent of marine landings) and growing. Decreases in abundance of traditional species, falling catch revenues, new markets for non-traditional species, increased demand for raw material for animal feeds and changes in regulations to prohibit discarding are all factors that may contribute to increased landings of non-target species.

However, global awareness of the bycatch problem has produced results. Turtle mortalities have been reduced through: (i) wider use of turtle excluder devices in shrimp trawl fisheries (these devices are a prerequisite for shrimp exports to the United States of America; and (ii) the promotion and use of circle hooks in pelagic longline fisheries. Although economically and ecologically important, less-charismatic bycatch species (including juveniles) have yet to be treated with the same intensity. In many fisheries, they remain a source of unregulated and unreported fishing mortality.

Global awareness on bycatch has also benefited seabirds. The IPOA and NPOA for seabirds (IPOA/NPOA-S) have stimulated improvements in seabird-avoidance techniques in commercial longline fisheries. However, while unreported and unobserved bycatch is a component of IUU fishing, the IPOA on IUU has tended to focus on illegal fishing. It may be that progress in managing bycatch species and reducing discards would be best served through a separate and focused international initiative.

As globally there are few management regimes that regulate and report on retained or discarded bycatch species, there is no way of knowing the true magnitude of the problem. Making all retained species a component of specific fisheries management arrangements remains a priority for those pursuing an ecosystem approach to fisheries. The lack of comprehensive monitoring programmes to assess bycatches and integrate them into population and multispecies models seriously impedes a full understanding of bycatch consequences and the efficacy of measures for their amelioration.

Aquaculture

Until about two decades ago, apart from very few subsistence operations, aquaculture production was largely market-driven. More recently, many governments around the world have been playing a more proactive role in aquaculture development. This role has been changing gradually and varying in nature depending on the importance or potential of aquaculture in the socio-economic life of the various countries.

Even where aquaculture has been designated among the strategic sectors and industries, and endorsed by policy-makers as a source of livelihood and a contributor to economic growth, poverty reduction or balance of payments, its most recent expansion has still been driven by the profit incentive. However, this time, it has been

accompanied by government involvement. In some cases, governments have intervened deliberately to provide fiscal and other incentives to entrepreneurs. Some countries in Africa are in the process of drafting aquaculture fiscal codes. Others have maintained an enabling economic environment in which entrepreneurs can compete but, having learned from earlier mistakes, they use good-governance tools to limit *laissez faire* excesses.

For entrepreneurs, good governance means providing law and order. In practice, it may mean: drafting a legislative framework; ensuring property rights; administering aquaculture regulations transparently; processing aquaculture licences rapidly and equitably; encouraging self-regulation through voluntary codes of practice; and promoting innovative, less-polluting production technologies. Many countries, both developed and developing, have enacted (or are in the process of drafting) national aquaculture legislations and regulations that govern the licensing, monitoring and control of aquaculture. These legal instruments ensure that any development of the industry is founded on sustainable ventures, is appropriately located, and is carried on in accordance with high standards of environmental and ecological protection. Most laws and regulations cover several aspects of the supply side of aquaculture, including planning and access, water and wastewater, seed, feed, aquaculture investment, and fish movement and disease control.

In terms of planning and access to productive resources, some countries have regulations regarding aquaculture zones. Under these regimes, aquaculture can only take place in designated zones, and any person wishing to engage in aquaculture must first apply for and obtain an aquaculture licence. In many instances, unlicensed operations can entail a fine, imprisonment or the destruction of the operation – or any combination of the three penalties. In some countries, there are also species-specific zones; only in particular zones can certain species be farmed. The challenge for many governments would be to license or register existing farms, in particular large numbers of small operations, which may not even qualify as an aquaculture operation. Although small in size, collectively they account for large areas of land that could continue to affect sustainability.

There are also laws and regulations on water access and use, and wastes. In most countries, the right to put up any structure in open water areas, such as fish traps and fish cages, or to dam flowing water for exclusive private use, requires a permit from the designated authority. However, such laws are often difficult to enforce because it is not always possible to monitor these activities. In many instances, local communities and/or farmers' associations manage water resources and resolve conflicts. Multiple uses of water, such as integrated fish–rice farming, have also been encouraged as an efficient way of using scarce water and a means of minimizing conflicts. In developed countries and in many developing countries where aquaculture is important, the governing authority generally defines effluent guidelines or standards for aquaculture wastewater discharges. In most cases, these are based not on risks or impacts upon receiving waters but on the performance of the technologies used for the treatment and control of the wastes. In many cases, the standards have been adopted from other countries. Aquaculture operations that intend to discharge wastewater must obtain a permit before initiating a discharge. The permit specifies the conditions and effluent limitations under which the operation may make a discharge, and it establishes pollutant monitoring and reporting requirements.

Seed production and seed quality are gradually becoming a focus for policies and regulations. In order to increase seed supply, some governments provide incentives to farmers in the form of soft loans or tax exemptions in lieu of subsidized seed produced from government hatcheries (government hatcheries are progressively being phased out). These incentives can be oriented to particular species that are deemed to have potential commercial value. In order to improve seed quality from the private sector, in many places, seed producers must be certified, and seed quality standards, which are often species-specific, are formulated and published. National and local seed inspection and certification committees ensure that these standards are adhered to by

certified producers. Moreover, many countries have legal provisions on the movement of fish (including broodstock and seed). In such countries, any introduction or import of eggs, fry, fingerlings or broodstock must be subjected to quarantine for evaluation and decision. There are also export regulations. The aim is to protect and maintain aquatic biosecurity and, in particular, to limit the spread of diseases within and beyond national boundaries. Some countries have established domestication and broodstock development and management programmes for some commercial species. This trend is continuing with significant success. However, because of the high costs of monitoring and enforcing the law, there are still many places in developing countries where aquatic animals move freely, without any inspection or certification.

Where aquaculture is developed, governments have generally focused on the quality of feed used, and set and controlled feed standards by regulation. Licences must be obtained for feed, additives and/or premixes produced domestically or imported. However, as with seed quality, monitoring can be constrained by a lack of financial resources or skilled personnel. In addition, the majority of fish feed in developing countries is still supplied by small, artisanal fish-feed units that usually do not adhere to any quality standards.

A further governance tool used by governments is that of promoting and supporting investments by small-scale farmers through economic incentives (including subsidized credit and collateral-free loans). A number of countries offer fiscal incentives, such as exemptions on, or reductions in, income tax, land taxes, sales taxes and import duties, to domestic and foreign investors. Some governments have also encouraged foreign investment but with limits on the extent of foreign participation. For the policy to be successful, they guarantee capital and profit repatriation. Where this has been applied, foreign participation has increased rapidly, especially in marine and brackish-water aquaculture.

Self-policing is becoming increasingly common. Farmers, particularly those with long-time horizons, are increasingly building on the FAO Code of Conduct for Responsible Fisheries (CCRF) to elaborate, support and enforce self-regulating management codes. Most have realized that it is in their best interests to minimize pollution because the latter directly affects their operations. However, there are arguments that self-regulation and environmental safeguards through voluntary codes of practice are ineffective forms of governance in the absence of binding legal obligations to enforce rules. Nevertheless, there are success stories on efficient self-regulation through cluster management. There is also evidence that, by empowering small-scale farmers, compliance with voluntary codes has improved the environmental sustainability of their operations, so enabling them to gain better access to international markets and to improve their competitiveness.

Having learned from past mistakes, many countries, early movers as well as newcomers in aquaculture, now emphasize environmental sustainability and social responsibility. In addition to laws and regulations, and voluntary codes of practice that aim to ensure environmental integrity, some of the means of achieving this goal include innovative, less-polluting production techniques, such as those based on the ecosystem approach to aquaculture (which emphasizes management for sustainability). In this regard, tools and indicators have been developed for the purpose of assessing and monitoring not only the impacts of aquaculture on the environment, but also the impacts of the environment on aquaculture and site selection.

In terms of improving social responsibility, governments are defining minimum wages, improved labour conditions, worker welfare systems, etc. – which are being embraced by many lobbyists. Certification systems for aquaculture practices and products are beginning to include standards for monitoring social responsibility and equity.

The international dimension of aquaculture governance is gradually gaining ground. For example, the EU has legislation on aquaculture and its value chain. It includes regulations on food additives, animal diseases, environment, labelling and packaging, marketing, research, sanitary and hygiene measures, structures and third

countries. These regulations are directly applicable and binding in all EU Member States without the need for any national parallel legislation. There is also an extensive array of international agreements, standards and procedures already in place for various aspects of aquaculture and its value chain elsewhere. Compliance with some of these agreements, standards and procedures is mandatory, and recognized competent authorities are empowered to verify compliance with these requirements.

The lack of financial and skilled human capacity to establish, monitor and enforce regulations in developing countries could particularly threaten efforts to govern aquaculture properly, thereby limiting its development in many countries. Most countries also have limited financial resources with which to monitor and enforce regulations. There is no indication that this situation will improve soon, particularly in countries with large numbers of small-scale farmers. There are still opportunities for self-governance, by empowering small-farmers through clustering, but significant effort will be required to realize their full potential. Policies and regulations may be enacted but, unless there are sufficient government personnel with adequate skills and financial resources to monitor and enforce them, they will remain ineffective. The lack of resources for monitoring and enforcement may be as critical as the absence of legislation or regulations.

There are many instances where regulations are overly cumbersome. Overregulation stifles entrepreneurial initiative and motivation – the very ingredients necessary for successful aquaculture. To avoid overregulation, policy-makers use a number of options, including consultation with farmers and other stakeholders, and they conduct a mandatory review of the costs and benefits of regulations prior to enactment.

Not only can the number of regulations hinder aquaculture development, the time to process regulations can have a similar effect. An example is the obligation to acquire permits or licences, which is now common in developed and developing countries. Depending on the country, it can take from three months to several years to obtain new licences to farm. To expedite the response to licence requests, some countries impose time constraints on the processing of the applications. In such countries, a decision has to be given within the established time limit; otherwise, the applicant has de facto a permit.

Trade and fisheries subsidies

New disciplines governing the use of subsidies in the fisheries sector are being negotiated in the WTO. This follows the WTO Ministerial Declaration mandating participants "to clarify and improve WTO disciplines on fisheries subsidies, taking into account the importance of this sector to developing countries" (paragraph 28, 20 November 2001). Much progress has been achieved since the negotiations were launched. In November 2007, the Chair of the group negotiating fisheries subsidies tabled a Chair's draft text. The Chair's draft proposes a broad ban on subsidies that contribute to overfishing and overcapacity. It also proposes general exceptions to the prohibitions for all WTO members and special and differential treatment (S&DT) for developing countries. However, the general exceptions and S&DTs are conditional on WTO members having in place a fishery management system designed to prevent overfishing. The Chair's text proposes that WTO members who wish to grant a subsidy that would fall under the general exception or S&DT provisions must notify FAO of their management system. It is proposed that FAO then undertake a peer review of the management system prior to the granting of the subsidy. However, at this stage, it should be noted that the negotiations in the WTO are still under way. When the fisheries subsidies negotiations have been concluded, the agreed text will clarify FAO's intended role and the nature of the peer review.

Following the accession of China and Viet Nam to the WTO in 2001 and 2007, respectively, all major fish producing, importing and exporting countries are members of the organization, with the exception of the Russian Federation. Countries whose accession is expected to be ratified in 2008 are Cape Verde and Ukraine. Parallel to the increase in WTO membership, a number of bilateral trade agreements with

strong relevance to fish trade have entered into force. The full impact of such bilateral agreements and regional trade agreements, in addition to (or in substitution of) broader multilateral agreements, remains to be seen. One trade agreement of significant relevance for trade in fish and fishery products is being negotiated at the regional level between six African, Caribbean and Pacific regions and the EU. The intention was to arrive at regional Economic Partnership Agreements (EPAs) and make them operational from January 2008. The deadline was important, as the waiver granted by the WTO to the preferences in the Cotonou Agreement expired at the end of 2007. However, by the deadline, only one region, the Caribbean, had concluded a full EPA with the EU.

Whereas the least developed countries (LDCs) from all regions continue to benefit from free market-access preferences to the EU market under the Everything But Arms initiative, this is not the case for non-LDCs. Therefore, many of these have entered into interim agreements with the EU. In total, 35 African, Caribbean and Pacific countries had entered into full or interim agreements by the end of 2007. Some of these agreements also include chapters on fisheries development and cooperation. Countries that are neither LDCs nor signatories to interim or full agreements can continue to export to the EU market under the EU's Generalised System of Preferences. However, this will lead to higher import duties for their products from 2008 onwards.

NOTES

1. See, in particular, FAO. 2002. *The State of World Fisheries and Aquaculture 2002*, Box 2, p. 9. Rome.
2. Comparing 1996 and 2006 data, the number of species items in the FAO database rose from 68 to 120, and unidentified catches reported above the family level fell from 68.3 to 57.1 percent.
3. The term "other aquatic animals" also includes amphibians (frogs) and reptiles (turtles). For brevity, referred to hereafter as "fish, crustaceans and molluscs" or "food fish supply" or "aquatic animals".
4. The regions match those presented in the "Outlook" section of this document.
5. While mussels and oysters are high-priced per kilogram of meat, they are relatively low-valued in terms of value per kilogram of whole animals, as shell weight can account for a large percentage of the total (live) weight. Statistics on aquaculture production are reported as live weight.
6. The production of aquatic plants is not considered in the figures in the remainder of this section.
7. FAO. (forthcoming). *Prospective analysis of aquaculture development: the Delphi method*. Fisheries Technical Paper No. 521. Rome.
8. A "maru-ship" is a Japanese ship operated partially by a non-Japanese crew.
9. EEA 18 consists of EU 15 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom) plus Iceland, Liechtenstein and Norway.
10. The ten new EU members: Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. No fleet data available for the land-locked countries (Czech Republic, Hungary and Slovakia).
11. For the EEA 18 members, no fleet report is available for the land-locked countries (Austria, Liechtenstein and Luxembourg.
12. The five case studies were: Status and trends of the fishery resources of Lake Constance (by R. Rösch); Status and trends of the Lake Victoria fisheries (by J. Kolding and O. Mkumbo); Status and trends of the fishery resources of the Amazon Basin in Brazil (by M.L. Ruffino); the Tonle Sap fishery (based on data provided by the Inland Fisheries Research and Development Institute (Cambodia) and the Mekong River Commission; and Review of the fisheries of Kyrgyzstan (produced under project GCP/GLO/162/EC). FAO intends to publish the five case studies in full.
13. J. Kolding, P. van Zwieten, O. Mkumbo, G. Silsbe and R. Hecky. 2008. Are the Lake Victoria fisheries threatened by exploitation or eutrophication? Towards an ecosystem based approach to management. *In* G. Bianchi and H.R. Skjoldal, eds. *The ecosystem approach to fisheries*. (in press). CABI Publishing.
14. If the estuarine fisheries are included, Amazon landings in the last decade averaged 23 percent.
15. Estimate based on consumption surveys (K.G. Hortle. 2007. *Consumption and the yield of fish and other aquatic animals from the Lower Mekong Basin*. MRC Technical Paper No. 16. Vientiane, Mekong River Commission). Most fish is caught by subsistence fisheries, but large commercial fisheries also take place, particularly in Cambodia and Viet Nam.
16. A dai is a bagnet or a stationary trawl.
17. A larger inundated area increases both fish habitat and availability of food.
18. World Trade Organization. 2007. *World Trade Report 2007*. Geneva.
19. Fish import figures differ from export figures because the former are usually reported in c.i.f. (cost, insurance and freight), whereas exports are reported at f.o.b. (free on board) values.
20. Cod and related species.

21. Statistics reported in this section are based on data published in FAO. (forthcoming). *Fish and fishery products. World apparent consumption statistics based on food balance sheets. Revision 9: 1961–2005*. FAO Fisheries Circular No. 821. Rome. Some discrepancies may occur with other sections that quote data made available to FAO more recently. Food Balance Sheet (FBS) data calculated by FAO refer to "average food available for consumption", which, for a number of reasons (for example, waste at the household level), is not equal to average food intake or average food consumption. It should be noted that the production of subsistence fisheries as well as border trade between some developing countries could be incorrectly recorded and might therefore lead to an underestimation of consumption.
22. The term "fish" indicates fish, crustaceans and molluscs, including frogs and turtles, excluding crocodiles, alligators, aquatic mammals and aquatic plants.
23. The database of the United Nations Population Division can be accessed at http://esa.un.org/unup/
24. In January 2008, the World Bank and the World Conservation Union (IUCN) convened the first global workshop on corruption in fisheries (Fisheries and Corruption – from bad to worse, Washington, DC, 30–31 January 2008). It addressed wide-ranging issues including: types of corruption in fisheries; corruption and allocation of resources; corruption along the value chain; transboundary corruption and collusion; and the limits of responsible fish politics. The meeting also considered governance and anti-corruption strategies and how to clean up corrupt practices. In comparison, governance and corruption issues in the timber sector are fairly well studied and documented.
25. Very few countries have developed national plans of action (NPOAs) to manage fishing capacity, as called for in the 1999 FAO International Plan of Action for the Management of Fishing Capacity. Largely reflecting the political consequences of fleet reduction programmes, it is probably the least implemented of the four international plans of action. Information available to FAO indicates that about ten NPOAs–Capacity have been elaborated. There is little information on the extent to which these NPOAs are being implemented.
26. The 2007 Regional Consultative Workshop on Managing Fishing Capacity and IUU Fishing in the Asian Region adopted a call to action in which it was agreed that fleet overcapacity and IUU fishing threaten economic development and food security, and that the proactive tackling of capacity and IUU fishing delivers concrete benefits throughout the fisheries sector and economy generally. See FAO. 2007. *Managing fishing capacity and IUU fishing in the Asian region*. AFPIC Regional Consultative Workshop. RAP publication 2007/18. Bangkok.
27. The European Union (EU) recognizes this situation in its new policy and legal framework to combat IUU fishing. In a press release on 17 October 2007, the EU pointed out that "cooperation with our partners remains vital in any attempt to defeat international crime. For that reason, in addition to the new measures we are putting in place within the EU, intensified cooperation with our international partners will be key to our success, as will support to developing countries to protect their own resources against yet further plunder". The press release went on to say that "fighting illegal fishing effectively can have a tremendously positive effect for many developing countries, their economies and their natural resources. Under both its Common Fisheries Policy and its development cooperation, the EU will therefore prepare a series of accompanying measures in the coming two years to help developing countries to fight IUU operations more effectively".
28. Capacity building should be an ongoing activity because of the continual loss of trained human resources. In some countries, including small island developing states, the "brain drain" from the public sector to the private sector and abroad is often acute, necessitating that capacity building be continued almost on a regular basis.

29. The purpose of the performance reviews is to identify the strengths, weaknesses and performance gaps. Their recommendations provide guidance *inter alia* on remedial measures to enhance RFMO performance. Actions to implement the recommendations, which depend on the will and agreement of members, have the potential to be controversial and difficult.
30. The Ministerial Conference on Fisheries Cooperation among African States bordering the Atlantic Ocean was created under the 1991 Dakar Convention to promote cooperation concerning fisheries management and development in West Africa. It has played an important role in several regional meetings concerning different fisheries issues including regional monitoring, control and surveillance cooperation. The jurisdiction of the Conference extends from Morocco to Namibia, and as such is the only organization covering the whole West Africa region, although it is only open to coastal states.
31. The four countries involved are Japan, the Republic of Korea, the Russian Federation and the United States of America.
32. The Fisheries Resources Monitoring System (FIRMS) aims to assemble systematically comprehensive and reliable information on fisheries and fishery resources at the national, regional and global levels. An FAO initiative, FIRMS operates in partnership with RFBs.
33. These international fora have included the seventh round of Informal Consultations of the States Parties to the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN Headquarters, New York, United States of America, 11–12 March 2008).
34. The Western and Central Pacific Fisheries Commission (WCPFC) area accounts for more than 50 percent of world tuna catches. The management measures that were rejected sought to reduce: (i) the impact of purse seining on juvenile bigeye and yellowfin; and (ii) longline catches of adult bigeye.
35. The initiative relating to the Regional Ministerial Meeting on Promoting Responsible Fishing Practices, including Combating Illegal, Unreported and Unregulated Fishing in the Region involves Southeast Asian countries as well as Australia, Papua New Guinea and Timor-Leste. It is an interesting type of cooperation in that the initiative spans Asia and the Pacific regions.
36. See for example note 26. See also the UK Royal Institute of International Affairs (Chatham House). 2008. *The growth and control of international environmental crime – summary report*. London.
37. For example, in the Pacific Islands, IUU fishing is increasing as tuna stocks in other parts of the world decline. This fishing is undertaken by vessels of both members and non-members of the WCPFC. It is estimated that IUU catches in the WCPFC area could be as high as 10 percent of reported catches, or 200 000 tonnes in total. (Information summarized from an interview with the Executive Director, WCPFC, in *Islands Business*, December 2007).
38. The outcome of an initial March 2008 consultation on flag state responsibility led by the Governments of Canada and Iceland is expected to provide input for an FAO expert consultation prior to COFI in 2009.
39. There is a high degree of international acceptance that countries are at liberty to restrict or ban the import of IUU-caught fish because it is seen as equivalent to a stolen product. Restricting imports of such fish is not an impediment to international trade, and such action would be deemed consistent with WTO rules.
40. M. Gianni. 2004. IUU fishing and the cost to flag of convenience countries. Paper presented at *Workshop on Illegal, Unreported and Unregulated Fishing Activities*, 19–20 April 2004. Paris, OECD.

41. The requirement for flag states to certify that all imported fish has been harvested in a legal manner took effect on 1 May 2007. It is now being imposed by all NEAFC members for frozen fish imports.
42. With respect to the promotion of information and knowledge, the expert consultation recommended that FAO, in collaboration with RFMOs and other relevant mechanisms, should: undertake a global review of high seas deep-sea fisheries; review legal issues pertaining to the management of these fisheries; conduct research aimed at the reconstitution and analysis of historical high seas deep-sea fisheries data; identify and promote cost-effective ways for research on fisheries and habitats; and address the issue of defining destructive fishing in the deep sea and provide further guidance on reducing such practices.