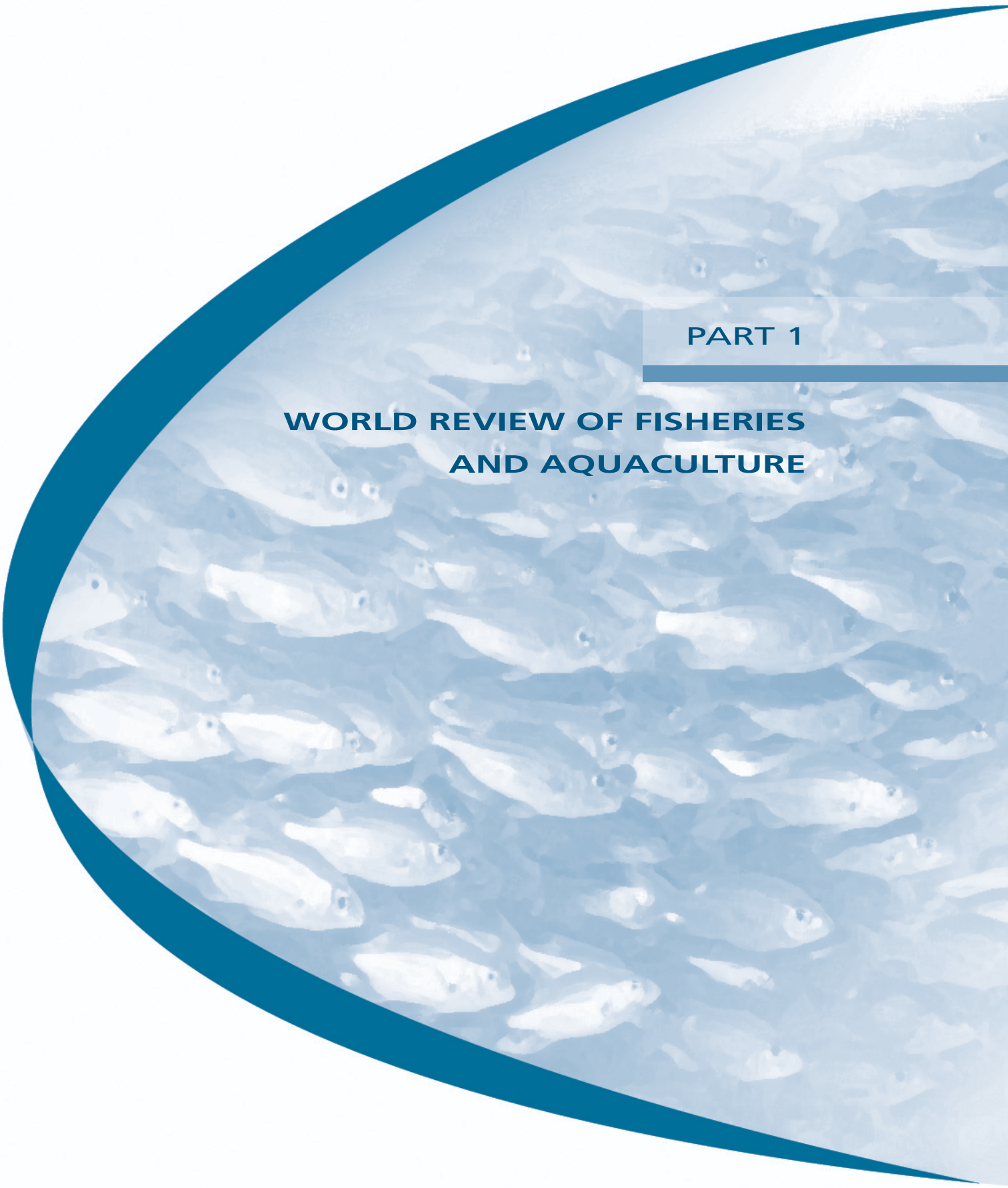


PART 1

WORLD REVIEW OF FISHERIES AND AQUACULTURE

WORLD REVIEW OF FISHERIES AND AQUACULTURE

Fisheries resources: trends in production, utilization and trade

OVERVIEW

Capture fisheries and aquaculture supplied the world with about 142 million tonnes of fish in 2008 (Table 1 and Figure 1; all data presented are subject to rounding). Of this, 115 million tonnes was used as human food, providing an estimated apparent per capita supply of about 17 kg (live weight equivalent), which is an all-time high (Table 1 and Figure 2). Aquaculture accounted for 46 percent of total food fish supply, a slightly lower proportion than reported in *The State of World Fisheries and Aquaculture 2008* owing to a major downward revision of aquaculture and capture fishery production statistics by China (see below), but representing a continuing increase from 43 percent in 2006. Outside China, per capita supply has remained fairly static in recent years as growth in supply from aquaculture has offset a small decline in capture fishery production and a rising population (Table 2). In 2008, per capita food fish supply was estimated at 13.7 kg if data for China are excluded. In 2007, fish accounted for 15.7 percent of the global population's intake of animal protein and 6.1 percent of all protein consumed. Globally, fish provides more than 1.5 billion people with almost 20 percent of their average per capita intake of animal protein, and 3.0 billion people with at least 15 percent of such protein. In 2007, the average annual per capita

Table 1
World fisheries and aquaculture production and utilization

	2004	2005	2006	2007	2008	2009
	(Million tonnes)					
PRODUCTION						
INLAND						
Capture	8.6	9.4	9.8	10.0	10.2	10.1
Aquaculture	25.2	26.8	28.7	30.7	32.9	35.0
Total inland	**33.8**	**36.2**	**38.5**	**40.6**	**43.1**	**45.1**
MARINE						
Capture	83.8	82.7	80.0	79.9	79.5	79.9
Aquaculture	16.7	17.5	18.6	19.2	19.7	20.1
Total marine	**100.5**	**100.1**	**98.6**	**99.2**	**99.2**	**100.0**
TOTAL CAPTURE	**92.4**	**92.1**	**89.7**	**89.9**	**89.7**	**90.0**
TOTAL AQUACULTURE	**41.9**	**44.3**	**47.4**	**49.9**	**52.5**	**55.1**
TOTAL WORLD FISHERIES	**134.3**	**136.4**	**137.1**	**139.8**	**142.3**	**145.1**
UTILIZATION						
Human consumption	104.4	107.3	110.7	112.7	115.1	117.8
Non-food uses	29.8	29.1	26.3	27.1	27.2	27.3
Population (*billions*)	6.4	6.5	6.6	6.7	6.8	6.8
Per capita food fish supply (*kg*)	16.2	16.5	16.8	16.9	17.1	17.2

Note: Excluding aquatic plants. Data for 2009 are provisional estimates.

apparent fish supply in developing countries was 15.1 kg, and 14.4 kg in low-income food-deficit countries (LIFDCs). In LIFDCs, which have a relatively low consumption of animal protein, the contribution of fish to total animal protein intake was significant – at 20.1 percent – and is probably higher than that indicated by official statistics in view of the underrecorded contribution of small-scale and subsistence fisheries.

China remains by far the largest fish-producing country, with production of 47.5 million tonnes in 2008 (32.7 and 14.8 million tonnes from aquaculture and capture fisheries, respectively). These figures were derived using a revised statistical methodology adopted by China in 2008 for all aquaculture and capture fishery

Figure 1

World capture fisheries and aquaculture production

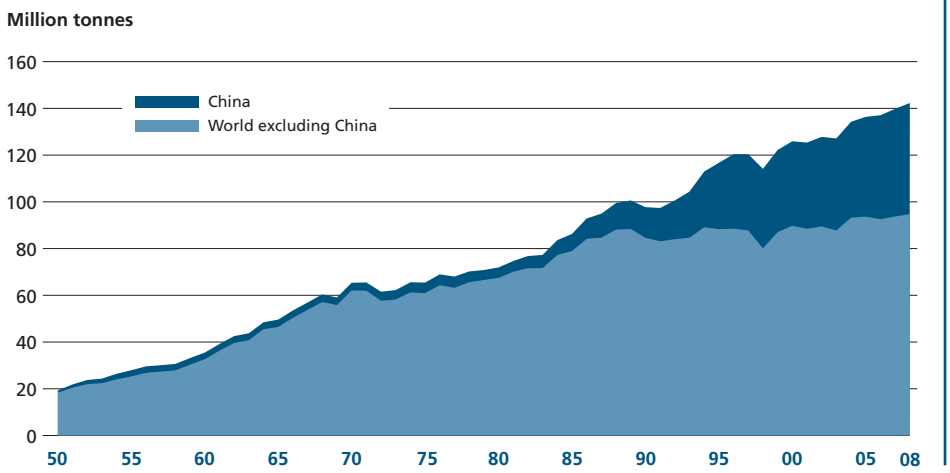


Table 2

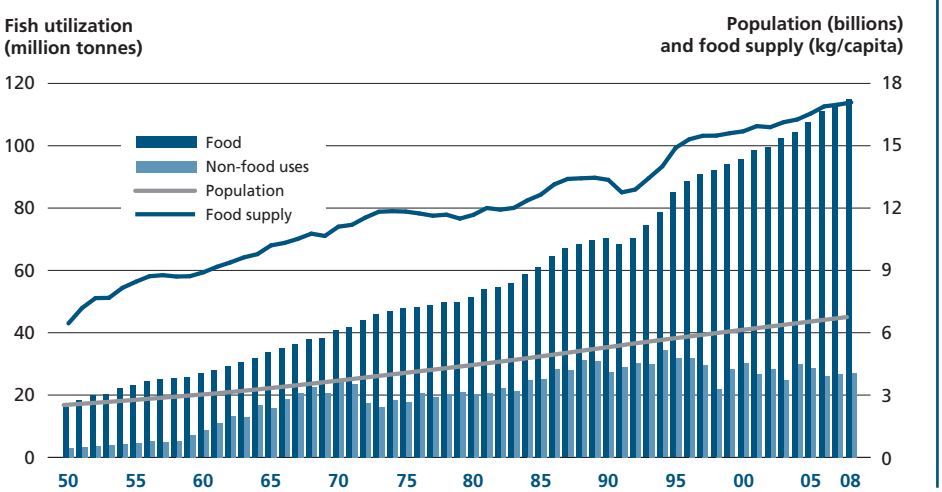
World fisheries and aquaculture production and utilization, excluding China

	2004	2005	2006	2007	2008	2009
	(Million tonnes)					
PRODUCTION						
INLAND						
Capture	6.5	7.2	7.6	7.7	8.0	7.9
Aquaculture	8.9	9.5	10.2	11.0	12.2	12.9
Total inland	**15.4**	**16.7**	**17.7**	**18.7**	**20.1**	**20.8**
MARINE						
Capture	71.4	70.3	67.5	67.5	67.0	67.2
Aquaculture	6.5	6.7	7.3	7.5	7.6	8.1
Total marine	**77.9**	**77.0**	**74.8**	**75.0**	**74.6**	**75.3**
TOTAL CAPTURE	**77.9**	**77.5**	**75.1**	**75.2**	**74.9**	**75.1**
TOTAL AQUACULTURE	**15.3**	**16.2**	**17.5**	**18.5**	**19.8**	**21.0**
TOTAL FISHERIES PRODUCTION	**93.2**	**93.7**	**92.6**	**93.7**	**94.8**	**96.1**
UTILIZATION						
Human consumption	68.8	70.4	72.4	73.5	74.3	75.5
Non-food uses	24.5	23.2	20.2	20.2	20.5	20.5
Population (*billions*)	5.2	5.2	5.3	5.4	5.4	5.5
Per capita food fish supply (*kg*)	13.4	13.5	13.7	13.7	13.7	13.7

Note: Excluding aquatic plants. Data for 2009 are provisional estimates.

Figure 2

World fish utilization and supply



production statistics and applied to statistics for 2006 onwards. The revision was based on the outcome of China's 2006 National Agricultural Census, which contained questions on fish production for the first time, as well as on results from various pilot sample surveys, most of which were conducted in collaboration with FAO. While revisions varied according to species, area and sector, the overall result was a downward correction of fishery and aquaculture production statistics for 2006 of about 13.5 percent. FAO subsequently estimated revisions for its historical statistics for China for 1997–2005. Notice of the impending revision by China had been given in *The State of World Fisheries and Aquaculture 2008*. Because of the major importance of China in the global context, China is in some cases discussed separately from the rest of the world in this publication.

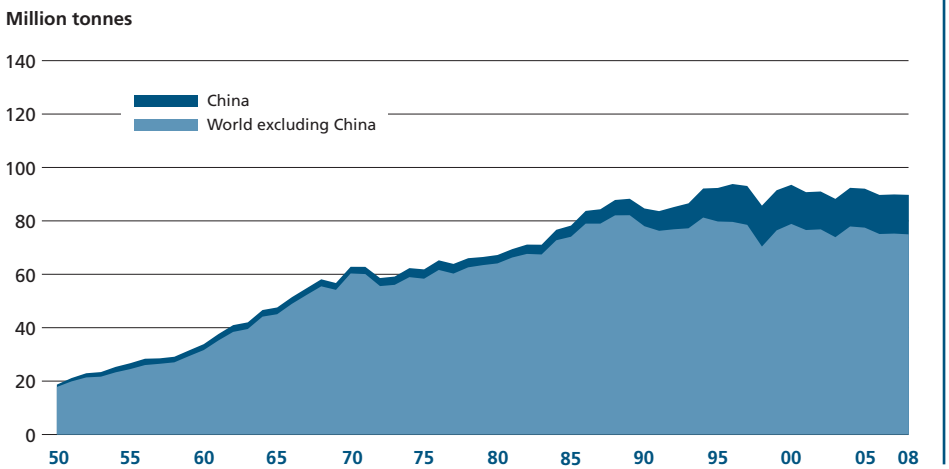
Global capture fisheries production in 2008 was about 90 million tonnes, with an estimated first-sale value of US$93.9 billion, comprising about 80 million tonnes from marine waters and a record 10 million tonnes from inland waters (Table 1 and Figure 3). World capture fisheries production has been relatively stable in the past decade (Figure 3), 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. Fluctuations in other species and regions tend to compensate for each other to a large extent. In 2008, China, Peru and Indonesia were the top producing countries. China remained by far the global leader with production of about 15 million tonnes.

Although the revision of China's fishery statistics reduced reported catches by about 2 million tonnes per year in the Northwest Pacific, this area still leads by far the ranking of marine fishing areas, followed by the Southeast Pacific, the Western Central Pacific and the Northeast Atlantic. The same species have dominated marine catches since 2003, with the top ten species accounting for about 30 percent of all marine catches. Catches from inland waters, two-thirds of which were reported as being taken in Asia in 2008, have shown a slowly but steadily rising trend since 1950, owing in part to stock enhancement practices and possibly also to some improvements in reporting, which still remains poor for inland water fisheries (with small-scale and subsistence fisheries substantially underrepresented in the statistics).

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 2008, an average annual growth rate of 6.6 percent.

Figure 3

World capture fisheries production



It is set to overtake capture fisheries as a source of food fish. While aquaculture production (excluding aquatic plants) was less than 1 million tonnes per year in the early 1950s, production in 2008 was 52.5 million tonnes, with a value of US$98.4 billion. Aquatic plant production by aquaculture in 2008 was 15.8 million tonnes (live weight equivalent), with a value of US$7.4 billion, representing an average annual growth rate in terms of weight of almost 8 percent since 1970. Thus, if aquatic plants are included, total global aquaculture production in 2008 amounted to 68.3 million tonnes with a first-sale value of US$106 billion. World aquaculture is heavily dominated by the Asia–Pacific region, which accounts for 89 percent of production in terms of quantity and 79 percent in terms of value. This dominance is mainly because of China's enormous production, which accounts for 62 percent of global production in terms of quantity and 51 percent of global value.

Growth rates for aquaculture production are slowing, reflecting the impacts of a wide range of factors, and vary greatly among regions. Latin America and the Caribbean showed the highest average annual growth in the period 1970–2008 (21.1 percent), followed by the Near East (14.1 percent) and Africa (12.6 percent). China's aquaculture production increased at an average annual growth rate of 10.4 percent in the period 1970–2008, but in the new millennium it has declined to 5.4 percent, which is significantly lower than in the 1980s (17.3 percent) and 1990s (12.7 percent). The average annual growth in aquaculture production in Europe and North America since 2000 has also slowed substantially to 1.7 percent and 1.2 percent, respectively. The once-leading countries in aquaculture development such as France, Japan and Spain have shown falling production in the past decade. It is expected that, while world aquaculture production will continue to grow in the coming decade, the rate of increase in most regions will slow.

The fish sector is a source of income and livelihood for millions of people around the world. Employment in fisheries and aquaculture has grown substantially in the last three decades, with an average rate of increase of 3.6 percent per year since 1980. It is estimated that, in 2008, 44.9 million people were directly engaged, full time or, more frequently, part time, in capture fisheries or in aquaculture, and at least 12 percent of these were women. This number represents a 167 percent increase compared with the 16.7 million people in 1980. It is also estimated that, for each person employed in capture fisheries and aquaculture production, about three jobs are produced in secondary activities, including post-harvest, for a total of more than 180 million jobs in the whole of the fish industry. Moreover, on average, each jobholder provides for three dependants or family members. Thus, the primary and secondary sectors support

the livelihoods of a total of about 540 million people, or 8.0 percent of the world population.

Employment in the fisheries sector has grown faster than the world's population and than employment in traditional agriculture. The 44.9 million people engaged in the sector in 2008 represented 3.5 percent of the 1.3 billion people economically active in the broad agriculture sector worldwide, compared with 1.8 percent in 1980. The majority of fishers and aquaculturists are in developing countries, mainly in Asia, which has experienced the largest increases in recent decades, reflecting in particular the rapid expansion of aquaculture activities. In 2008, 85.5 percent of fishers and fish farmers were in Asia, followed by Africa (9.3 percent), Latin America and the Caribbean (2.9 percent), Europe (1.4 percent), North America (0.7 percent) and Oceania (0.1 percent). China is the country with the highest number of fishers and fish farmers, representing nearly one-third of the world total. In 2008, 13.3 million people were employed as fishers and fish farmers in China, of whom 8.5 million people were full time. In 2008, other countries with a relatively high number of fishers and fish farmers were India and Indonesia.

Although the highest concentration of people employed in the primary sector is in Asia, average annual production per person there is only 2.4 tonnes, whereas it is almost 24 tonnes in Europe and more than 18 tonnes in North America. This reflects the degree of industrialization of fishing activities, and, in Africa and Asia, also the key social role played by small-scale fisheries. The differences are even more evident in the aquaculture sector, where, for example, fish farmers' average annual production in Norway is 172 tonnes per person, while in Chile it is about 72 tonnes, in China 6 tonnes and in India only 2 tonnes.

Although capture fisheries continue to provide by far the greater number of jobs in the primary sector, it is apparent that the share of employment in capture fisheries is stagnating or decreasing and increased opportunities are being provided by aquaculture. According to the estimates based on the available data for 2008, fish farmers accounted for one-quarter of the total number of workers in the fisheries sector, totalling almost 11 million people. Since 1990, fish farmers have experienced the greatest increases in their numbers, with most of the growth occurring in Asia, particularly in China, where the number of fish farmers increased by 189 percent in the period 1990–2008.

Employment in fishing is decreasing in capital-intensive economies, in particular in most European countries, North America and Japan. This is the result of several factors, including decreased catches, programmes to reduce fishing capacity and increased productivity through technical progress. It is estimated that about 1.3 million people were employed in fisheries and aquaculture in developed countries in 2008, a decrease of 11 percent compared with 1990.

Analyses indicate that the global fishing fleet is made up of about 4.3 million vessels and that this figure has not increased substantially from an FAO estimate of a decade ago. About 59 percent of these vessels are powered by engines. The remaining 41 percent are traditional craft of various types, operated by sails and oars, concentrated primarily in Asia (77 percent) and Africa (20 percent). These unmotorized boats are engaged in fishing operations, usually inshore or on inland waters. The estimated proportion of non-powered boats is about 4 percent lower than that obtained in 1998. Of the total number of fishing vessels powered by engines, the vast majority (75 percent) were reported from Asia and the rest mostly from Latin America and the Caribbean (8 percent), Africa (7 percent) and Europe (4 percent). The proportion of countries where the number of vessels either decreased or remained the same (35 percent) was greater than that of those where it increased (29 percent). In Europe, 53 percent of the countries decreased their fleet and only 19 percent of countries increased it. There was no increase in North America, while in the Pacific and Oceania region the fleet size either remained the same or decreased in a larger proportion of countries. In the Near East, 6 out of 13 countries (46 percent) increased the number of vessels in their fleets. In Latin America and the Caribbean, Asia and

Africa, an even greater proportion of countries increased their national fleets in terms of number of vessels.

The proportion of marine fish stocks estimated to be underexploited or moderately exploited declined from 40 percent in the mid-1970s to 15 percent in 2008, whereas the proportion of overexploited, depleted or recovering stocks increased from 10 percent in 1974 to 32 percent in 2008. The proportion of fully exploited stocks has remained relatively stable at about 50 percent since the 1970s. In 2008, 15 percent of the stock groups monitored by FAO were estimated to be underexploited (3 percent) or moderately exploited (12 percent) and able to produce more than their current catches. This is the lowest percentage recorded since the mid-1970s. Slightly more than half of the stocks (53 percent) were estimated to be fully exploited and, therefore, their current catches are at or close to their maximum sustainable productions, with no room for further expansion. The remaining 32 percent were estimated to be either overexploited (28 percent), depleted (3 percent) or recovering from depletion (1 percent) and, thus, yielding less than their maximum potential production owing to excess fishing pressure, with a need for rebuilding plans. This combined percentage is the highest in the time series. The increasing trend in the percentage of overexploited, depleted and recovering stocks and the decreasing trend in underexploited and moderately exploited stocks give cause for concern.

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, are fully exploited. The two main stocks of anchoveta (*Engraulis ringens*) in the Southeast Pacific and those of Alaska pollock (*Theragra chalcogramma*) in the North Pacific and blue whiting (*Micromesistius poutassou*) in the Atlantic are fully exploited. Several Atlantic herring (*Clupea harengus*) stocks are fully exploited, but some are depleted. Japanese anchovy (*Engraulis japonicus*) in the Northwest Pacific and Chilean jack mackerel (*Trachurus murphyi*) in the Southeast Pacific are considered to be fully exploited. Some limited possibilities for expansion may exist for a few stocks of chub mackerel (*Scomber japonicus*), which are moderately exploited in the Eastern Pacific, while the stock in the Northwest Pacific was estimated to be recovering. In 2008, the largehead hairtail (*Trichiurus lepturus*) was estimated to be overexploited in the main fishing area in the Northwest Pacific. Of the 23 tuna stocks, most are more or less fully exploited (possibly up to 60 percent), some are overexploited or depleted (possibly up to 35 percent) and only a few appear to be underexploited (mainly skipjack). In the long term, because of the substantial demand for tuna and the significant overcapacity of tuna fishing fleets, the status of tuna stocks may deteriorate further if there is no improvement in their management. Concern about the poor status of some bluefin stocks and the difficulties in managing them led to a proposal to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2010 to ban the international trade of Atlantic bluefin. Although it was hardly in dispute that the stock status of this high-value food fish met the biological criteria for listing on CITES Appendix I, the proposal was ultimately rejected. Many parties that opposed the listing stated that in their view the International Commission for the Conservation of Atlantic Tunas (ICCAT) was the appropriate body for the management of such an important commercially exploited aquatic species. Despite continued reasons for concern in the overall situation, it is encouraging to note that good progress is being made in reducing exploitation rates and restoring overfished fish stocks and marine ecosystems through effective management actions in some areas such as off Australia, on the Newfoundland–Labrador Shelf, the Northeast United States Shelf, the Southern Australian Shelf, and in the California Current ecosystems.

Inland fisheries are a vital component in the livelihoods of people in many parts of the world, in both developing and developed countries. However, irresponsible fishing practices, habitat loss and degradation, water abstraction, drainage of wetlands, dam construction and pollution (including eutrophication) often act together, thus compounding one another's effects. They have caused substantial declines and other

changes in inland fishery resources. Although these impacts are not always reflected by a discernable decrease in fishery production (especially when stocking is practised), the fishery may change in composition and value. The poor state of knowledge on inland fishery resources and their ecosystems has led to differing views on the actual status of many resources. One view maintains that the sector is in serious trouble because of the multiple uses of and threats to inland water ecosystems. The other view holds that the sector is in fact growing, that much of the production and growth has gone unreported and that stock enhancement through stocking and other means has played a significant role. Irrespective of these views, the role of inland fisheries in poverty alleviation and food security needs to be better reflected in development and fisheries policies and strategies. The tendency to undervalue inland fisheries in the past has resulted in inadequate representation in national and international agendas. In recognition of this, the "Outlook" section of this publication focuses on inland fisheries in an effort to improve awareness of their role and importance.

As a highly perishable commodity, fish has specific requirements and a significant capacity for processing. Almost 81 percent (115 million tonnes) of world fish production in 2008 was destined for human consumption, while the rest (27 million tonnes) was used for non-food purposes such as fishmeal and fish oil (20.8 million tonnes), culture, bait, and pharmaceutical uses as well as for direct feeding in aquaculture and for fur animals.

In 2008, 39.7 percent (56.5 million tonnes) of total world fish production was marketed as fresh, while 41.2 percent (58.6 million tonnes) of fish was frozen, cured or otherwise prepared for direct human consumption. Since the mid-1990s, the proportion of fish used for direct human consumption has grown as more fish is used as food and less for producing fishmeal and fish oil. Of the fish destined for direct human consumption, fish in live or fresh form was the most important product, with a share of 49.1 percent, followed by frozen fish (25.4 percent), prepared or preserved fish (15.0 percent) and cured fish (10.6 percent). Live and fresh fish grew in quantity from 45.4 million tonnes in 1998 to 56.5 million tonnes in 2008 (live weight equivalent). Processed fish for human consumption increased from 46.7 million tonnes in 1998 to 58.6 million tonnes in 2008 (live weight equivalent). Freezing represents the main method of processing fish for human consumption and it accounted for a 49.8 percent share of total processed fish for human consumption and 20.5 percent of total fish production in 2008. Anchoveta and other small pelagics are the main species used for reduction, and the production of fishmeal and fish oil is strictly linked to the catches of these species.

Trade in fish represents a significant source of foreign currency earnings, in addition to the sector's important role in employment, income generation and food security. In 2008, trade in fish and fishery products represented a share of about 10 percent of total agricultural exports and 1 percent of world merchandise trade in value terms. The share of fishery and aquaculture production (live weight equivalent) entering international trade as various food and feed products increased from 25 percent in 1976 to 39 percent in 2008, reflecting the sector's growing degree of openness to, and integration in, international trade. In 2008, exports of fish and fishery products reached a record value of US$102.0 billion, 9 percent higher than in 2007, almost double the US$51.5 billion corresponding value in 1998. In real terms (adjusted for inflation), fishery exports grew by 11 percent in the period 2006–08 and by 50 percent between 1998 and 2008. In the period from late 2006 to mid-2008, international agricultural prices (particularly of basic foods) surged to record levels in nominal terms owing to several factors including a tightening in own supplies, the intertwining of global markets, exchange rate fluctuations, and rising crude oil prices and freight rates. These soaring prices affected large population segments, in particular among the poor in many developing countries. Prices of fish and fishery products were also affected by the food price crisis, following the general upward trend in all food prices. The FAO Fish Price Index indicates an increase of 37 percent between February 2007 and September

2008, when it reached a record high. Prices for species from capture fisheries increased more than those for farmed species because of the larger impact from higher energy prices on fishing vessel operations than on farmed species. The FAO Fish Price Index showed a drastic drop from September 2008 to March 2009 with the global financial crisis and recession, after which it recovered somewhat. Preliminary estimates indicate that trade in fish and fishery products declined by 7 percent in 2009 compared with 2008. Available data for the first few months of 2010 indicate that there have been increasing signs that fish trade is recovering in many countries, and the long-term forecast for fish trade remains positive, with a growing share of fish production entering international markets.

China, Norway and Thailand are the top three fish exporters. Since 2002, China has been by far the leading fish exporter, contributing almost 10 percent of 2008 world exports of fish and fishery products, or about US$10.1 billion, and increasing further to US$10.3 billion in 2009. China's fishery exports have grown considerably since the 1990s, and a growing share of these exports consists of reprocessed imported raw material. Developing countries, in particular China, Thailand and Viet Nam, accounted for 80 percent of world fishery production in 2008 with their exports accounting for 50 percent (US$50.8 billion) of world exports of fish and fishery products in value terms. Low-income food-deficit countries are playing an active and growing role in the trade in fish and fishery products, with their fishery exports reaching US$19.8 billion in 2008. World imports of fish and fish products reached the new record of US$107.1 billion in 2008, growing by 9 percent compared with previous year. Preliminary data for 2009 point to a 9 percent decrease, as a consequence of the economic downturn and the contraction in demand in key importing countries. Japan, the United States of America and the European Union (EU) are the major markets, with a total share of about 69 percent in 2008. Japan is the world's largest single national importer of fish and fishery products, with imports valued at US$14.9 billion in 2008, a growth of 13 percent compared with 2007, although its imports decreased by 8 percent in 2009. The EU is by far the largest market for imported fish and fishery products with imports in 2008 worth US$44.7 billion, up 7 percent on 2007, and representing 42 percent of total world imports. However, if intraregional trade among EU countries is excluded, the EU imported US$23.9 billion from non-EU suppliers. This still makes the EU the largest market in the world, with about 28 percent of the value of world imports (excluding intra-EU trade). Figures for 2009 indicate a downward trend in EU imports, with a 7 percent decrease in value recorded. The Latin America and the Caribbean region continues to maintain a solid positive net fishery exporter role, as do the Oceania region and the developing countries of Asia. By value, Africa has been a net exporter since 1985, but it is a net importer in quantity terms, reflecting the lower unit value of the imports (mainly small pelagics). Europe and North America are characterized by a fishery trade deficit. High-value species such as shrimp, prawns, salmon, tuna, groundfish, flatfish, seabass and seabream are highly traded, in particular as exports to more affluent economies, and low-value species such as small pelagics are also traded in large quantities. Products derived from aquaculture production are contributing an increasing share of total international trade in fishery commodities, with species such as shrimp, prawns, salmon, molluscs, tilapia, catfish, seabass and seabream.

Governance of small- and large-scale fisheries and of aquaculture is receiving increasing attention. Latest estimates indicate that small-scale fisheries contribute more than half of the world's marine and inland fish catch, almost all of which is destined for direct human consumption. These fisheries employ more than 90 percent of the world's 35 million capture fishers and they support another 84 million people employed in jobs associated with fish processing, distribution and marketing. There are also millions of other rural dwellers, particularly in Asia and Africa, involved in seasonal or occasional fishing activities with few alternative sources of income and employment. Almost half of the people employed in the primary and secondary sectors associated with small-scale fisheries are women. More than 95 percent of small-scale fishers and related workers in post-harvest sectors live in developing countries. In

spite of their economic, social and nutritional benefits, as well as their contribution to societal and cultural values, small-scale fishing communities often face precarious and vulnerable living and working conditions. Poverty remains widespread for millions of fishing people, especially in sub-Saharan Africa and South and Southeast Asia. Overfishing and potential depletion of fishery resources constitute a real threat to many coastal communities relying on small-scale fisheries, but social structures and institutional arrangements also play a central role in engendering poverty. Critical factors that contribute to poverty in small-scale fishing communities include: insecure access rights to fishery resources; poor or absent health and educational services; lack of social safety nets; vulnerability to natural disasters and climate change; and exclusion from wider development processes owing to weak organizational structures and inadequate representation and participation in decision-making. These factors all have important consequences for the governance of small-scale fisheries. Addressing poverty requires that marginalized groups be included in the institutional processes related to their development including fishery management through new institutional approaches. A human rights approach has been proposed that requires strengthening the capacity of fishing communities to be aware of, claim and exercise their rights effectively. It also requires all duty-bearers, including states, to fulfil their human rights obligations, including through legislation. Devolved management responsibilities and comanagement arrangements with strong involvement of local resource users together with the state have a role to play, but these require human capacity at the local level as well as legal, practical and community-based arrangements.

The role and obligations of regional fishery bodies (RFBs), and particularly those with a management remit, in international fisheries governance are growing steadily, but strengthening their performance still remains the major challenge. Most RFBs consider illegal, unreported and unregulated (IUU) fishing, effective implementation of monitoring, control and surveillance (MCS) and overcapacity in fishing fleets as being the main challenges to their performance. Most RFBs have reported an inability to control IUU fishing and highlighted the impact that this has on undermining attempts at effective fisheries management, although there have been some notable successful developments in this regard. Difficulties in implementation of the ecosystem approach to fisheries (EAF), the control of bycatch and the promotion of economic development in member countries are also widespread among RFBs. A new inland fishery body, the Central Asian and the Caucasus Fisheries and Aquaculture Commission, is in the process of development with the objective to promote the development, conservation, rational management and best utilization of living aquatic resources, including the sustainable development of aquaculture. A convention has been adopted for the proposed South Pacific Regional Fisheries Management Organisation, which, when it enters into force, will close a gap that exists in the international conservation and management of non-highly migratory fish stocks and protection of biodiversity in the marine environment extending from the easternmost part of the South Indian Ocean through the Pacific Ocean towards the exclusive economic zones (EEZs) of South America. The RFBs share information of joint interest through the Regional Fishery Bodies Secretariat Network (RSN).

The RFBs are at the forefront in the fight against IUU fishing. The tuna RFBs have demonstrated the benefits of more rigorous interregional collaboration and harmonization of activities to address IUU fishing, and this provides a basis for wider collaboration among non-tuna RFBs. A certification scheme to stem the flow of IUU-caught fishery products into the EU market was introduced in 2010. The preparation of national plans of action to combat IUU fishing, as called for in the FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU) of 2001, has stalled after the development of about 40 such national plans, despite their undoubted value. The FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal Unreported and Unregulated Fishing was finalized in 2009 and its application will serve to reduce the effects of IUU fishing.

Problems persist with the high levels of unwanted and often unreported bycatch and discards in many fisheries around the world, including the capture of ecologically

important species and juveniles of economically valuable species. The latest estimate of global discards from fishing is about 7 million tonnes per year. Apart from the mortality discarding inflicts on the commercial fishery resources, there are also issues about the mortalities of rare, endangered or vulnerable species and socio-economic considerations about the non-utilization of discarded bycatch. To respond to concerns about this raised in the FAO Committee on Fisheries (COFI) and the United Nations General Assembly, FAO will lead the development of international guidelines on bycatch management and reduction of discards.

FAO Guidelines were adopted in 2008 to assist states and regional fisheries management organizations (RFMOs) in sustainably managing deep-sea fisheries in the high seas and are increasingly being implemented. The Guidelines provide advice on topics vital to fisheries management such as data and reporting, enforcement and compliance, management measures, conservation-related aspects, criteria for identification of vulnerable marine ecosystems (VMEs) and impact assessment.

Consumers of fish, particularly in the world's richer economies, are increasingly demanding that retailers guarantee that the fish they offer is not only of high quality and safe to eat but also that it derives from fisheries that are sustainable. For retailers to provide such guarantees, they must receive, together with the fish, certificates that guarantee the wholesomeness of the product, that the product label correctly identifies the species, that the fish originates in sustainable fisheries and that the chain of custody is unbroken. As a consequence, several large-scale retailers are demanding certification to their own private standards schemes in the areas of both food safety and quality and sustainability. Public administrations in importing countries are also in the process of responding to consumer demands while regulating the industry to reduce fraudulent practices. One of the main strategies for doing this is to impose product traceability schemes on the industry that verify the integrity of the supply chain and take measures when that integrity is broken. Traceability initiatives, whether implemented by non-governmental organizations (NGOs), governments or RFBs, are becoming increasingly prevalent. Recent initiatives include the adoption of or progress with the development of ecolabelling or certification guidelines for marine fisheries, inland fisheries and aquaculture.

In the past two decades, considerable progress has been made in addressing aquaculture governance issues through national and international corporate efforts with the common goal of sustainability of the sector. Approaches have varied from top-down, command and control of the sector's development with little or no consultation with stakeholders, through a "market-driven" approach where government policy is to let the private sector largely lead aquaculture development, to "participatory governance" involving industry self-regulation, comanagement by industry representatives and government regulators, or community partnerships. Participatory governance is increasingly becoming the norm. Where aquaculture governance has proved fruitful, it appears that governments have followed four main guiding principles, namely: accountability, effectiveness and efficiency, equity, and predictability. Accountability would be reflected in timely decisions and would imply stakeholder participation in decision-making processes. Effectiveness and efficiency consist of making the right decisions and implementing them effectively in a cost-effective way. Equity requires that all groups, particularly the most vulnerable ones, have opportunities to improve or maintain their well-being through the guaranteeing of procedural fairness, distributional justice and participation in decision-making. Predictability relates to fairness and consistency in the application of laws and regulations and in the implementation of policies. While there have been laudable efforts throughout the sector, aquaculture governance remains an issue in many countries. There are still conflicts over marine sites, disease outbreaks, negative public perceptions of aquaculture in certain countries, an inability of small-scale producers to meet foreign consumers' quality requirements and inadequate development of the sector in certain jurisdictions despite favourable demand and supply conditions.

CAPTURE FISHERIES PRODUCTION

Total capture fisheries production

In the early 1970s, an FAO study compiled by Gulland[1] estimated the potential fish (excluding invertebrates) harvest of resources of the oceans at close to 100 million tonnes but, considering it unlikely that all stocks could be exploited at the optimal level, set also a more realistic forecast at 80 million tonnes. However, even this lower estimate has never been approached, and global marine fish catch production peaked in 1996 at 74.7 million tonnes. Since the mid-1990s and throughout the 2000s, several studies[2] have predicted the rapid decline of marine fisheries worldwide. Paradoxically, a glance at the total global capture statistics collated by FAO almost 40 years after those analysed by Gulland prompts a word that has very rarely been used to describe catch trends: stability.

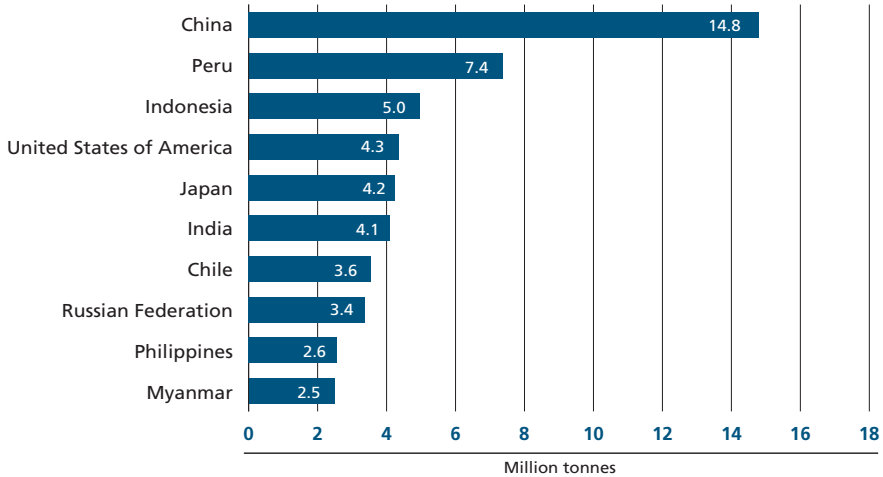
In fact, despite a marked variability in the annual total catch by several countries, fishing areas and species (the three fields included in the FAO capture database), the world total (marine and inland) capture production for the period 2006–08 was very steady at about 89.8 million tonnes (Table 1 and Figure 3). In those years, a minor decrease in global marine catches was compensated for by an increase of 0.2 million tonnes in total inland waters capture production for both 2007 and 2008. Even the usually highly variable anchoveta catches, which caused the drop in total marine catches between 2005 and 2006, remained fairly stable for three subsequent years (2006–08) for the first time since 1970.

Collation by FAO of national fishery statistics encountered more difficulties in 2009 than in previous years. The number of non-reporting countries increased, and, on average, a worsening of the quality of capture statistics submitted was also noted. As for other activities depending on public funding, it is probable that some schemes to collect national fishery data were cut or reduced owing to the global economic crisis. However, national administrations should consider as a priority maintaining data collection systems that, despite reduced budgets, would continue to enable reliable trend studies on national and international fishery production.

The most significant change in the ranking of the top ten producers (Figure 4) was the gaining of a position by two Asian countries (i.e. Indonesia and India), which surpassed two American countries (i.e. the United States of America and Chile) whose total capture production decreased by 10 and 15 percent, respectively, in comparison with 2006. In addition to the performance of the Asian countries mentioned above,

Figure 4

Marine and inland capture fisheries: top ten producer countries in 2008



other major Asian fishing countries (i.e. Bangladesh, Myanmar, Philippines and Viet Nam) have been reporting regularly increasing capture statistics in the last ten years despite well-known cases of local overfishing and natural disasters, such as the December 2004 tsunami and cyclones, that have occurred in this area in recent years.

World marine capture fisheries production

Although the revision of China's fishery statistics reduced reported catches by about 2 million tonnes per year in the Northwest Pacific, this area still leads by far the ranking of marine fishing areas (Figure 5). As already stated, 2006–08 global marine production was practically stable although individual fishing areas showed distinct catch trends.

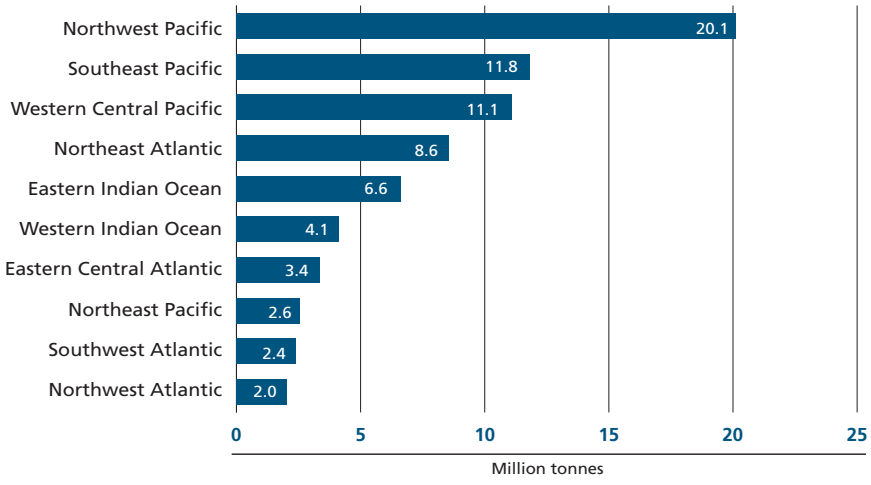
In the Northwest, Northeast and Western Central Atlantic, capture production reached recent peaks in 2004, 2001 and 2000, respectively, but in the following years catches consistently decreased with overall reductions of 13, 23 and 30 percent, respectively. In the Mediterranean and Black Seas, catches decreased by 12 percent in 2008 in comparison with the high catches of the previous year, a negative result shared by all five major fishing countries. Catch trends in the Atlantic areas did not vary much in 2006–08.

Growth in total catch in the Indian Ocean has been sustained since 1950, but in 2007 and 2008 this trend reversed in the Western Indian Ocean whereas it kept its pace in the Eastern Indian Ocean. The catch decrease in the Western Indian Ocean is mostly due to a reduction in tuna catches for both local and distant waters fleets.

Among the six very large and highly diverse fishing areas into which the Pacific Ocean is divided, recent changes in catch trends have occurred in the Northeast, Southwest and Eastern Central Pacific areas. In the Northeast Pacific, a catch decline has been noted since 2006 for both Canada and the United States of America, the only two countries catching significant quantities in this area. In the Southwest Pacific, the catch has decreased since 2006. In this area, New Zealand's share of total catch was 73 percent in the period but it is noteworthy that 23 percent was caught by European and North Asian vessels, which travel to this distant area to target pelagic and demersal fish and cephalopods. Starting in the 1980s, total catch in the Eastern Central Pacific has been fluctuating around an average of 1.6 million tonnes but a positive trend since 2005 has produced an overall 20 percent catch increase.

Figure 5

Capture fisheries production: principal marine fishing areas in 2008



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

For the Southern Ocean (Antarctic) areas, FAO derives catch statistics from information produced by the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR). Owing to the strict and effective management regime applied by this RFB, catch variations in this region are usually small, but a marked increase in krill catches was registered in 2008.

The dominant species in marine fishery catches (Figure 6) have been the same since 2003 and only a few changes in the ranking have occurred in the last six years, another sign of a relative stability. The share of the top ten species in global marine catches has varied little, oscillating between 29 and 33 percent. However, there are differences among the trend trajectories of the various species groups and the most striking are described below.

Growth of tuna fisheries halted in 2008 as catches of this species group decreased by 2.6 percent after the 2007 global record of almost 6.5 million tonnes (Figure 7). While maximum tuna catches in the Pacific Ocean (which represents about 70 percent of the global catches) and in the Indian Ocean were reached in 2007 and 2006, respectively, the peak of Atlantic tuna catches dates back to 1993. Shark catches decreased by almost 20 percent from their 2003 peak at 0.9 million tonnes. It is hoped that this reduction is partially due to the effectiveness of the management measures (e.g. finning ban) implemented at the national and regional levels to regulate both fisheries targeting sharks and shark bycatch, rather than to stock decline resulting from overfishing of sharks.

The decline of the gadiformes ("cods, hakes, haddocks" in Figure 7) seems relentless. In 2008, catches of this species group as a whole did not total 8 million tonnes, a level that had been until then consistently exceeded since 1967 and that reached a peak of almost 14 million tonnes in 1987. In the last decade, catches of Atlantic cod, the iconic species of this group, have been somewhat stable in the Northwest Atlantic at about 50 000 tonnes (very low by historical standards), but in the Northeast Atlantic catches have further decreased by 30 percent.

Cephalopod catches set a new record in 2008, although their growth seems to have levelled off. This is the species group that has shown the strongest performance in recent years, with a gain of more than 1 million tonnes since 2002 (Figure 7). Crabs are another group of invertebrates that reached a maximum in 2008, with overall catches growing by one-quarter in the last six years. On the other hand, shrimp catches have

Figure 6

Marine capture fisheries production: top ten species in 2008

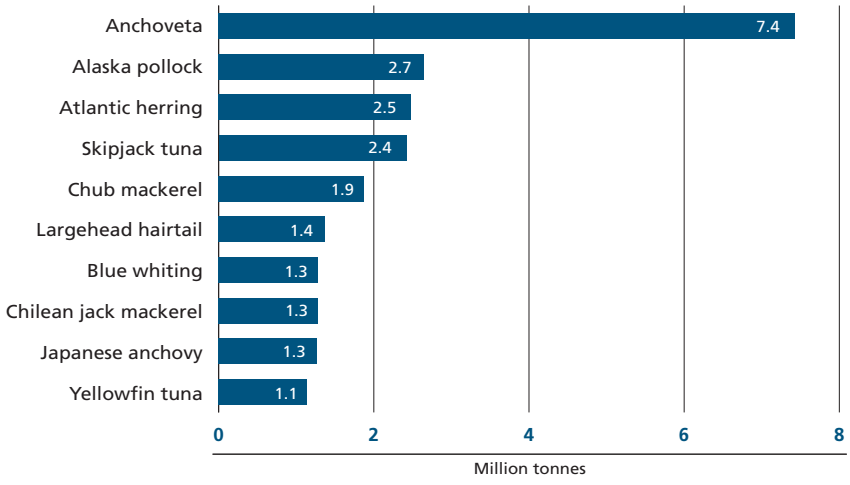


Figure 7

Catch trends by valuable marine species groups

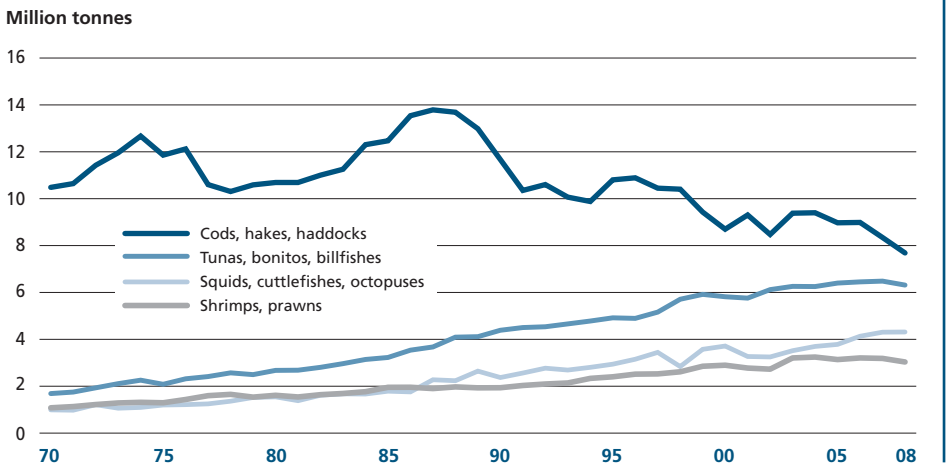
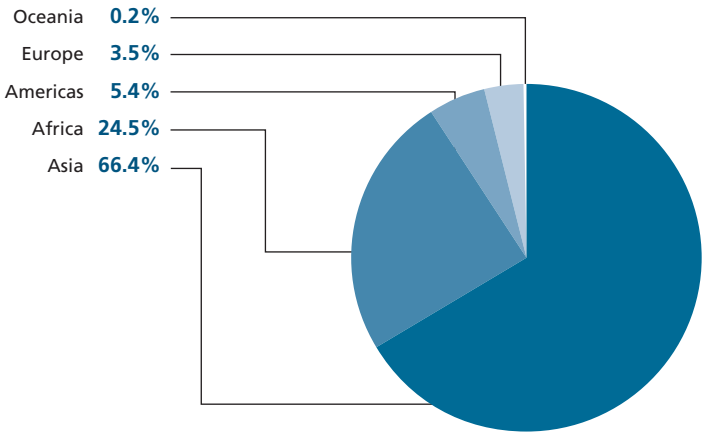


Figure 8

Inland capture fisheries by continent in 2008



Note: World inland capture fisheries production amounted to 10.2 million tonnes in 2008.

decreased slightly but remained at more than 3 million tonnes in 2008 (Figure 7). The four groups of bivalves as a whole were very steady in 2005–08, although different trends are shown by the groups. Oyster and mussel catches have been declining since 2000, whereas scallops and clams have recently recovered from previously negative trends.

World inland capture fisheries production

Global inland capture fisheries production was fairly stable between 2000 and 2004 at about 8.6 million tonnes, but in the following four years it showed an overall increase of 1.6 million tonnes, reaching 10.2 million tonnes in 2008 (Table 1). Asia accounted for two-thirds of the world production (Figure 8).

Table 3 shows the variations between 2004 and 2008 for the 14 countries with catches of more than 200 000 tonnes each in 2008 and which together represented about 78 percent of the 2008 world catches. The unexpected recent growth in global total production, despite increasing concern about environmental conditions of

Table 3
Inland capture fisheries: major producer countries

Country	2004	2008	Variation 2004–2008	
	(Tonnes)	(Tonnes)	(Tonnes)	(Percentage)
China	2 097 167 [1]	2 248 177	151 010	7.2
Bangladesh	732 067	1 060 181	328 114	44.8
India	527 290	953 106	425 816	80.8
Myanmar	454 260	814 740	360 480	79.4
Uganda	371 789	450 000 [1]	78 211	21.0
Cambodia	250 000	365 000	115 000	46.0
Indonesia	330 879	323 150	–7 729	–2.3
Nigeria	182 264	304 413	122 149	67.0
United Republic of Tanzania	312 040	281 690	–30 350	–9.7
Brazil	246 101	243 000 [1]	–3 101	–1.3
Egypt	282 099	237 572	–44 527	–15.8
Thailand	203 200	231 100	27 900	13.7
Democratic Republic of the Congo	231 772 [1]	230 000 [1]	–1 772	–0.8
Russian Federation	178 403	216 841	38 438	21.5

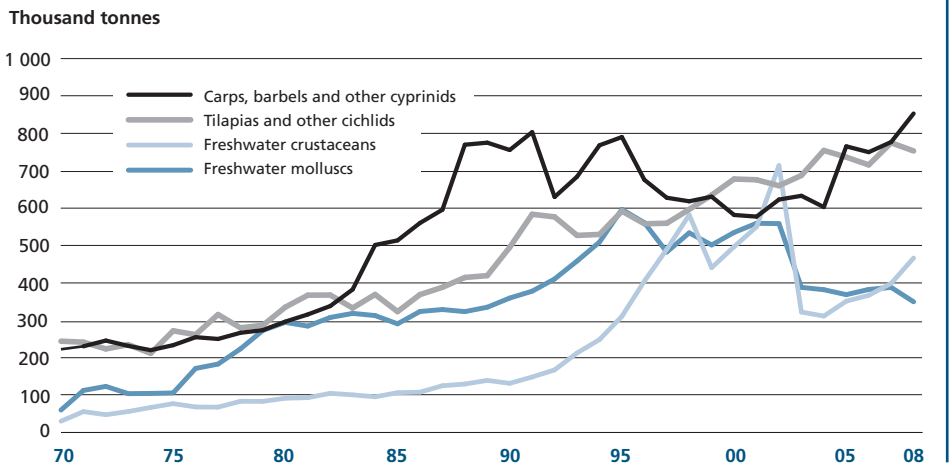
[1] FAO estimate.

inland waterbodies and their fish stocks, was the consequence of the considerable rise in catches reported to FAO by several major inland fishing countries (i.e. China, Bangladesh, India, Myanmar, Uganda, Cambodia, Nigeria and Russian Federation), as the total of all other catches varied very little between 2004 and 2008. Statistics provided by these countries merit a closer and case-by-case analysis given that a striking increment in inland waters catch could be the consequence of sound fishery management (including re-stocking of wild populations), improved coverage within the data collection systems, or a tendency to report continuously increasing production.

Inland water fishing is often a subsistence or recreational activity with fishing sites geographically scattered, making gathering information very difficult. In many countries, national administrations do not manage to secure adequate funding for the collection of reliable inland catch statistics. About one-third of the countries do not submit any information on inland waters catch statistics, forcing FAO to estimate the national production. Although several countries have made efforts in the last decade

Figure 9

Catch trends by major inland waters species groups



to improve the quality of inland catch statistics and report a finer breakdown of species composition, the global level of unidentified catches remains very high – exceeding half of the total inland waters catch production.

Figure 9 shows catch trends since 1970 by major species groups caught in inland fisheries. In 2005, cyprinids returned as the dominant group after being exceeded for some years by the tilapias group (and in 2002 also by freshwater crustaceans). Catches of freshwater molluscs have decreased significantly since 2002, and this may be due to their extreme vulnerability to habitat degradation, overexploitation, and predation by alien species.[3] It is noteworthy that catch trends for inland water species groups present several more abrupt ups and downs than those of marine species groups (compare Figures 7 and 9). Rather than being explained by highly variable catches, this is mostly the result of some major inland water fishing countries varying throughout the years the attribution of aggregated catches between "freshwater fishes not elsewhere included (NEI)" and major groups such as "cyprinids NEI". This can be seen as another indication of the poor quality of inland water catch statistics reported to FAO.

AQUACULTURE

World production of food fish

Aquaculture remains a growing, vibrant and important production sector for high-protein food. The reported global production of food fish from aquaculture, including finfishes, crustaceans, molluscs and other aquatic animals for human consumption, reached 52.5 million tonnes in 2008. The contribution of aquaculture to the total production of capture fisheries and aquaculture continued to grow, rising from 34.5 percent in 2006 to 36.9 percent in 2008. In the period 1970–2008, the production of food fish from aquaculture increased at an average annual rate of 8.3 percent, while the world population grew at an average of 1.6 percent per year. The combined result of development in aquaculture worldwide and the expansion in global population is that the average annual per capita supply of food fish from aquaculture for human consumption has increased by ten times, from 0.7 kg in 1970 to 7.8 kg in 2008, at an average rate of 6.6 percent per year.

Production from aquaculture is mostly destined for human consumption. Globally, aquaculture accounted for 45.7 percent of the world's fish food production for human consumption in 2008, up from 42.6 percent in 2006. In China, the world's largest aquaculture producer, 80.2 percent of fish food consumed in 2008 was derived from aquaculture, up from 23.6 percent in 1970. Aquaculture production supplied the rest of the world with 26.7 percent of its food fish, up from 4.8 percent in 1970.

Despite the long tradition of aquaculture practices in a few countries over many centuries, aquaculture in the global context is a young food production sector that has grown rapidly in the last 50 years or so. World aquaculture output has increased substantially, from less than 1 million tonnes of annual production in 1950 to the 52.5 million tonnes reported for 2008, increasing at three times the rate of world meat production (2.7 percent from poultry and livestock together) in the same period. In contrast to world capture fisheries production, which has almost stopped growing since the mid-1980s, the aquaculture sector maintained an average annual growth rate of 8.3 percent worldwide (or 6.5 percent excluding China) between 1970 and 2008. The annual growth rate in world aquaculture production between 2006 and 2008 was 5.3 percent in volume terms. The growth rate in the rest of the world (6.4 percent) from 2006 to 2008 was higher than that for China (4.7 percent).

The value of the world aquaculture harvest, excluding aquatic plants, is estimated at US$98.4 billion in 2008. The actual total output value from the entire aquaculture sector should be significantly higher than this level, because the value of aquaculture hatchery and nursery production and that of the breeding of ornamental fishes are yet to be estimated and included.

If aquatic plants are included, world aquaculture production in 2008 was 68.3 million tonnes, with an estimated value of US$106 billion.

World production of aquatic plants

Aquaculture produced 15.8 million tonnes (live weight equivalent) of aquatic plants in 2008, with a total estimated value of US$7.4 billion. Of the world total production of aquatic plants in the same year, 93.8 percent came from aquaculture. The culture of aquatic plants has enjoyed a consistent expansion in production since 1970, with an average annual growth rate of 7.7 percent. The production is overwhelmingly dominated by seaweeds (99.6 percent by quantity and 99.3 percent by value in 2008).

Countries in East and Southeast Asia dominate seaweed culture production (99.8 percent by quantity and 99.5 percent by value in 2008). China alone accounted for 62.8 percent of the world's aquaculture production of seaweeds by quantity. Other major seaweed producers are Indonesia (13.7 percent), Philippines (10.6 percent), Republic of Korea (5.9 percent), Japan (2.9 percent) and Democratic People's Republic of Korea (2.8 percent). In 2007, Indonesia replaced the Philippines as the world's second-largest seaweed producer and remained so in 2008. In value terms, Japan maintained its position as the second-most important producer because of its high-valued Nori production. In East Asia, almost all cultured seaweed species are for human consumption, although Japanese kelp is also used as a raw material for the extraction of iodine and algin. In contrast, seaweed farming in Southeast Asia, with *Eucheuma* seaweeds as the major species, is mainly producing raw material for carrageenan extraction.

Chile is the most important seaweed culturing country outside Asia, producing 21 700 tonnes in 2008. Africa also harvested 14 700 tonnes of farmed seaweeds in 2008, with the United Republic of Tanzania (mainly Zanzibar), South Africa and Madagascar as the leading producers. Farmed seaweed production in the United Republic of Tanzania and in Madagascar, mostly *Eucheuma* seaweeds for export, was much underreported previously. In South Africa, cultured seaweeds are harvested mainly as feed for the culture of perlemoen abalone (*Haliotis midae*).

In 2008, the highest production of cultured seaweed was of Japanese kelp (*Laminaria japonica*, 4.8 million tonnes), followed by *Eucheuma* seaweeds (*Kappaphycus alvarezii* and *Eucheuma* spp., 3.8 million tonnes), Wakame (*Undaria pinnatifida*, 1.8 million tonnes), *Gracilaria* spp. (1.4 million tonnes) and Nori (*Porphyra* spp., 1.4 million tonnes).

According to the national reports received by FAO, the production of algae culture in freshwater was 68 400 tonnes in 2008, and virtually all the production was of *Spirulina* from China (62 300 tonnes) and Chile (6 000 tonnes). Worldwide, *Spirulina* spp. are cultured in many countries, predominantly in cement tanks, as an ingredient in animal feeds and as a nutrition supplement for people.[4] Production is both large-scale as a commercial business and small-scale for consumption by local communities. Production data are not systematically collected and reported worldwide. In recent years, the culture of the freshwater alga *Haematococcus pluvialis* has been developed in a few countries (e.g. Chile, China, India, Japan and the United States of America) for the extraction of astaxanthin, a natural pigment and strong antioxidant used in many fields including aquaculture feeds. In addition, the culture of lipid-rich species of freshwater algae for biofuel production, still in its initial stages, is the latest development in freshwater algae culture. Compared with seaweed farming, the culture of freshwater algae is generally poorly reported worldwide.

Production by region: growth patterns and top producers

Asia has retained its progressively dominant position in world aquaculture production. Asia accounted for 88.8 percent of world aquaculture production by quantity and 78.7 percent by value in 2008, while China alone accounted for 62.3 percent of world aquaculture production by quantity and 51.4 percent by value in the same year (Table 4).

Table 4
Aquaculture production by region: quantity and percentage of world production

Selected groups and countries		1970	1980	1990	2000	2006	2008
Africa	**(tonnes)**	**10 271**	**26 202**	**81 015**	**399 788**	**754 406**	**940 440**
	(percentage)	***0.40***	***0.60***	***0.60***	***1.20***	***1.60***	***1.80***
Sub-Saharan Africa	(tonnes)	4 243	7 048	17 184	55 802	154 905	238 877
	(percentage)	*0.20*	*0.10*	*0.10*	*0.20*	*0.30*	*0.50*
North Africa	(tonnes)	6 028	19 154	63 831	343 986	599 501	701 563
	(percentage)	*0.20*	*0.40*	*0.50*	*1.10*	*1.30*	*1.30*
America	**(tonnes)**	**173 491**	**198 850**	**548 200**	**1 422 637**	**2 367 320**	**2 405 166**
	(percentage)	***6.80***	***4.20***	***4.20***	***4.40***	***5.00***	***4.60***
Caribbean	(tonnes)	350	2 329	12 169	39 692	36 610	40 054
	(percentage)	*0.00*	*0.00*	*0.10*	*0.10*	*0.10*	*0.10*
Latin America	(tonnes)	869	24 590	179 367	799 235	1 640 001	1 720 899
	(percentage)	*0.00*	*0.50*	*1.40*	*2.50*	*3.50*	*3.30*
North America	(tonnes)	172 272	171 931	356 664	583 710	690 709	644 213
	(percentage)	*6.70*	*3.70*	*2.70*	*1.80*	*1.50*	*1.20*
Asia	**(tonnes)**	**1 786 286**	**3 540 960**	**10 786 593**	**28 400 213**	**41 860 117**	**46 662 031**
	(percentage)	***69.60***	***75.20***	***82.50***	***87.60***	***88.40***	***88.80***
Asia excluding China	(tonnes)	1 021 888	2 211 248	4 270 587	6 821 665	11 831 528	13 717 947
	(percentage)	*39.80*	*47.00*	*32.70*	*21.00*	*25.00*	*26.10*
China	(tonnes)	764 380	1 316 278	6 482 402	21 522 095	29 856 841	32 735 944
	(percentage)	*29.80*	*28.00*	*49.60*	*66.40*	*63.10*	*62.30*
Near East	(tonnes)	18	13 434	33 604	56 453	171 748	208 140
	(percentage)	*0.00*	*0.30*	*0.30*	*0.20*	*0.40*	*0.40*
Europe	**(tonnes)**	**510 713**	**770 200**	**1 616 287**	**2 072 160**	**2 209 097**	**2 366 354**
	(percentage)	***19.90***	***16.40***	***12.40***	***6.40***	***4.70***	***4.50***
Non-EU countries (+ Cyprus and Israel)	(tonnes)	39 431	49 985	582 305	676 685	925 664	1 088 594
	(percentage)	*1.50*	*1.10*	*4.50*	*2.10*	*2.00*	*2.10*
EU countries (27)	(tonnes)	471 282	720 215	1 033 982	1 395 475	1 283 433	1 277 760
	(percentage)	*18.40*	*15.30*	*7.90*	*4.30*	*2.70*	*2.40*
Oceania	**(tonnes)**	**8 421**	**12 224**	**42 005**	**121 312**	**160 126**	**172 214**
	(percentage)	***0.30***	***0.30***	***0.30***	***0.40***	***0.30***	***0.30***
World	**(tonnes)**	**2 566 882**	**4 705 841**	**13 074 100**	**32 416 110**	**47 351 066**	**52 546 205**

Notes: Data exclude aquatic plants. Data for 2008 contain provisional data of some countries.

The growth patterns in aquaculture production are not uniform among the regions, as illustrated in Figure 10. Latin America and the Caribbean shows the highest average annual growth (21.1 percent), followed by the Near East (14.1 percent) and Africa (12.6 percent). China's aquaculture production increased at an average annual growth rate of 10.4 percent in the period 1970–2008. However, in the new millennium, China's growth rate declined to 5.4 percent, which is significantly lower than in the 1980s (17.3 percent) and 1990s (12.7 percent). The average annual growth in production in Europe and North America since 2000 has slowed substantially to 1.7 percent and 1.2 percent, respectively. The once-leading countries in aquaculture development, e.g. France, Japan and Spain, have shown falling production in the most recent decade. It is expected that, while world aquaculture production will continue to grow, the rate of increase in most of the regions will slow in the coming decade.

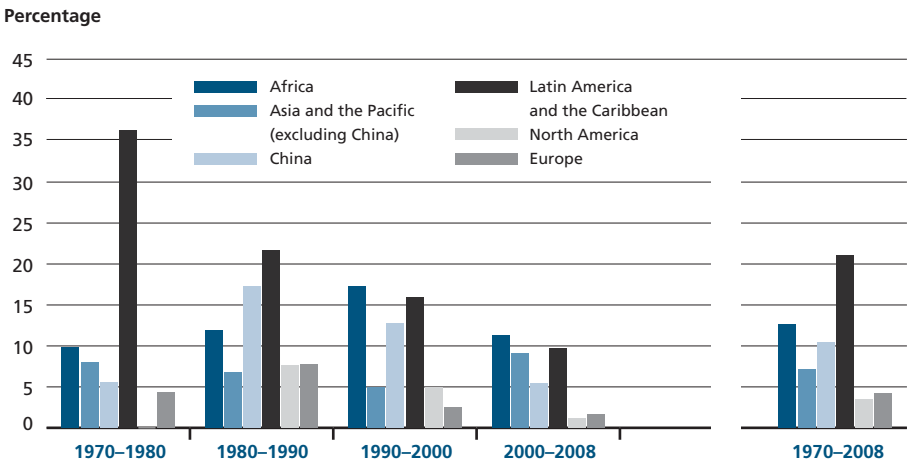
In 2008, the top 15 producers listed in Table 5 harvested 92.4 percent of total world production of food fish from aquaculture. Indonesia replaced Thailand as the fourth-largest producer.

By economic class, aquaculture in all developing countries in 2008 produced 48.63 million tonnes of food fish valued at US$84.03 billion, accounting for 92.5 percent and 85.4 percent of world aquaculture production quantity and value,

respectively. However, the combined share of the least-developed countries remains very low in terms of world aquaculture production quantity (3.6 percent) and value (3.1 percent). Aquaculture production of 1.9 million tonnes in 2008 for the least-developed countries was dominated by Bangladesh (52.8 percent) and Myanmar (35.5 percent), followed by the Lao People's Democratic Republic (4.1 percent), Uganda (2.7 percent), Cambodia (2.1 percent) and Nepal (1.4 percent). Developed countries produced only 3.92 million tonnes, accounting for 7.5 percent of world aquaculture production in terms of quantity, but the value of their production was 14.6 percent of the world total (Table 6).

Figure 10

World aquaculture production: annual growth by region since 1970



Note: Data exclude aquatic plants.

Table 5

Top 15 aquaculture producers by quantity in 2008 and growth

	Production			Average annual rate of growth		
	1990	2000	2008	1990–2000	2000–2008	1990–2008
	(Thousand tonnes)			*(Percentage)*		
China	6 482	21 522	32 736	12.7	5.4	9.4
India	1 017	1 943	3 479	6.7	7.6	7.1
Viet Nam	160	499	2 462	12.0	22.1	16.4
Indonesia	500	789	1 690	4.7	10.0	7.0
Thailand	292	738	1 374	9.7	8.1	9.0
Bangladesh	193	657	1 006	13.1	5.5	9.6
Norway	151	491	844	12.6	7.0	10.0
Chile	32	392	843	28.3	10.1	19.8
Philippines	380	394	741	0.4	8.2	3.8
Japan	804	763	732	–0.5	–0.5	–0.5
Egypt	62	340	694	18.6	9.3	14.4
Myanmar	7	99	675	30.2	27.1	28.8
United States of America	315	456	500	3.8	1.2	2.6
Republic of Korea	377	293	474	–2.5	6.2	1.3
Taiwan Province of China	333	244	324	–3.1	3.6	–0.2

Note: Data exclude aquatic plants.

Table 6
Aquaculture production quantity and value by economic class in 2008

	Quantity		Value	
	(Million tonnes)	*(Percentage)*	*(US$ billions)*	*(Percentage)*
Developed countries	3.92	7.50	14.42	14.60
Least-developed countries	1.90	3.60	3.01	3.10
Other developing countries	46.72	88.90	81.03	82.30
World	**52.55**	**100.00**	**98.45**	**100.00**

Note: Data exclude aquatic plants.

Production by environment and species group

Aquaculture production using freshwater contributes 59.9 percent to world aquaculture production by quantity and 56.0 percent by value. Aquaculture using seawater (in the sea and also in ponds) accounts for 32.3 percent of world aquaculture production by quantity and 30.7 percent by value. Aquaculture in seawater produces many high-value finfish, crustaceans and abalone species, but also a large amount of oysters, mussels, clams, cockles and scallops. Although brackish-water production represented only 7.7 percent of world production in 2008, it accounted for 13.3 percent of total value, reflecting the prominence of relatively high-valued crustaceans and finfishes cultured in brackish water.

In 2008, freshwater fishes continued to dominate with a production of 28.8 million tonnes (54.7 percent) valued at US$40.5 billion (41.2 percent), followed by molluscs (13.1 million tonnes), crustaceans (5 million tonnes), diadromous fishes (3.3 million tonnes), marine fishes (1.8 million tonnes) and other aquatic animals (0.6 million tonnes) (Figure 11).

The production of freshwater fishes in 2008 was dominated by carps (*Cyprinidae*, 20.4 million tonnes, or 71.1 percent). A small portion (2.4 percent) of freshwater fishes was cultured in brackish water, including tilapia farmed in Egypt. In 2008, the largest producer of all carps was China (70.7 percent) followed by India (15.7 percent). Another 10.2 percent of all carps were produced by Bangladesh, Myanmar, Viet Nam, Indonesia and Pakistan. Growth in the production of pangas catfish (*Pangasius* spp.) in Viet Nam has been dramatic in recent years, with 1.2 million tonnes produced in 2008.

The main components of mollusc production in 2008 were oysters (31.8 percent), carpet shells and clams (24.6 percent), mussels (12.4 percent) and scallops (10.7 percent). While mollusc production as a whole grew at a average annual rate of 3.7 percent in the period 2000–08, production of the "luxury" group of abalones increased from 2 800 tonnes to 40 800 tonnes in the same period, at an annual growth rate of 39.9 percent.

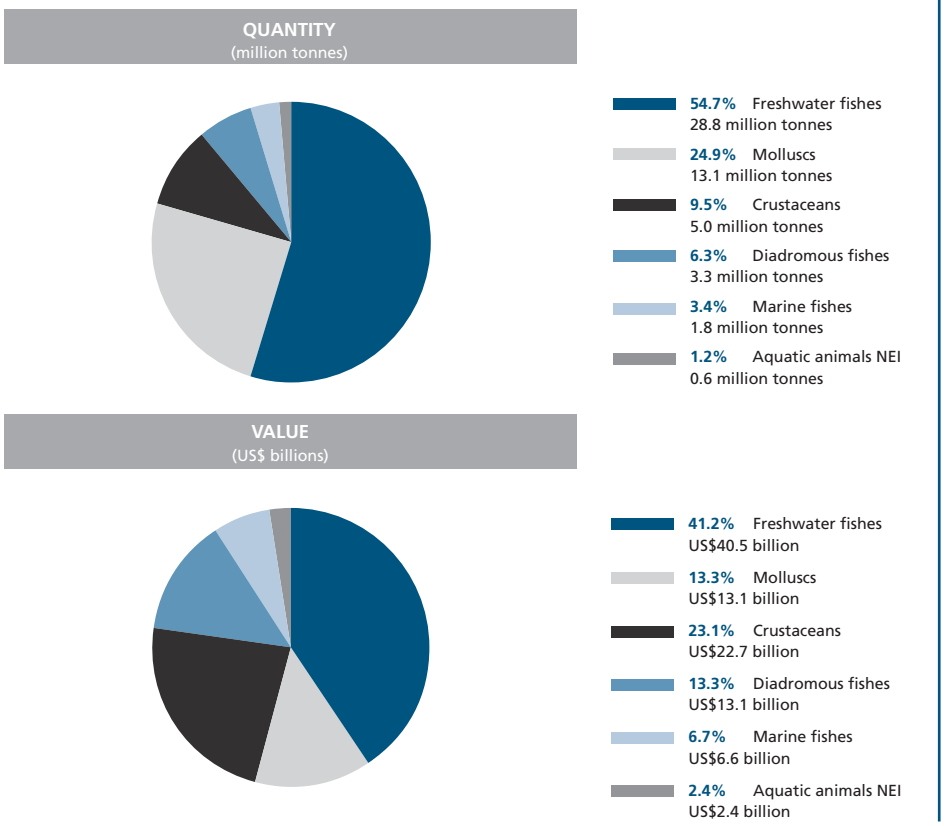
World production of crustaceans was relatively even in distribution among brackish water (2.4 million tonnes, or 47.7 percent), freshwater (1.9 million tonnes, or 38.2 percent) and marine water (0.7 million tonnes, or 14.1 percent). Crustaceans farmed in freshwater include more than 0.5 million tonnes of the marine species white leg shrimp (*Penaeus vannamei*) produced by China, which was previously reported as production from brackish water.

Diadromous fish production in 2008 was dominated by Atlantic salmon (1.5 million tonnes, or 44 percent), milkfish (0.68 million tonnes, or 20.4 percent), rainbow trout (0.58 million tonnes, or 17.4 percent) and eels (0.26 million tonnes, or 7.9 percent – *Anguilla japonica* and *A. anguilla* combined). Norway and Chile are the world's leading aquaculture producers of salmonids, accounting for 36.4 percent and 28 percent of world production, respectively. Other European countries produced another 18.9 percent, while Asia and North America contributed only 7.9 percent and 7.4 percent, respectively. Atlantic salmon (*Salmo salar*) production in Chile was hit hard by a disease outbreak in 2009, leading to the loss of half of the production.

With regard to marine fishes, flatfish production increased significantly from 26 300 tonnes in 2000 to 148 800 tonnes in 2008, with China and Spain being the

Figure 11

World acquaculture production: major species groups in 2008



Note: NEI = not elsewhere included.

leading producers. The major species concerned are turbot (*Psetta maxima*), bastard halibut (*Paralichthys olivaceus*) and tongue sole (*Cynoglossus semilaevis*). Norway's production of Atlantic cod (*Gadus morhua*) grew significantly in the period 2000–08.

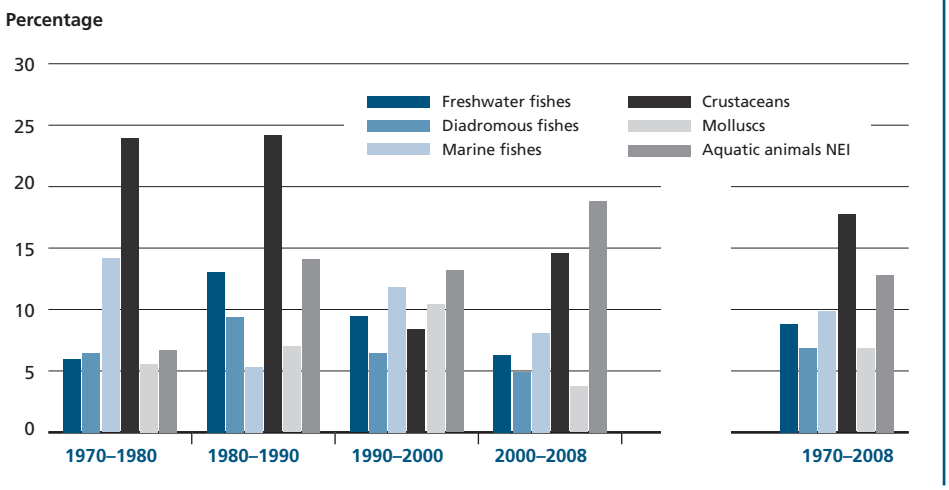
More than half the volume (0.35 million tonnes, or 57 percent) of miscellaneous aquatic animals are produced in freshwater. The most important species are soft-shelled turtles followed by frogs. Production in marine water (0.27 million tonnes, or 43 percent) includes jellyfishes, Japanese sea cucumbers and sea squirts as major species.

Aquaculture production of all major species groups continued to increase in the period 2000–08 (Figure 12), although finfish and mollusc production grew more slowly than in the period 1990–2000. In contrast, crustacean production grew at an average annual rate of almost 15 percent in this period, faster than in the previous decade. The rapid increase in crustacean production largely reflects the dramatic increase in white leg shrimp culture in China, Thailand and Indonesia. Figure 13 presents world aquaculture production by major species group in the period 1970–2008.

The contribution from aquaculture to global total production of major species groups has increased markedly since 1950, except for marine fishes. In 2008, aquaculture accounted for 76.4 percent of global freshwater finfish production, 64.1 percent of molluscs, 68.2 percent of diadromous fishes and 46.4 percent of crustacean production (Figure 14). Although cultured crustaceans still account for less than half of the total crustacean global production, the culture production of penaeids (shrimps and prawns) in 2008 was 73.3 percent of the total production. While

Figure 12

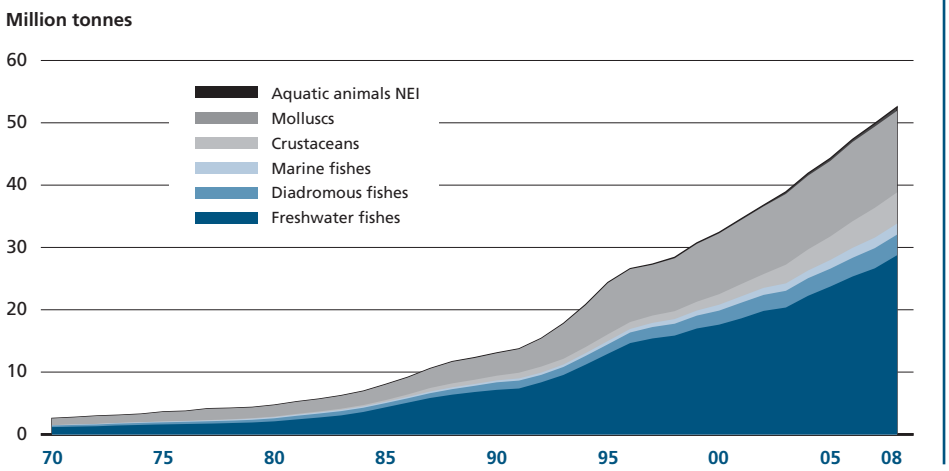
Trends in world aquaculture production:
average annual growth rate for major species groups 1970–2008



Note: NEI = not elsewhere included.

Figure 13

Trends in world aquaculture production: major species groups



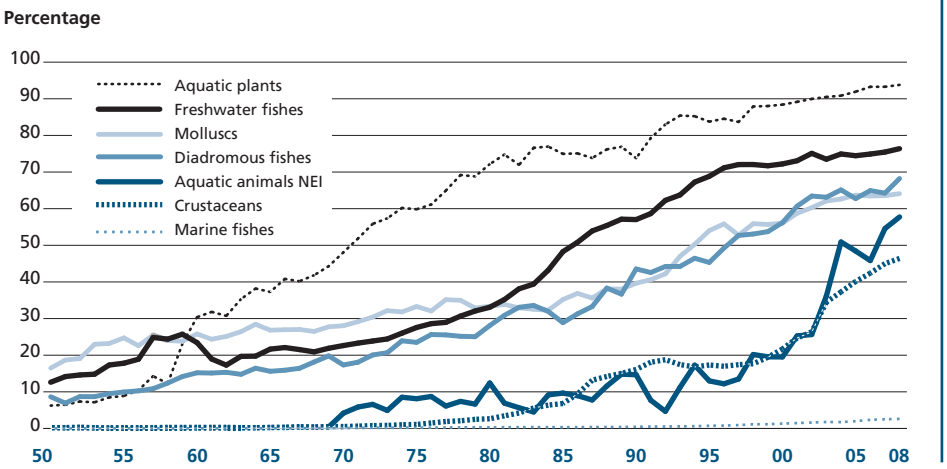
Note: NEI = not elsewhere included.

the overall share of aquaculture in total production of marine fishes was as low as 2.6 percent, aquaculture does dominate production for some species, e.g. flathead grey mullet, gilthead seabream, silver seabream, European seabass, turbot, cobia, red drum and bastard halibut. For many species now produced through aquaculture, the farmed production is substantially higher than the highest catch ever recorded.

Culture in earthen ponds is the most important farming method in Asia for finfish and crustacean production in freshwater and brackish water. In China, 70.4 percent of aquaculture production in freshwater relied on pond culture in 2008, while the rest of the production came from artificial reservoirs (11.7 percent), natural lakes (7.7 percent), rice paddy fields (5.6 percent), canals (2.7 percent) and other facilities (2.6 percent). The

Figure 14

Contribution of aquaculture to global production: major species groups



Note: NEI = not elsewhere included.

average yield of pond culture in China was 6.8 tonnes per hectare in 2008. Rice–fish culture, often operating at family scale with renovated paddy fields, has expanded rapidly among rice farmers in China in recent decades, and the total area of rice fields used for aquaculture was 1.47 million hectares in 2008, with an average yield of 0.79 tonnes of food fish per hectare. Rice fields produced 1.2 million tonnes of food fish in 2008, up 15 percent on 2006. Egypt produced 27 900 tonnes of food fish from rice in 2008, accounting for 4 percent of the total production in the country.

While aquaculture production is almost completely destined for human consumption, a special situation is observed in China in the culture of high-value Mandarin fish (*Siniperca chuatsi*; 230 000 tonnes), which is estimated to have consumed about 1 million tonnes of low-price carps purposely cultured in small sizes as live "feed fish" in 2008.

Production of introduced species and hybrids

Similar to other agriculture subsectors, the use of introduced species has played an important role in aquaculture production, particularly in Asia. Tilapia production outside Africa totalled 2.4 million tonnes in 2008, representing 8 percent of all finfish produced in freshwater and brackish water outside Africa. The production of tilapias in the Philippines, Indonesia, Thailand, Malaysia and China accounted for 34.7 percent, 19.5 percent, 15.3 percent, 14.3 percent and 3.4 percent of their respective national aquaculture production. The culture of white leg shrimp, introduced from America, reached a total of 1.8 million tonnes outside America in 2008. This accounted for 80.7 percent of the global aquaculture production of this species and 40.7 percent of the production of all cultured crustaceans outside America. Largemouth black bass, introduced from America, is now an important species in freshwater aquaculture in China, and its production in 2008 was almost 160 000 tonnes. China also produced 51 000 tonnes of introduced red drum in 2008, accounting for 7 percent of total production of cultured finfish from marine waters in the country. In China, aquaculture production of turbot, native to Europe, has reached an annual level of 50 000–60 000 tonnes in recent years, which is about seven times the total culture production of turbot in Europe. Of the world production of 0.46 million tonnes of channel catfish in 2008, only about half was cultured in its native country (the United States of America), while the other half was grown in China and several other countries. Native to the Yangtze River basin in China, the Mandarin fish introduced to the Pearl

River basin in southern China accounted for more than 0.1 million tonnes in 2008, or 44 percent of the total production of this species. Piarapatinga (*Piaractus brachypomus*) and pacu (*Piaractus mesopotamicus*) introduced from South America are now widely farmed in China, Myanmar, Thailand and Viet Nam. East Asian countries like China have been importing European eel seed stock collected from the wild for aquaculture. China produced more than 0.2 million tonnes of cultured eels in 2008, of which a significant portion was European eel. However, new regulations in Europe on this species will result in reduced exports of European eel seed stock to Asia.

The introduction of white leg shrimp to Asia has given rise to a boom in farming of this species in China, Thailand, Indonesia and Viet Nam in the last decade, resulting in an almost complete shift from the native black tiger shrimp (*Penaeus monodon*) to this introduced species in Southeast Asia. The ban on the introduction and culture of white leg shrimp was lifted in 2008 in India, and this will have a major impact on the marine shrimp farming sector in India in years to come. The giant river prawn (*Macrobrachium rosenbergii*) has been introduced from South and Southeast Asia to China and some countries in South America for culture. In 2008, China alone produced 128 000 tonnes of giant river prawn, accounting for 61.5 percent of the total production of this species. Red swamp crayfish (*Procambarus clarkii*), unintentionally introduced from North America to China several decades ago, is now the third-most important crustacean species cultured in freshwater in China, with a reported production of 365 000 tonnes in 2008.

Introduced from America, Atlantic bay scallop (*Argopecten irradians*) is now widely cultured in China – estimated to account for more than half of the country's total production of 1.1 million tonnes of scallops in 2008. Pacific cupped oyster (*Crassostrea gigas*) has been introduced widely in many countries for aquaculture.

Although the use of hybrids in aquaculture is very common for certain desirable traits, the statistical data available so far do not provide a clear picture of the production level of all hybrids in aquaculture worldwide. A considerable number of hybrids are used in various countries for aquaculture. Out of the 1.1 million tonnes of production reported from China as Nile tilapia, about one-quarter is a hybrid between Nile tilapia (*Oreochromis nilotica*) and blue tilapia (*O. aureus*). Thailand produces about 136 000 tonnes of hybrid catfish (between *Clarias gariepinus* and local *C. macrocephalus*), which was 9.9 percent of the country's total aquaculture production. A significant portion of the 324 100 tonnes of snakehead produced in China in 2008 was the hybrid between *Channa argus* and *C. maculate,* which is reported to accept formulated feeds more readily in farming. The hybrid of *Piaractus mesopotamicus* and *Colossoma macropomum* is farmed in Brazil, with production levels exceeding 10 000 tonnes in recent years. The United States of America has cultured hybrid striped bass, *Morone chrysops* x *M. saxatilis*, for two decades and its production was about 5 000 tonnes in the period 2000–08.

FISHERS AND FISH FARMERS

The fish sector is a source of income and livelihood for millions of people around the world. Linked to the strong increase in fish production, employment in capture fisheries and aquaculture has grown substantially in the last three decades, with an average rate of increase of 3.6 percent per year since 1980. According to the most recent estimate, in 2008, 44.9 million people were directly engaged, full time or, more frequently, part time, in capture fisheries or in aquaculture. This number represents a 167 percent increase compared with the 16.7 million people in 1980. Employment in the fisheries sector has grown faster than the world's population and than employment in traditional agriculture. The 44.9 million in 2008 represented 3.5 percent of the 1.3 billion people economically active in the broad agriculture sector worldwide, compared with 1.8 percent in 1980.

The majority of fishers and aquaculturists are in developing countries, mainly in Asia, which has experienced the largest increases in recent decades, reflecting the rapid expansion of aquaculture activities. In 2008, 85.5 percent of fishers and fish

farmers were in Asia, followed by Africa (9.3 percent), Latin America (2.9 percent), Europe (1.4 percent), North America (0.7 percent) and Oceania (0.1 percent) (Table 7). China is the country with the largest number of fishers and fish farmers, representing nearly one-third of the world total. In 2008, 13.3 million people were employed as fishers and fish farmers in China, of whom 8.5 million people were full time. In 2008, other countries with a significant number of fishers and fish farmers were India and Indonesia (Table 8).

Table 9 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 Asia, but average annual production per person there is only 2.4 tonnes, whereas it is almost 24 tonnes in Europe and more than 18 tonnes in North America. The high figure for Oceania (23 tonnes) 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, in Africa and Asia, also the key role played by small-scale fisheries. The differences are even more evident in the aquaculture sector, where, for example, fish farmers in Norway have an average annual production of 172 tonnes per person, while in Chile the figure is about 72 tonnes, in China 6 tonnes and in India only 2 tonnes.

The national statistics available to FAO are often too irregular and lacking in enough detail to permit a more in-depth analysis of the employment structure at the world level. However, it is apparent that, in the most important fishing nations systematically providing this information, the share of employment in capture fisheries is stagnating or decreasing and increased opportunities are being provided by aquaculture. According to the estimates based on the available data for 2008, fish farmers accounted for one-quarter of the total number of workers, totalling almost 11 million people. However, these figures are indicative and they underestimate the real number as many countries still do not collect employment data separately for the two sectors. Since 1990, fish farmers have experienced the greatest increases in their numbers, with most of the growth occurring in Asia, particularly in China, where the number of fish farmers increased by 189 percent in the period 1990–2008.

Table 7
World fishers and fish farmers by continent

	1990	1995	2000	2005	2008
			(Thousands)		
Africa	1 832	1 950	3 657	3 683	4 187
Asia	23 736	28 096	35 242	36 860	38 439
Europe	626	466	746	662	641
Latin America and the Caribbean	1 104	1 104	1 250	1 271	1 287
North America	385	376	343	338	337
Oceania	55	52	49	54	56
World	**27 737**	**32 043**	**41 287**	**42 868**	**44 946**
Of which fish farmers[1]					
Africa	1	11	78	120	123
Asia	3 698	6 692	6 647	9 828	10 143
Europe	14	12	66	78	80
Latin America and the Caribbean	68	86	187	438	443
North America	...	...	...	...	...
Oceania	1	1	5	4	4
World	**3 783**	**6 803**	**6 983**	**10 467**	**10 793**

Note: ... = data not available.
[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.

On the other hand, employment in fishing is decreasing in capital-intensive economies, in particular in most European countries, North America and Japan. This is the result of several factors combined, including decreased catches, capacity reduction programmes and increased productivity due to technical progress. For example, in Norway, employment in the fisheries sector has been declining for several years. In 1990, about 27 500 people were employed in marine fishing, but this number had decreased by 53 percent to 12 900 people in 2008. In Japan, the number of marine fishery workers decreased from 549 000 in 1970 to 370 600 in 1990 and then continued falling to reach a low of about 200 000 in 2008.

Estimates indicate that in 2008 about 1.3 million people were employed in fisheries and aquaculture in developed countries, representing a decrease of 11 percent compared with 1990. A characteristic of the fishers and fish farmers in more developed

Table 8
Number of fishers and fish farmers in selected countries

Country	Fishery		1990	1995	2000	2005	2008
WORLD	FI + AQ	(number)	**27 737 435**	**32 043 098**	**41 287 272**	**42 868 290**	**44 945 985**
		(index)	***67***	***78***	***100***	***104***	***109***
	FI	(number)	23 954 755	25 240 316	34 304 228	32 400 874	34 153 137
		(index)	*70*	*74*	*100*	*94*	*100*
	AQ	(number)	3 782 680	6 802 782	6 983 044	10 467 416	10 792 848
		(index)	*54*	*97*	*100*	*150*	*155*
China	FI + AQ	(number)	11 173 463	11 428 655	12 935 689	12 902 777	13 327 846
		(index)	*86*	*88*	*100*	*100*	*103*
	FI	(number)	9 432 464	8 759 162	9 213 340	8 389 161	8 288 287
		(index)	*102*	*95*	*100*	*91*	*90*
	AQ	(number)	1 740 999	2 669 493	3 722 349	4 513 616	5 039 559
		(index)	*47*	*72*	*100*	*121*	*135*
Iceland	FI + AQ	(number)	6 951	7 165	6 265	5 265	4 665
		(index)	*111*	*114*	*100*	*84*	*74*
Indonesia	FI + AQ	(number)	3 323 135	4 177 286	4 776 713	4 719 390	4 692 020
		(index)	*70*	*87*	*100*	*99*	*98*
	FI	(number)	1 700 839	2 072 464	2 633 954	2 212 776	2 342 020
		(index)	*65*	*79*	*100*	*84*	*89*
	AQ	(number)	1 622 296	2 104 822	2 142 759	2 506 614	2 350 000
		(index)	*76*	*98*	*100*	*117*	*110*
Japan[1]	FI + AQ	(number)	370 600	301 440	260 200	222 160	204 000
		(index)	*142*	*116*	*100*	*85*	*78*
Norway	FI + AQ	(number)	24 979	21 776	18 589	18 848	17 800
		(index)	*134*	*117*	*100*	*101*	*96*
	FI	(number)	20 475	17 160	14 262	14 626	12 904
		(index)	*144*	*120*	*100*	*103*	*90*
	AQ	(number)	4 504	4 616	4 327	4 222	4 896
		(index)	*104*	*107*	*100*	*98*	*113*
Peru[1]	FI + AQ	(number)	43 750	62 930	66 361	70 036	72 410
		(index)	*66*	*95*	*100*	*106*	*109*
	FI	(number)	...	60 030	63 798	66 395	68 660
		(index)	...	*94*	*100*	*104*	*108*
	AQ	(number)	...	2 900	2 563	3 641	3 750
		(index)	...	*113*	*100*	*142*	*146*

Note: FI = fishing, AQ = aquaculture; index: 2000 = 100; ... = data not available.
[1] Data for 2008 are FAO estimates.

Table 9
Fishery production per fisher or fish farmer in 2008

Continent	Production (capture + aquaculture)[1]	Percentage of production	Number of fishers and fish farmers	Percentage of persons	Production per person
	(Tonnes)	*(%)*	*(No.)*	*(%)*	*(Tonnes/year)*
Africa	8 183 302	5.8	4 186 606	9.3	2.0
Asia	93 579 337	65.8	38 438 646	85.5	2.4
Europe	15 304 996	10.8	640 676	1.4	23.9
Latin America and the Caribbean	17 703 530	12.4	1 287 335	2.9	13.8
North America	6 170 211	4.3	336 926	0.7	18.3
Oceania	1 286 340	0.9	55 796	0.1	23.1
Total	**142 287 124**	**100.0**	**44 945 985**	**100.0**	**3.2**

[1] Production excludes aquatic plants. Data for total production also include 59 408 tonnes of "others not elsewhere specified", which are not included in any aggregate by continent.

economies is their advancing average age, mainly resulting from the profession's decreasing appeal to younger generations. For many young people, neither the pay nor the quality of life aboard fishing vessels compares favourably with those of land-based industries. Moreover, widespread concerns about the status of some 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. For example, in Europe, fishers from the economies in transition or from developing countries are starting to replace local fishers.

Fishers are often employed in marine and inland waters part time or as an occasional occupation. In 2008, in addition to the estimated 45 million part-time and full-time fishers, about 6 million occasional fishers and fish farmers were reported to FAO (of whom 2.8 million in India and 1.2 million in China). Among the main reasons explaining this phenomenon are: the variation in seasonal resource availability, seasonal weather fluctuations, limits on year-round activity (e.g. closures of selected fisheries at certain times of the year and quotas on catches of selected species) or on the number of commercial licences and the number of fish caught per trip. Increasingly, operators are having to turn to other activities for supplementary income.

In many countries, especially in developing countries, most fishers and their families work in coastal artisanal fisheries and associated activities. It is also estimated that the great majority of fishers work on small vessels. However, it is very difficult to obtain exhaustive statistics for these activities as well as to measure their socio-economic importance. Nonetheless, it is undeniable that they are important in terms of their contribution to production, income and food security for the coastal communities.

The number of people employed in direct production in the fisheries and aquaculture sector cannot be taken as the only indicator of the magnitude of fisheries to the national economy. In addition to fishers and fish farmers, people engage 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 linked with the fisheries sector. No official data are available on the estimated numbers of people involved in these other activities. Some estimates indicate that, for each person employed in capture fisheries and aquaculture production, about three jobs are produced in the secondary activities, including post-harvest, for a total of more than 180 million jobs in the whole of the fish industry. Moreover, on average, each jobholder 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 540 million people, or 8.0 percent of the world population.

THE STATUS OF THE FISHING FLEET

Introduction: general weakness of data quality

In 2009, FAO obtained data on national fishing fleets (either through direct reporting or through disseminated statistics) from 137 countries, which represent about 67 percent of the countries involved in capture fisheries. This number represents an improvement as in 2007 information from only 97 countries was available to FAO. Nonetheless, the quality of data varies widely from fragmented records to long time series of consistent and continuous statistics. Data reported to FAO are sometimes based on national registers and/or other administrative records. These registers often do not cover small boats, especially those used in inland waters, as such craft are often not subject to compulsory registration. Even where they are, the registers concerned are often managed by provincial or municipal authorities, and they are easily overlooked in reporting at the national level. Moreover, registers and administrative records often include non-operational units. This means that the number of fishing vessels is generally underreported in global analyses.

In addition to the above-mentioned available datasets, alternatives and supporting information were vigorously sought and used in this analysis, and, hence, data from a further 50 countries were estimated based on the best available information. It should be noted that the reliability of estimates of the global size of fishing fleet is problematical.

However, the national reports (from 137 countries) together represent the vast majority (96 percent) of the global fishing fleet of decked and undecked vessels; the 50 countries for which derived estimates were made added just 4 percent to the total number of fishing vessels.

Estimate of global fleet and regional distribution

The analysis indicates that the global fishing fleet is made up of about 4.3 million vessels and that this figure has not increased substantially from an earlier FAO estimate a decade ago.

About 59 percent of these vessels are powered by engines. The remaining 41 percent are traditional craft of various types, operated by sails and oars, concentrated primarily in Asia (77 percent) and Africa (20 percent). This large number of unmotorized boats are engaged in fishing operations, usually inshore or on inland waters. The estimated proportion of non-powered boats is about 4 percent lower than that obtained in 1998. Although the quality of this estimate is uncertain for the reasons described above, this reflects a worldwide trend towards the motorization of small and medium-sized artisanal craft worldwide.

Of the total number of fishing vessels powered by engines, the vast majority (75 percent) were reported from Asia (Figure 15). The rest were mainly reported from Latin America and the Caribbean (8 percent), Africa (7 percent) and Europe (4 percent).

While the numbers of vessels have been decreasing in some parts of the world in recent years, they have being increasing in others. As a result, the global fleet size in net terms has not changed substantially in the last decade. Figure 16 illustrates the pattern of change in fleet size by examining the proportion of countries whose fleet size increased, decreased or remained unchanged between 2006 and 2009.

Globally, the proportion of countries where the number of vessels either decreased or remained the same (35 percent) was greater than that of those where it increased (29 percent). However, the data available did not allow the trend to be determined for a substantial proportion (36 percent) of countries. The best-documented situation was that of Europe, where 53 percent of the countries reduced their fleet and only 19 percent of countries increased it. There was no increase in North America, while in the Pacific and Oceania region the fleet size either remained the same or decreased

Figure 15

Distribution of motorized fishing vessels by region in 2008

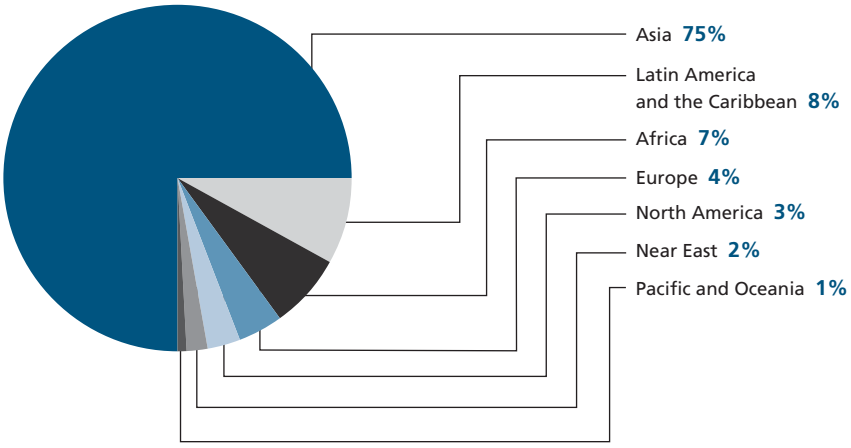
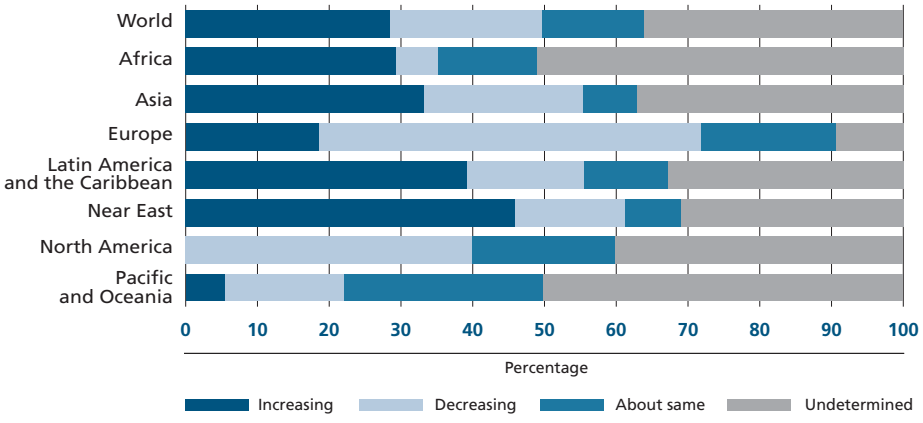


Figure 16

Changes in vessel numbers: proportion of countries by region, 2006–2009



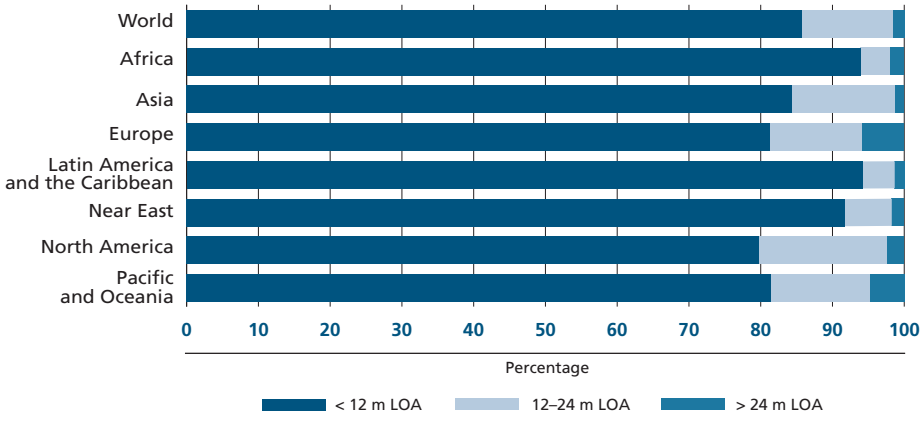
in a larger proportion of countries. In the Near East, 6 out of 13 countries (46 percent) increased the number of vessels. In Latin America and the Caribbean, Asia and Africa, an even greater proportion of countries increased the number of vessels in their national fleets. However, the results should be viewed with caution given the large uncertainty implied by the high proportion of countries for which it was not possible to indicate any trend. Nevertheless, the general tendencies observed here seem to be consistent with other observations.

Size distribution – importance of small boats

About 86 percent of the motorized fishing vessels in the world are less than 12 m in length; such vessels dominate everywhere, particularly in Africa, Latin America and the Caribbean, and the Near East (Figure 17). Less than 2 percent of all motorized fishing craft correspond to industrialized fishing vessels of more than 24 m in length (with a gross tonnage [GT] of generally more than 100 GT); this percentage is higher in Europe (6 percent), the Pacific and Oceania (5 percent), North America and Africa.

Figure 17

Size distribution of motorized fishing vessels



Note: LOA = length overall.

As indicated above, the bulk of the global fishing fleet is considered to be small vessels for which data are not readily available. This is particularly the case in Africa, parts of Asia and the Americas. In many cases, this category of the fleet is not even registered, or information on it resides in local registries to which few have access. As the inland fishing fleets usually consist of vessels of less than 12 m length overall (LOA), much of the fleet is not registered and is most likely omitted from most analyses involving the global number of fishing vessels, particularly in developing countries.

The EU Fleet Register for the European Economic Area (EEA) is the largest and most detailed fishing vessels database that is publicly accessible. At the end of 2009, the EU Fleet Register listed some 84 800 fishing vessels, of which 4 percent were more than 100 GT and a further 3 percent were between 50 and 100 GT, but the vast majority (93 percent) were less than 50 GT. In terms of LOA, 4 percent were longer than 24 m, another 4 percent were between 18 and 24 m, 3 percent were between 15 and 18 m, and a further 6 percent were between 12 and 15 m. Again, the vast majority (83 percent) were less than 12 m LOA (defined as small-scale under EU Council Regulation [EC] No. 2792/1999).

The structure of the fleets in terms of average power and average tonnage differs within the EEA. For example, Greece has the most fishing vessels (17 255 vessels in 2009) but they are of a comparatively small size (87 917 total GT, and 0.5 million total kW). However, the United Kingdom and Norway, with very similar numbers (about 6 510 fishing vessels each), have fleets with, respectively, two to four times the capacity of Greece's fishing fleet (206 945 total GT for the United Kingdom, 367 688 total GT for Norway), and they have considerably greater power (0.83 million total kW for the United Kingdom, 1.25 million total kW for Norway).

Table 10 provides examples from selected nations illustrating the importance of small vessels in various fleets. The proportion of vessels of less than 100 GT is well over 90 percent in most cases. Therefore, if measures are taken to limit fleet capacity, choices will have to be made between reductions in the industrial or the small-scale fleets. When deciding on such policies, many nations face difficult dilemmas as not only resources but also social and political issues are involved. Regarding engine power, the fleets from different nations differ more widely in terms of the proportion of vessels below 50 horsepower (HP) (37 kW). Within the EU, marked differences exist between fleets from different nations depending on their areas of operations. For example, while more than 82 percent of the vessels in Greece's fishing fleet

have engines of 50 HP or less, the corresponding figure for Sweden is only about 38 percent.

In terms of the areas of operation of the small Asian vessels, about 38 percent of them are dedicated to fishing on inland waters. In Africa and in Latin America and the Caribbean, small vessels constitute that vast sector of artisanal and subsistence fisheries on which the livelihoods of a great number of fisher households depend. In this context, efforts are being made in Africa as well as Central America to establish vessel registers as part of fishery resources management plans and policies.

Effect of overcapacity reduction efforts

Several countries have tried to resolve the issues of overcapacity by establishing reduction targets. However, data from other countries indicate a continuing expansion of their fleets. For example, the number of motorized fishing vessels in Cambodia increased by 16 percent from 38 253 in 2006 to 44 420 in 2008. Indonesia's fleet of motorized fishing vessels increased by 15 percent from 337 188 in 2005 to 387 178 in 2007. Viet Nam reported a 6 percent increase in offshore fishing vessels (those with engines of more than 90 HP) from a total of 21 232 in 2006 to 22 529 in 2008, and Malaysia reported an 8.6 percent increase in licensed fishing vessels from 23 376 to 25 376 for the same period. The case of Sri Lanka illustrates the potential for overshoot in efforts to re-establish a fishing fleet partly destroyed by the tsunami that swept the region in 2004. Sri Lanka had a pre-tsunami fishing fleet of 15 307 motorized vessels, which according to official reports was reduced to about 6 700 vessels (a 44 percent reduction) by the tsunami. By 2007, the fishing fleet numbered 23 464 motorized

Table 10
Percentage of small vessels in selected nations with reference to engine power and tonnage

Country	Date of data	Powered vessels (Number)	< 50 horsepower	< 50 gross tonnage (Percentage)	< 100 gross tonnage
Cambodia[1]	2008	44 420	98.9	–	99.0
Chile[1]	2008	6 801	–	–	97.8
Egypt[1]	2007	4 543	43.1	–	80.7
Indonesia[2]	2007	387 178	–	97.8	98.9
Japan[3]	2007	296 576	–	–	99.6
Thailand[1]	2007	13 056	–	71.0	97.0
Viet Nam[4]	2008	130 377	77.0	–	89.0
EU (selected)[5]					
Denmark	2009	2 861	57.7	92.3	95.5
Finland	2009	3 253	64.6	98.6	99.5
Greece	2009	17 255	82.1	97.9	99.0
Ireland	2009	2 098	57.3	85.9	92.0
Italy	2009	13 625	50.3	92.2	97.1
Portugal	2009	8 565	73.3	96.4	97.5
Spain	2009	11 143	64.7	87.5	91.9
Sweden	2009	1 454	37.8	89.8	93.1

[1] Response to FAO questionnaire 2008, national authorities.
[2] Ministry of Marine Affairs and Fisheries and Japan International Cooperation Agency. 2009. *Indonesian Fisheries Statistics Index 2009* (available at www.dkp.go.id/upload/jica/book_file/02_statindex2009.pdf).
[3] Fisheries Agency, Government of Japan. 2008. *Statistic Tables of Fishing Vessels.* General Report No. 60.
[4] National Directorate of Aquatics and Resource Exploitation and Protection. 2009. *Briefing document on the current status of Viet Nam's fishery sector.* DECAFIREP official figures, from POSMA, FSPS II. Prepared by the Post-Harvest and Marketing Component of the Fishery Sector Programme Support Phase II.
[5] Fleet Register On the Net (available at ec.europa.eu/fisheries/fleet/index.cfm?method=Download.menu).

vessels, and by 2008 the number had increased even further to 23 555 motorized fishing vessels.

Viet Nam incorporated a fleet reduction target of 40 000 small fishing boats as part of its 2006–2010 fisheries master plan. The number of small fishing boats was considered too high and partly responsible for overfishing in inshore waters. Therefore, fishers were encouraged to use larger and better-equipped fishing vessels and to fish further offshore, and a subsidy programme has been in effect towards this end. Whether the reduction target will be achieved remains to be seen.

China's 2003–2010 marine fishing vessel reduction plan has aimed to achieve a marine fishing fleet of 192 390 vessels with a total combined power of 11.4 million kW. The latest available information (2007) reports a total of 288 779 marine fishing vessels with a total combined power of 14.7 million kW. Japan has applied various schemes in order to reduce its fishing fleet. From 1981 to 2004, a total of 1 615 mid- to large-scale fishing vessels were scrapped under a government scheme of direct payment assistance for fishing fleet reduction. The historical data series of the number of motorized marine fishing vessels confirms the downward trend. In 2005, Japan had 308 810 registered marine fishing vessels with a combined total power of 12.44 million kW. By 2007, the number of vessels had dropped to 296 576 with a combined total power of 12.84 million kW. Thus, while the number of vessels declined, mean engine power increased, rising from 40.3 kW in 2005 to 43.3 kW in 2007. This is generally the case when decommissioning programmes are set in place as usually the first vessels to leave tend to be the most inefficient, while the most efficient vessels tend to remain active the longest.

In the EU, policies have been directed to ensuring sustainable fishing over a long period within a sound ecosystem through the appropriate management of fisheries while offering stable economic and social conditions to those involved in the activity. The restructuring of the European fishing fleet to achieve a sustainable balance between the fleet and the available fishery resources has been a major goal of such policies. Indeed, the evolution of the combined number, tonnage and power of Europe's fishing vessels does indicate downward tendencies in the last decade. For example, the fishing fleet of the EEA18 (which comprises the combined fleets from Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom) contracted from 90 573 vessels at the end of 2006 to 85 676 vessels at the end of 2008, a net reduction of 5.4 percent. In the same period, total tonnage decreased from 2.3 million GT to 2.2 million GT (a net reduction of 4.8 percent), while total power decreased from 8.44 million kW to 8.05 million kW (a net reduction of 4.6 percent). Notwithstanding such downward trends for the combined data of the EEA18 fishing fleet, similarly to the Japanese case, average power has actually increased. Thus, the mere reduction in the number of fishing vessels does not clearly reduce the actual fishing capacity of the fleet, as defined in terms of tonnage and engine power.

The EU tried to deal with this problem by establishing ceilings for total tonnage and total power for the fleets of each member state. Later, the measures were revised to limit the effort, defined as the product of the total number of vessels multiplied by the total tonnage (or total power) multiplied by the number of days at sea (or other measure of actual fishing activity).

Notwithstanding efforts aimed at reducing fleet capacity, high fuel prices seem an even more powerful force to reduce fishing activities – up to one-third of the small boats in Viet Nam have been reported as confined to port since 2008. Rising prices of fuel oil in 2007 and 2008 have also been thought to have a major impact and have prevented fishing operations in countries as diverse as Guatemala, Japan, Namibia, Philippines, and Sao Tome and Principe. There is some evidence that, at least in the United States of America, the current high fuel prices are reducing the use of high-powered fishing vessels.

THE STATUS OF FISHERY RESOURCES

Marine fisheries

Global production of marine capture fisheries reached a peak of 86.3 million tonnes in 1996 and then declined slightly to 79.5 million tonnes in 2008, with great interyear fluctuations. In 2008, the Northwest Pacific had the highest production of 20.1 million tonnes (25 percent of the global marine catch), followed by the Southeast Pacific, with a total catch of 11.8 million tonnes (15 percent), the Western Central Pacific with 11.1 million tonnes (14 percent) and the Northeast Atlantic, with 8.5 million tonnes (11 percent) (Figure 18).

The proportion of stocks estimated to be underexploited or moderately exploited declined from 40 percent in the mid-1970s to 15 percent in 2008 (Figure 19). In contrast, the proportion of overexploited, depleted or recovering stocks increased from 10 percent in 1974 to 32 percent in 2008. The proportion of fully exploited stocks has remained relatively stable at about 50 percent since the 1970s, with scattered, slightly lower levels between 1985 and 1997. In 2008, 15 percent of the stock groups monitored by FAO were estimated to be underexploited (3 percent) or moderately exploited (12 percent) and, therefore, able to produce more than their current catches. This is the lowest percentage recorded since the mid-1970s. Slightly more than half of the stocks (53 percent) were estimated to be fully exploited and, therefore, their current catches are at or close to their maximum sustainable productions, with no room for further expansion. The remaining 32 percent were estimated to be either overexploited (28 percent), depleted (3 percent) or recovering from depletion (1 percent) and, thus, yielding less than their maximum potential production owing to excess fishing pressure in the past, with a need for rebuilding plans. This combined percentage is the highest in the time series. While the degree of uncertainty about these estimates may be great (Box 1), the apparently increasing trend in the percentage of overexploited, depleted and recovering stocks and the decreasing trend in underexploited and moderately exploited stocks do give cause for concern.

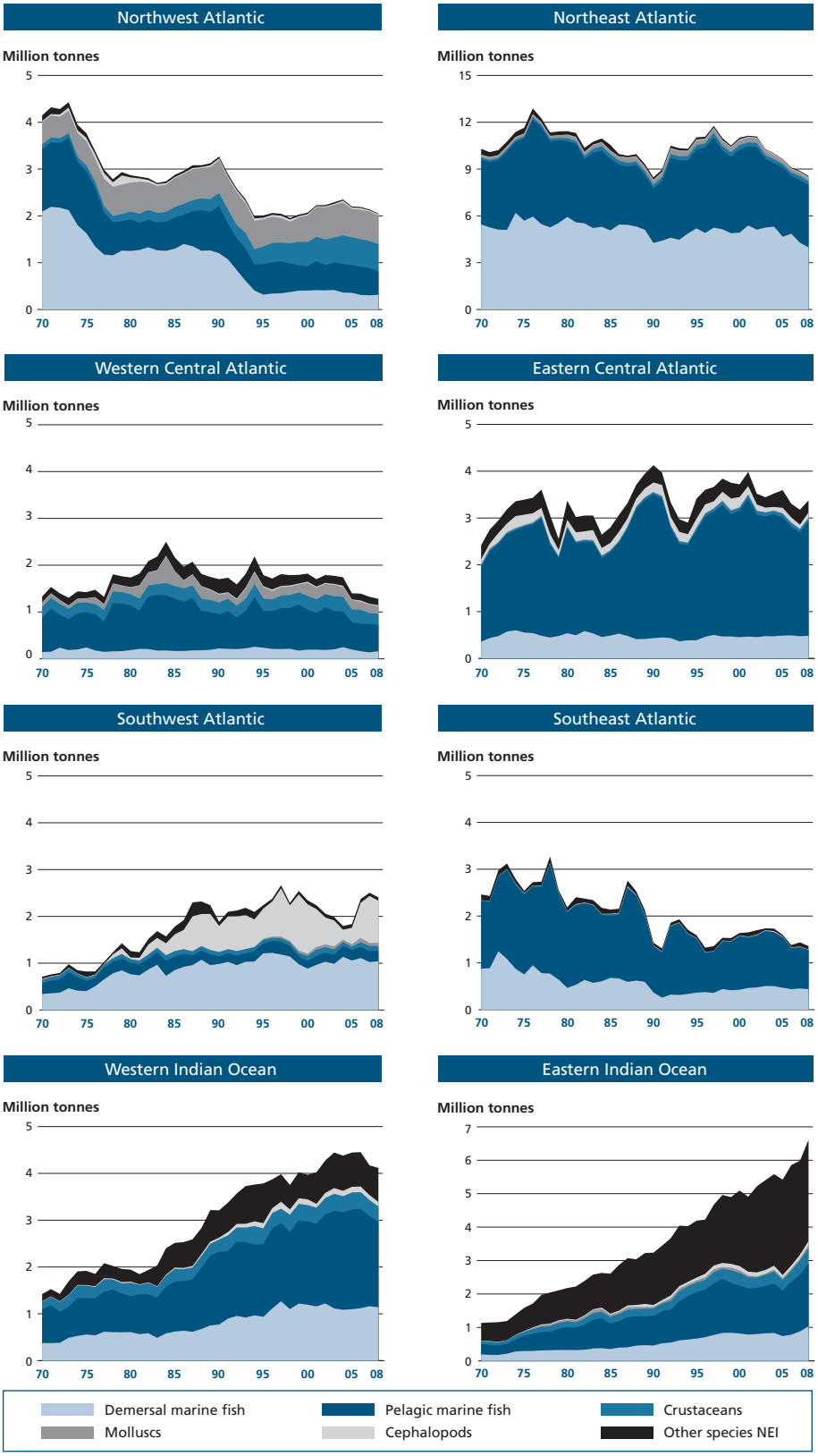
Most of the stocks of the top ten species, which account in total for about 30 percent of the world marine capture fisheries production in terms of quantity (Figure 6), are fully exploited and, therefore, have no potential for increased production, while some stocks are overexploited and increases in their production could only be possible with effective rebuilding plans in place. The two main stocks of anchoveta (*Engraulis ringens*) in the Southeast Pacific and those of Alaska pollock (*Theragra chalcogramma*) in the North Pacific and blue whiting (*Micromesistius poutassou*) in the Atlantic are fully exploited. Several Atlantic herring (*Clupea harengus*) stocks are fully exploited, but some are depleted. Japanese anchovy (*Engraulis japonicus*) in the Northwest Pacific and Chilean jack mackerel (*Trachurus murphyi*) in the Southeast Pacific are considered to be fully exploited. Some limited possibilities for expansion may exist for a few stocks of chub mackerel (*Scomber japonicus*), which are moderately exploited in the Eastern Pacific, while the stock in the Northwest Pacific was estimated to be recovering. In 2008, the largehead hairtail (*Trichiurus lepturus*) was estimated to be overexploited in the main fishing area in the Northwest Pacific.

The total catch of tuna and tuna-like species was about 6.3 million tonnes in 2008. The principal market tuna species – albacore, bigeye, bluefin (three species), skipjack and yellowfin – contributed 4.2 million tonnes, a decline of about 0.2 million tonnes from the peak in 2005. About 70 percent of that catch was taken from the Pacific. The skipjack was the most productive tropical market tuna (contributing about 57 percent to the 2008 catch of principal tunas) and yellowfin and bigeye were the other productive tropical species (contributing about 27 and 10 percent, respectively).

Of the 23 tuna stocks, most are more or less fully exploited (possibly up to 60 percent), some are overexploited or depleted (possibly up to 35 percent) and only a few appear to be underexploited (mainly skipjack). However, an increase in skipjack catches is not desirable at present as it may negatively affect bigeye and

Figure 18

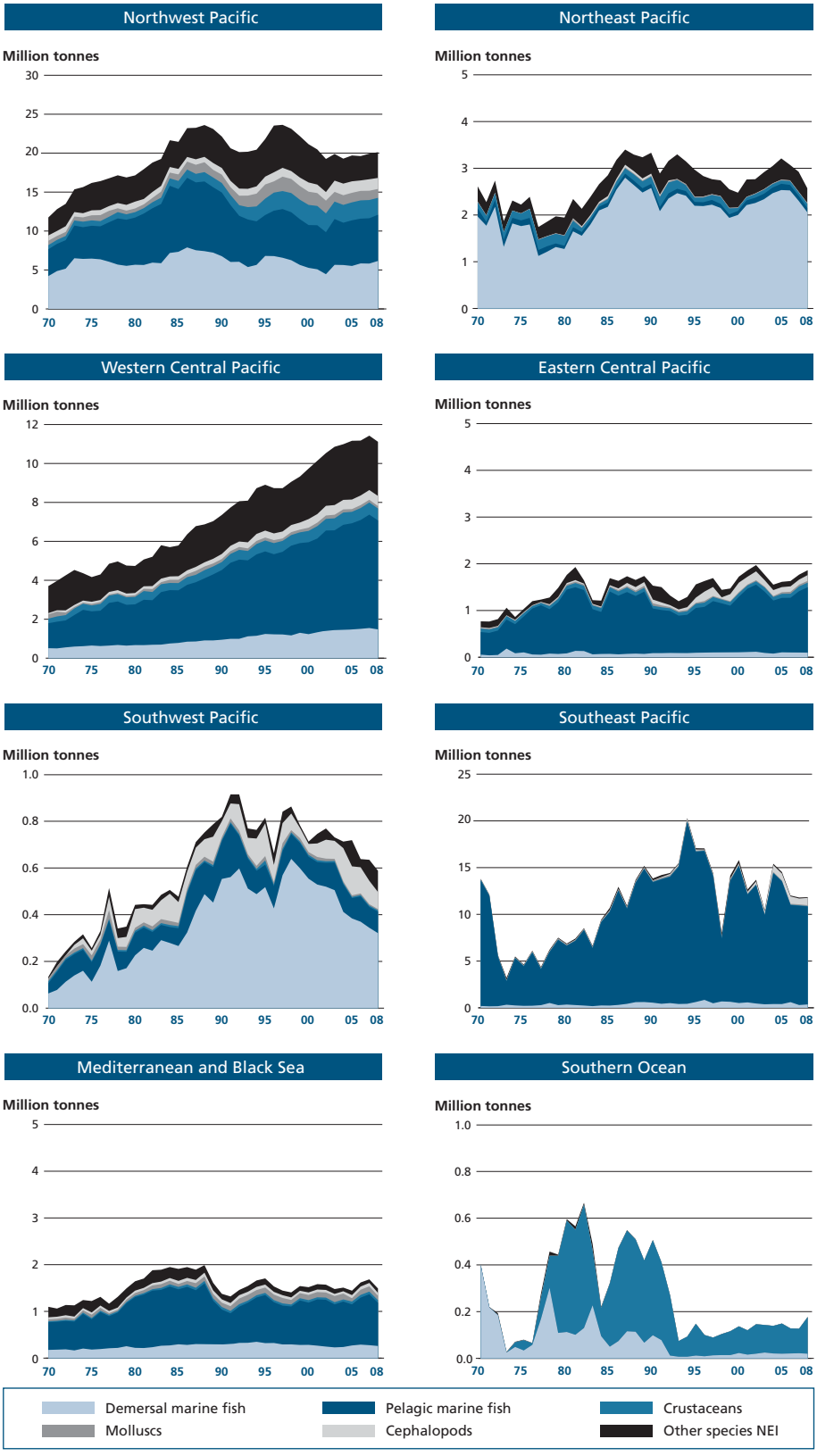
Capture fisheries production in marine areas



(Continued)

Figure 18 *(cont.)*

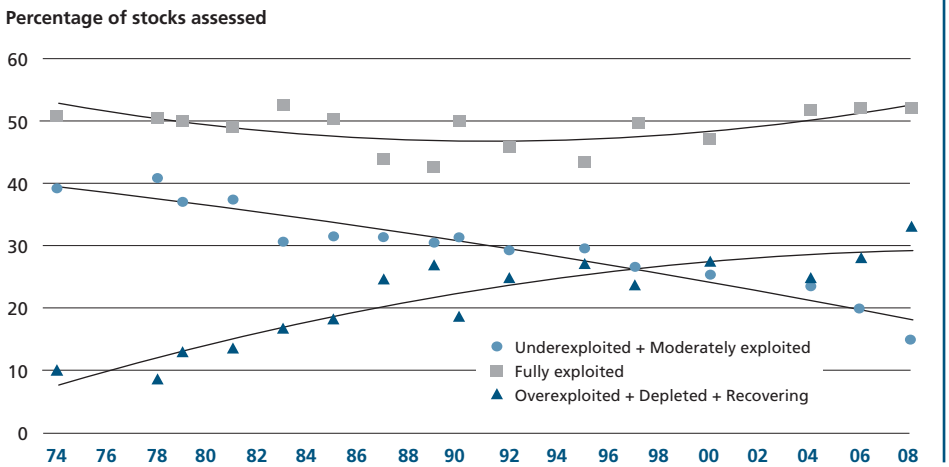
Capture fisheries production in marine areas



Note: NEI = not elsewhere included.

Figure 19

Global trends in the state of world marine stocks since 1974



yellowfin tunas. Only for very few stocks of principal tunas is their status unknown or very poorly known. In the long term, because of the substantial demand for tuna and the significant overcapacity of tuna fishing fleets, the status (and consequently catches) of tuna stocks may deteriorate further if there is no improvement in their management.

The concern about the poor status of some bluefin stocks and the difficulties facing many tuna management organizations in managing these stocks effectively led to a proposal by Monaco in 2010 to ban the international trade of Atlantic bluefin under the CITES. Although it was hardly in dispute that the stock status of this high-value food fish met the biological criteria for listing on CITES Appendix I, the proposal was ultimately rejected. Many parties that opposed the listing stated that in their view the ICCAT was the appropriate body for the management of such an important commercially exploited aquatic species.

In the Northwest Pacific, small pelagics are the most abundant category, with Japanese anchovy providing about 1.9 million tonnes in 2003, but having since declined to 1.2 million tonnes in 2008. Other important contributors to the total catch in the area 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 Eastern Central and Southeast Pacific, there have been no major changes in the state of stock exploitation, while there have been some improvements regarding the assessment and management of some key fish stocks at both the national and international levels. Regarding international cooperation, after 3–4 years of intense negotiations, some of the member parties of the proposed South Pacific Regional Fisheries Management Organization (Chile, Colombia, Cook Islands, New Zealand and Peru) adopted the Convention on the Conservation and Management of the High Seas Fishery Resources of the South Pacific Ocean, in Auckland, New Zealand, on 14 November 2009. This convention promotes the international conservation and management of non-highly-migratory fisheries and protection of biodiversity in the area extending from the easternmost part of the South Indian Ocean through the Pacific towards the EEZs of South America. Central American countries have also improved regional cooperation for the assessment and management of important coastal fisheries resources in their area. In addition, a moderate El Niño developed in 2009 and continued throughout the equatorial Pacific in the early months of 2010. Deep tropical convection remained enhanced across central and eastern parts of the

tropical Pacific, with relatively mild impacts reported on the state of stocks and fisheries in the eastern Pacific.

Total production in the Western Central Pacific grew continuously to a maximum of 11.4 million tonnes in 2007 and then decreased slightly in 2008. This area contributes about 14 percent of global marine production. Despite this apparently positive situation, there are reasons for concern regarding the state of the resources, with most stocks being either fully exploited or overexploited (many also depleted), particularly in the western part of the South China Sea. The high catches have probably been maintained through expansion of the fisheries to new areas, and possible double counting in the transshipment of catches between fishing areas, which leads to bias in estimates of production, potentially masking negative trends in stock status.

In the Northeast Atlantic, the blue whiting stock has recovered since the 1990s with current catches of about 1 million tonnes, although a managed decline in the short term is probable owing to recent low recruitment. Fishing mortality has been reduced in cod and plaice, with recovery plans in place for the major stocks of these species. The Arctic cod spawning stock was particularly large in 2008, having recovered from the low levels observed from the 1960s to the 1980s. Similarly, the Arctic saithe and haddock stocks have increased to high levels, although stocks elsewhere remain fully exploited or overexploited. The largest stocks of sand eel and capelin remain overexploited. Concern remains for redfishes and deep-water species for which there are limited data and which are likely to be vulnerable to overfishing. The northern shrimp stocks are generally in good condition, but there are indications that some stocks are being overexploited. Harvest control rules based on a more consistent maximum sustainable yield policy have been, or are being, developed for many stocks, including blue whiting, mackerel, Arctic haddock, Arctic cod, and the larger herring and plaice stocks.

Although fishery resources in the Northwest Atlantic continue to be under stress from previous and/or current exploitation (with some 35 percent of stocks estimated to be depleted in 2008), some overexploited and depleted stocks have recently shown signs of recovery in response to an improved management regime in the past decade (e.g. Greenland halibut, yellowtail flounder, Atlantic halibut, haddock and spiny dogfish). However, this is not the case for Atlantic cod, once the most important and abundant commercial fish species in the Northwest Atlantic, which dramatically collapsed in the early 1990s and has not recovered yet.

There have been several important changes in the status of the stocks in the Southeast Atlantic since the last assessment in 2006. The important hake resources remain fully exploited to overexploited. However, there are signs of some recovery in the deepwater hake stock (*Merluccius paradoxus*) off South Africa and in the shallow-water Cape hake (*Merluccius capensis)* off Namibia as a consequence of good recruitment years and of the strict management measures introduced since 2006. The status of most stocks of coastal fishes remains fully exploited or overexploited, some being 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, a situation that was already evident in the last review in 2008. In contrast, the status of Southern African anchovy has continued to improve from fully to moderately exploited, due especially to a series of years with good recruitment conditions, while Whitehead's round herring continues to be underexploited to moderately exploited. The condition of Cape horse mackerel and Cunene horse mackerel stocks has deteriorated, particularly off Namibia and Angola, where both species are currently overexploited. Sardinellas (*S. aurita* and *S. maderensis*) off Angola are still moderately to fully exploited. The condition of the perlemoen abalone stock continues to be worrying. Exploited heavily by illegal fishing, it is currently overfished and probably depleted.

Another area of concern is the Southwest Atlantic, where more than half of the 16 assessed species were deemed to be depleted or overfished, among them Argentina hake (*Merluccius hubbsi*), southern blue whiting (*Micromesistius australis*), Patagonian toothfish (*Dissostichus eleginoides*) and the Argentine shortfin squid (*Illex argentinus*).

In the Eastern Central Atlantic, total catches were about 3.4 million tonnes in 2008, slightly below the 2000–08 average of about 3.5 million tonnes. The small pelagic species constitute the bulk of the landings, followed by the miscellaneous coastal fishes. The single most important species in terms of landings is sardine (*Sardina pilchardus*), with annual landings in the range of 600 000–800 000 tonnes in the last nine years. In the area from Cape Boujdor southwards to Senegal, the sardine is still considered moderately exploited, otherwise most of the pelagic stocks are considered fully exploited. Some are considered overexploited, such as the sardinella stocks off Northwest Africa and in the Gulf of Guinea. To a large extent, the demersal fish

Box 1

Assessment of data-poor fisheries

The statistics presented in *The State of World Fisheries and Aquaculture 2010* on the status of marine fisheries are frequently referred to in international policy documents and in the media to draw attention to the issue of the sustainability of the world's fisheries. While this information represents a unique effort to provide a global overview on the state of fishery resources, it should be noted that the stocks included in this analysis, and for which assessments are available, represent only a fraction of the total number of exploited stocks around the world. The proportion of the exploited stocks that are subject to some sort of formal assessment is highest for the fisheries operated by developed countries, particularly in high-latitude areas, and lowest for tropical multispecies fisheries exploited by fleets from developing countries or by distant-water fleets.

A conservative estimate is that probably only 10 percent of the exploited fish stocks are assessed, but not always regularly. Although these assessed stocks include the largest single-species stocks and account for almost 80 percent of the total declared landings, it is clear that for the large majority of the exploited fish stocks there is no or little information on their status. In addition to the difficulty of developing a reliable global overview of the state of fish stocks, this situation also undermines the ability of states to manage their fisheries sustainably. The FAO Code of Conduct for Responsible Fisheries requires that all fisheries should be managed using the "best available knowledge", and for most fisheries this information should necessarily include stock status and an understanding of the impacts of fishing on the target species and their supporting ecosystem. Growth in the international trade in fishery products, combined with increasing consumer awareness about sustainability issues, often results in the adoption of ecolabeling schemes, which requires documentation on the state of exploited fish stocks for the application of certification procedures.

To ensure the long-term sustainability of fishery resources, it is essential that exploited stocks be regularly assessed and that the results of these assessments be incorporated into the fisheries management process. In most of the industrialized large-scale fisheries, states regularly collect biological and statistical data and monitor stock status through

resources are fully exploited to overexploited in most of the area, and the white grouper stock (*Epinephelus aeneus*) off Senegal and Mauritania remains in a severe condition. The status of some of the deepwater shrimp stocks seems to have improved and they are now considered moderately exploited, whereas the other shrimp stocks in the region range from fully exploited to overexploited. The commercially important octopus (*Octopus vulgaris*) and cuttlefish (*Sepia* spp.) stocks remain overexploited.

In the Mediterranean Sea, the overall situation has remained stable but difficult since the last global assessment. All hake (*Merluccius merluccius*) and red mullet (*Mullus barbatus*) stocks are considered overexploited, as are probably also the main stocks of sole and most seabreams. The main stocks of small pelagic fish (sardine and anchovy) are assessed as either fully exploited or overexploited.

In the Black Sea, the situation of small pelagic fish (mainly sprat and anchovy) has recovered somewhat from the drastic decline suffered in the 1990s, probably as a

mathematical modelling. However, the collection of such data is often quite expensive, requires a stable research and monitoring system and calls for specialized expertise that is not always available (or is scarce) in many countries or regions. Therefore, this approach may not be applicable to many of the world's fisheries.

It has become clear that there is a need to identify or develop methods and procedures that are less data-demanding, but which can be used to assess the status of fish stocks and to provide the information necessary for designing effective management plans. To increase the awareness of these methods among a wider audience, including the advantages and disadvantages of the different approaches, FAO is preparing a set of guidelines for the assessment of fish stocks in data-poor situations. These guidelines will lay out the main principles as regards the use of these tools, with the precautionary principle as the overarching reference. These methods require fewer data in comparison with traditional stock assessments, but they make more explicit use of local knowledge and informal approaches. Assessments of uncertainty and risk will be a key part of such methods. The assessment procedure will be more closely linked to fisheries management and the decision-making process.

The trade-offs between intensity of exploitation and data availability will be made clearer, in that intensively exploited fisheries will require more intensive and frequent data collection and monitoring than moderately exploited ones. Guidance as regards other criteria that may be relevant in deciding the level of cost and complexity of the assessment (and of management) will also be provided. This will help to ensure that costs are commensurate with the value of the fishery, and that the level of complexity matches the capacity available in the given context.

With this and other similar initiatives, it is expected that the coming years will see a clear increase in the number of assessed stocks, and also a strengthening of the link between stock assessment and fisheries management under a risk assessment framework. This work is fully consistent with, and is an aspect of, implementing an ecosystem approach to fisheries.

consequence of unfavourable oceanographic conditions, but they are still considered fully exploited to overexploited.

The Eastern Indian Ocean is still experiencing a high growth rate in catches, with a 10 percent increase from 2007 to 2008, now totalling 6.6 million tonnes. The Bay of Bengal and Andaman Sea regions have seen total catches increasing steadily, and there are no signs of the catch levelling off. However, a very high percentage (about 42 percent) of the catches in this area are attributed to the category "marine fishes not identified", which is a cause of concern as regards the need for monitoring stock status and trends. Increased catches may in fact be due to the expansion of fishing to new areas or species. Declining catches in the fisheries within Australia's EEZ can partly be explained by a reduction in effort and in catches following a structural adjustment and a ministerial direction in 2005 aimed at ceasing overfishing and allowing overfished stocks to rebuild. The economics of fishing in this area are expected to improve in the medium and long terms, but higher profits can also be expected for individual fishers in the short term because fewer vessels are operating.

In the Western Indian Ocean, total landings reached a peak of 4.45 million tonnes in 2006, but dropped to 4.12 million tonnes in 2008. Tuna and tuna-like species are the largest catch contributor among other species groups – 0.88 million tonnes or 21 percent of the total landings of the area in 2008. Recent assessments have shown that stocks of narrow-barred Spanish mackerel (*Scomberomerus commerson*) are overfished. Catch data in this area are often found not to be detailed enough for stock assessment purposes. However, the South West Indian Ocean Fisheries Commission conducted stock assessments for 140 species in its mandatory area in 2008 based on best-available data and found that 29 percent are overexploited or depleted, 53 percent are moderately or fully exploited and 18 percent are underexploited, which is higher than the global average.

It should be noted that the declining global catch in the last few years, together with the increased percentage of overexploited, depleted or recovering stocks and the decreased proportion of underexploited and moderately exploited species around the world, strengthens the likelihood that the production of wild capture fisheries will not be able to increase unless effective management plans are put in place to rebuild overfished stocks. The situation seems more critical for some highly migratory, straddling and other fishery resources that are exploited solely or partially in the high seas. The United Nations Fish Stocks Agreement (UNFSA), which entered into force in 2001, should be used as a legal basis for management measures for the high seas fisheries.

It is encouraging to note that good progress is being made in reducing exploitation rates and restoring overfished fish stocks and marine ecosystems through effective management actions in some areas. For example, among the fish stocks managed by Australia, the number of fish stocks classified as overfished and/or subject to overfishing fell from 24 in 2005 to 18 in 2008; in contrast, the number of stocks classified as fully fished and underfished increased from 19 to 39 in the same period.[5] Since the 1990s, the Newfoundland–Labrador Shelf, the Northeast United States Shelf, the Southern Australian Shelf, and the California Current ecosystems have shown substantial declines in fishing pressure, such that they are now at or below the modelled exploitation rate that gives the multispecies maximum sustainable yield of the ecosystem.[6]

Inland fisheries

Inland fisheries are a vital component in the livelihoods of people in many parts of the world, in both developing and developed countries. Inland fisheries provide high-quality protein, essential nutrients and minerals that are often difficult to obtain from other food sources. In developing areas, inland fisheries provide economic opportunities and a "safety net" that allows for continued food production when other sectors may fail. In developed countries, and in an increasing number of

developing countries, inland fisheries are used for recreation rather than for food production, another avenue to economic development and growth.

However, the status of inland fishery resources and the ecosystems that support them is generally poorly known. This has led to differing views on the actual status of many resources. One view maintains that, because of the multiple uses of and threats to inland water ecosystems, the sector is in serious trouble. The other view holds that the sector is in fact growing and that much of the production and growth has gone unreported. The statistics reported to FAO indicate an overall increase of 1.6 million tonnes in the period 2004–08, and in 2008 the sector contributed 10.2 million tonnes to global capture fisheries production – a record contribution. For further details on inland water catch trends, see the "World inland capture fisheries production" section (on page 16) and the discussion below on these statistics.

The simple phrase "inland fisheries" belies the extremely diverse nature of this subsector, and thus makes assessment of the state of inland fishery resources extremely difficult. Inland fisheries include a range of fishing techniques in a variety of inland waterbodies. Inland fisheries exist in natural areas such as streams, rivers, swamps, lakes and inland seas, in temporary waterbodies such as floodplains and seasonal ponds, and also in artificial and modified habitats such as irrigation systems, rice paddies, reservoirs and enclosed natural waterbodies (e.g. ox-bow lakes). Fishing techniques also range from small hand-held nets in rice paddies to industrial-scale trawlers on inland seas. In remote rural areas, fishery management, monitoring and reporting are difficult and often non-existent.

The reluctance by public administrations to spend resources on monitoring inland fisheries, to which the high cost of collecting information is a contributing factor, leads to a poor state of knowledge on inland fisheries and their resources. This in turn hinders the formulation of comprehensive and appropriate policies for the sector.

The assessment of inland fishery resources is generally done by each country on its own, even for watersheds shared with neighbouring countries. This is in spite of the fact that most inland fishery scientists recommend the "watershed" as the appropriate unit for fishery management and resource assessment. They do so because biological, ecological and physiochemical processes within the watershed are interdependent and will determine fishery production.

Although irresponsible fishing practices can and do affect the state of inland fishery resources, factors external to the fishery are often more important for the status of the stocks. Habitat loss and degradation, water abstraction, drainage of wetlands, dam construction, and pollution and eutrophication often act together, thus compounding one another's effects. They have caused substantial declines and/or changes in inland fishery resources. Although these impacts are not always reflected by a discernable decrease in fishery production (especially where stocking is practised), the fishery may change in composition and value.

In response to the above impacts on inland fisheries, enhancement programmes have been initiated in many areas of the world. One common form of enhancement is the stocking of early life-history stages produced in aquaculture hatcheries. Thus, fishery production may be maintained not by natural recruitment but by the release of hatchery-raised individuals. Reporting on the contribution of hatchery-produced stock is often poor (or even absent), and resource assessments based primarily on catch from a stocked fishery could be misleading, particularly where there is significant natural recruitment.

There is a growing appreciation of the need to improve inland fishery statistics. This is principally because inland fisheries provide significant food and income to many rural areas in developing countries. Even in peri-urban areas and industrialized countries, inland fisheries provide significant employment and income-generating opportunities through recreational and fishing and environmentally related activities. Where in-depth analysis has been undertaken, it has revealed that officially reported inland fishery production has underestimated actual production by as much as 1 000 percent

in some areas.[7] Focused studies on inland fishery production have demonstrated that officially reported production has underestimated the true amount by an average of about 40 percent.[8] On the other hand, the constant increases in inland water catch production reported by several major fishing countries (Table 3) seem somewhat unrealistic given the environmental conditions of inland waterbodies. In some cases, these increases may be due largely to improvements in the data collection system. Studies have examined existing information to look for reporting irregularities and novel approaches are being tried,[9] such as including a question on inland fisheries in periodic national agriculture census.

The role of inland fisheries in poverty alleviation and food security needs to be better reflected in development and fisheries policies and strategies. The tendency to undervalue inland fisheries has resulted in inadequate coverage in national and international agendas. In recognition of this, the "Outlook" section of *The State of World Fisheries and Aquaculture 2010* focuses on inland fisheries in an effort to improve awareness of their role and importance.

FISH UTILIZATION AND PROCESSING

Fisheries production is rather diversified where species and product forms are concerned. As a highly perishable commodity, fish has specific requirements and a significant capacity for processing. The many options for preparing fish allow for a wide range of presentations, making fish a very versatile food commodity. It is generally distributed as 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.

In 2008, nearly 81 percent (115 million tonnes) of world fish production was destined for human consumption, while the rest (27 million tonnes) was used for non-food purposes. Seventy-six percent of world fish production destined for non-food purposes (20.8 million tonnes) was reduced to fishmeal and fish oil; the remaining 6.4 million tonnes was largely utilized as fish for ornamental purposes, for culture (fingerlings, fry, etc.), for bait, for pharmaceutical uses as well as raw material for direct feeding in aquaculture, for livestock and for fur animals.

In 2008, 39.7 percent (56.5 million tonnes) of world fish production was marketed as fresh, while 41.2 percent (58.6 million tonnes) of fish was frozen, cured or otherwise prepared for direct human consumption.

Since the mid-1990s, the proportion of fish used for direct human consumption has grown. This tendency has come about as more fish is used as food and less for producing fishmeal and fish oil.

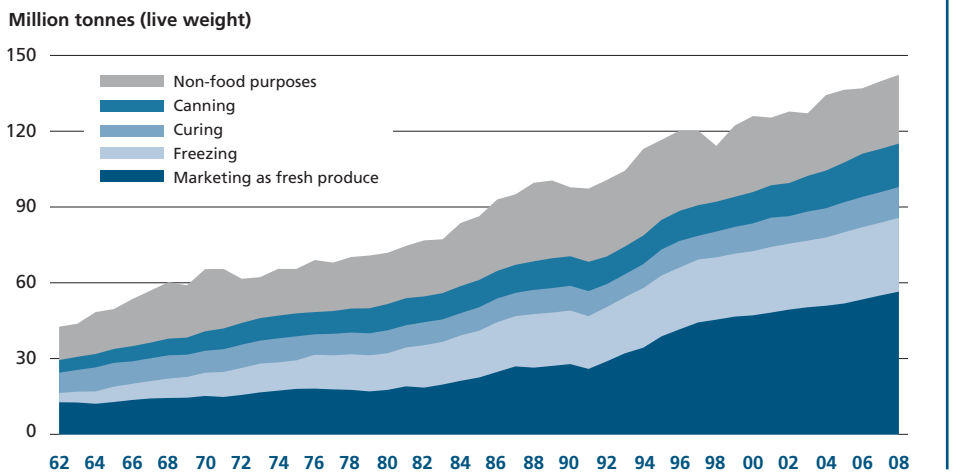
Small pelagics, in particular anchoveta, are the main groups of species used for reduction, and the production of fishmeal and fish oil is strictly linked to the catches of these species. The El Niño phenomenon has considerable effects on catches of anchoveta, which has experienced a series of peaks and drastic drops in the last few decades. Fishmeal production peaked in 1994 at 30.2 million tonnes (live weight equivalent) and has followed a fluctuating trend since then. In the last three years, it has experienced minimum variations (20.8 million tonnes in 2008) as catches of anchoveta have been rather stable.

Of the fish destined for direct human consumption, fish in live or fresh-fish form was the most important product, with a share of 49.1 percent, followed by frozen fish (25.4 percent), prepared or preserved fish (15.0 percent) and cured fish (10.6 percent). Live and fresh fish increased in quantity from 45.4 million tonnes in 1998 to 56.5 million tonnes in 2008 (live weight equivalent). Processed fish for human consumption increased from 46.7 million tonnes in 1998 to 58.6 million tonnes in 2008 (live weight equivalent). Freezing represents the main method of processing fish for human consumption, and it accounted for a 49.8 percent share of total processed fish for human consumption and 20.5 percent of total fish production in 2008 (Figure 20).

These general data mask significant differences. The utilization of fish and, more significantly, the processing methods vary according to the continent, region, nation

Figure 20

Utilization of world fisheries production (breakdown by quantity), 1962–2008



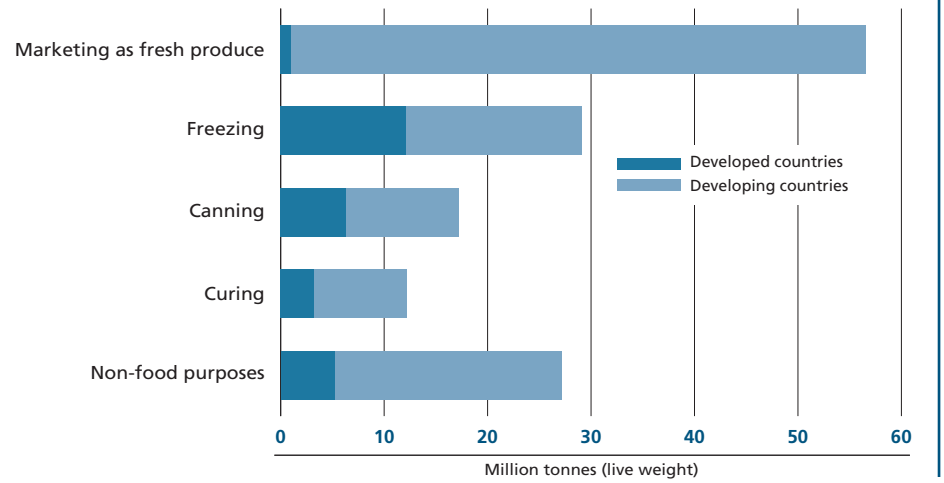
and even within countries. The highest percentage of fishmeal is produced by Latin American countries (47 percent of the total). The proportion of cured fish is higher in Africa (14 percent of the total) compared with other continents (the world average is 8.6 percent). In Europe and North America, more than two-thirds of fish used for human consumption is in frozen and canned forms.

In Africa, but also significantly in Asia, a large proportion of fish is marketed in live or fresh forms. Live fish is particularly appreciated in Asia (especially by the Chinese population) and in niche markets in other countries, mainly among immigrant Asian communities. However, it is not possible to determine the exact amount of fish marketed in live form from available statistics. Live fish are valuable but difficult to market and transport. They are often subject to stringent health regulations and quality standards. In some parts of Southeast Asia, and particularly in China, the commercialization and trade are not formally regulated but based on tradition. However, in markets such as the EU, live fish have to comply with requirements *inter alia* concerning animal welfare during transportation. Commercialization of live fish has increased in recent years as a result of technological developments, improved logistics and increased demand. An elaborate network of handling, transport, distribution, display and holding facilities has been developed to support the marketing of live fish. New technological systems include specially designed or modified tanks and containers, as well as trucks and other transport vehicles equipped with aeration or oxygenation facilities to keep fish alive during transportation or holding and display. Major innovations in refrigeration, ice-making and transportation are also permitting the distribution of more fish in fresh form.

However, notwithstanding technical changes and innovations, many countries, especially developing countries, still lack adequate infrastructure, including hygienic landing centres, electric power supply, potable water, roads, long supply chains as well services such as ice, ice plants, cold rooms and refrigerated transport. These factors, linked with tropical temperatures, cause a high percentage of post-harvest losses and quality deterioration, with consequent risk to the health of consumers. 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 in developing countries is traded primarily in live or fresh form (representing 60.0 percent of fish destined for human consumption in 2008) or after curing through drying, smoking or fermentation (9.8 percent in 2008). However, in the last few years, developing countries have experienced a growth in the share of frozen products (18.4 percent in 2008, up from 7.7 percent in 1998) and of

Figure 21

Utilization of world fisheries production (breakdown by quantity), 2008



prepared or preserved forms (11.8 percent in 2008, compared with 7.8 percent in 1998) (Figure 21).

In developed countries, most fish is retailed either as a frozen or as a prepared or preserved product. The share of frozen fish has been increasing in the last four decades and it represented 43.5 percent of total production in 2008. In many developed countries, processors are often facing reduced margins owing to increased competition from low-cost processing countries. Processors that operate without strong brands are also experiencing growing problems linked to the scarcity of domestic raw material and they are being forced to import fish for their business. Processors of traditional products, in particular of canned products, have been losing market share to suppliers of fresh and frozen products as a result of long-term shifts in consumer preferences as well as in changes in processing and in the general fisheries industry.

The fish industry is dynamic by nature and in the last two decades the utilization and processing of fish production have diversified significantly, particularly into high-value fresh and processed products, fuelled by changing consumer tastes and advances in technology, packaging, logistics and transport. Processing is becoming more intensive, geographically concentrated, vertically integrated and linked with global supply chains. 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 the 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, for which shelf-life and transportation time are important, 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.

Improved processing technology enables higher yields and results in a more lucrative product being derived from the available raw material for fish for human consumption as well as for the production of fishmeal and fish oil. In developed countries, innovation in value addition 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 require 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 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 of providing livelihood support to 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.

Improved processing technologies are also important in the utilization of fish waste derived from the fish-processing industry. Chitin and chitosan obtained from shrimp and crab shells have a variety of uses, such as in water treatments, cosmetics and toiletries, food and beverages, agrochemicals and pharmaceuticals. Fish skin is used as a source of gelatine as well as leather in making clothing, shoes, handbags, wallets, belts and other items. Larger fish are more suited to leather production owing to the size of the skins. Common sources of leather include shark, salmon, ling, cod, hagfish, tilapia, Nile perch, carp and seabass. Shark cartilage is used in many pharmaceutical preparations and reduced in powder, creams and capsules, as are other parts of sharks, e.g. ovaries, brain, skin and stomach. Fish collagen is used in the pharmaceutical industry, as are carotenoids and astaxanthins – pigments that can be extracted from crustacean wastes. Fish silage and fish protein hydrolysates obtained from fish viscera are finding applications in the pet feed and 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. In addition, shark teeth are used in handicrafts; similarly, the shells of scallops and mussels can be used in handicrafts and jewellery, and for making buttons. Calcium carbonate for industrial use can be obtained from mussel shells. Oyster shells are used in some countries as a raw material in the construction of buildings and for the production of quicklime (calcium oxide). Small fish bones, with a minimum amount of meat, are also consumed as snacks in some Asian countries. Procedures for the industrial preparation of biofuel from fish waste as well as from seaweeds are being developed.

FISH TRADE AND COMMODITIES

Fish and fishery products are highly traded. They have long been commercialized, and in the period 1976–2008 the fishery trade grew significantly, at an average annual rate of increase of 8.3 percent in value terms. This rise was aided by structural changes in the fishery sector, including the growing globalization of the fisheries and aquaculture value chain, and by the outsourcing of processing to countries where comparatively low wages and production costs provide a competitive advantage. In addition, increasing consumption of fishery commodities, trade liberalization policies, globalization of food systems and technological innovations furthered the overall increase in international fish trade. Improvements in processing, packaging,

transportation and changes in distribution and marketing significantly changed the way fishery products were prepared, marketed and delivered to consumers. All these factors facilitated and increased the movement of production in relative terms from local consumption to international markets. The share of production (live weight equivalent) entering international trade as various food and feed products increased from 25 percent in 1976 to 39 percent in 2008 (Figure 22), reflecting the sector's growing degree of openness to, and integration in, international trade.

Until 2008, increasing fish exports coincided with an impressive global trade expansion. According to the United Nations Comtrade database, real merchandise exports increased by 27 percent between 2006 and 2008, well above the average annual rate of growth of 11 percent in the period 1998–2008. Among important factors explaining this increase, there was the influence exerted by price movements and exchange rates on trade flows, also 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) *vis-à-vis* the US dollar.

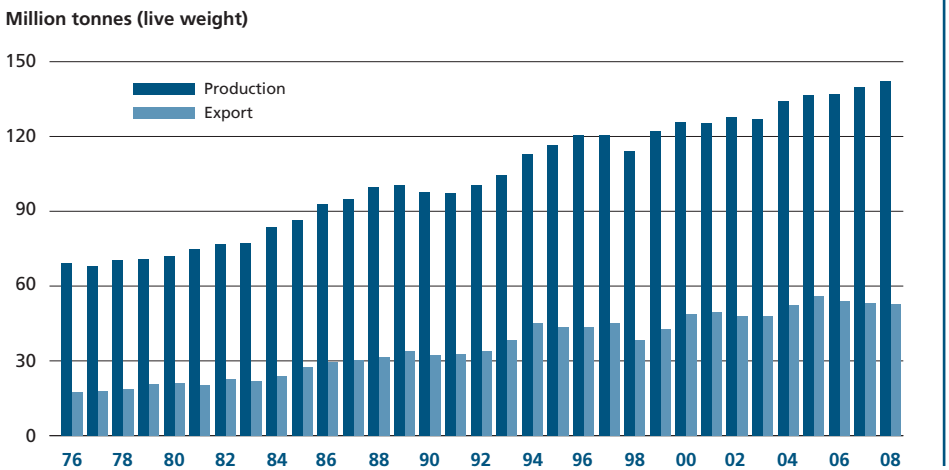
Trade in fish and fishery products is characterized by a wide range of product types and participants. In 2008, 197 countries reported exports of fish and fishery products. The role of fishery trade varies among countries and is important for many economies, in particular for developing nations. Trade in fish represents a significant source of foreign currency earnings, in addition to the sector's important role in employment, income generation and food security. In 2008, trade in fish and fishery products represented about 10 percent of total agricultural exports (excluding forest products) and 1 percent of world merchandise trade in value terms.

In 2008, exports of fish and fishery products reached a record of US$102.0 billion, 9 percent higher than 2007, nearly doubling the US$51.5 billion corresponding value in 1998. In real terms (adjusted for inflation), fishery exports grew by 11 percent in the period 2006–08, by 50 percent between 1998 and 2008 and by 76 percent between 1988 and 2008. In quantity terms (live weight equivalent), exports reached a peak at 56 million tonnes in 2005, representing an increase of 28 percent since 1995 and of 104 percent since 1985. Thereafter, export volumes decreased, accounting for 55 million tonnes in 2008. This decline was mainly because of a fall in production of and trade in fishmeal (down 10 percent in the period 2005–08), but also to the first signs of contraction in demand, and therefore of trade, as a consequence of the food price crisis, which affected consumer confidence in major markets.

In the period from late 2006 to mid-2008, international agricultural prices (particularly of basic foods) escalated to record levels in nominal terms. A series of long-

Figure 22

World fisheries production and quantities destined for export



and short-term factors contributed to this growth. They included the tightening in own supplies and the intertwining of global markets, exchange rate fluctuations, and rising crude oil prices and freight rates. These soaring prices affected large population segments, in particular among the poor in many developing countries. Prices of fish and fishery products were also affected by the food price crisis, following the general upward trend in all food prices. The FAO Fish Price Index (for more information on this issue, see Box 2) indicates an increase from 93.6 in February 2007 to 128.0 in September 2008. This represents the highest value reached during the period covered by the index (from 1994 to the present, with the base year 1998–2005 = 100). Prices for species from capture fisheries increased more than those for farmed species (which reached 137.7 versus 117.7 in September 2008, with 2005 as base year = 100) because of the larger impact from higher energy prices on fishing vessel operations than on farmed species. Aquaculture also experienced higher costs, in particular for feedstuffs.

In late 2007, a global financial crisis began. This crisis erupted into a full-blown economic recession in September 2008, representing the greatest financial and economic challenge since the Second World War. With the crisis, food prices fell dramatically. The FAO Fish Price Index reported a drastic drop from 128.0 in September 2008 to 112.6 in March 2009, after which it recovered to 119.5 in November 2009. Virtually no country has escaped the impact of the widening crisis, whose effects are likely to be felt through to 2011. Global gross domestic product (GDP) declined by 2.2 percent in 2009, and trade flows contracted sharply, with a drop of 14.4 percent in world merchandise trade in 2009. Preliminary estimates indicate that trade in fish and fishery products declined by 7 percent in 2009 compared with 2008.

Although the most acute phase of the global financial crisis seems to have passed and GDP growth rates are starting to improve, the outlook for the global economy remains uncertain and the recovery is fragile and slow. According to the World Bank's Global Economic Prospects 2010 report,[10] the world economy is expected to recover, with GDP projected to grow by 2.7 percent in 2010 and 3.2 percent in 2011. World trade volumes are forecast to expand by 4.3 percent in 2010 and 6.2 percent in 2011. Available data for the first few months of 2010 indicate that there have been increasing signs that fish trade is recovering in many countries, and the long-term forecast for fish trade remains positive, with a growing share of fish production entering international markets.

Table 11 shows the top ten exporters and importers of fish and fishery products in 1998 and 2008. China, Norway and Thailand are the top three exporters. Since 2002, China has been by far the leading fish exporter, contributing almost 10 percent of 2008 world exports of fish and fishery products, or about US$10.1 billion, and increasing further to US$10.3 billion in 2009. China's fishery exports have grown considerably since the 1990s, although at present they represent only 1 percent of its total merchandise exports. A growing share of fishery exports consists of reprocessed imported raw material. China has experienced a significant increase in its fishery imports, up from US$1 billion in 1998 to US$5.1 billion in 2008, when it was the sixth-largest importer. However, imports declined by 3 percent in 2009 to US$5.0 billion. With the exception of 2009, this increase in imports reflects the lowered import duties following China's accession to the World Trade Organization (WTO) in late 2001, the rising imports of raw material for reprocessing, as well as the growing domestic consumption of high-value species that are not available from local sources.

Viet Nam has also experienced significant growth in its exports of fish and fish products, up from US$0.8 billion in 1998 to US$4.6 billion in 2008, when it became the fifth-largest exporter in the world. Its growing exports are linked to its flourishing aquaculture industry, in particular to the production of *Pangasius* and of both marine and freshwater shrimps and prawns.

In addition to China, Thailand and Viet Nam, many other developing countries play a major role in global fisheries. In 2008, developing countries accounted for 80 percent of world fishery production. Their exports accounted for 50 percent (US$50.8 billion) of world exports of fish and fishery products in value terms and 61 percent

(33.8 million tonnes in live weight equivalent) in terms of quantity. Fishmeal represents a significant share of their exports (36 percent by quantity, but only 5 percent by value in 2008). Developing countries have an important segment of world exports of non-food fish exports (75 percent in 2008 in terms of quantity). However, developing countries have also considerably increased their share of the quantity of world fish exports destined for human consumption, from 46 percent in 1998 to 55 percent in 2008.

Box 2

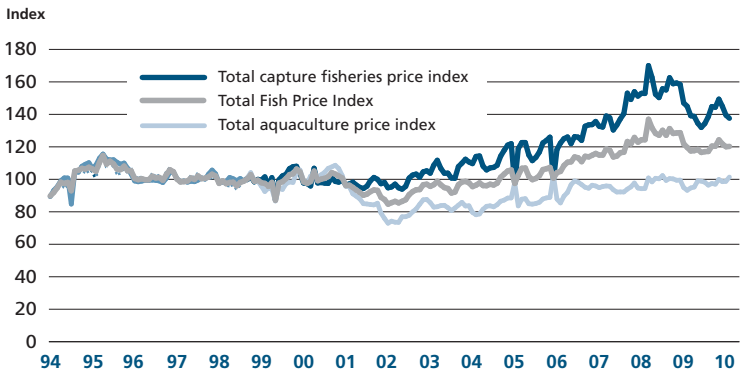
FAO Fish Price Index

With the development of the FAO Fish Price Index and its regular publication in the FAO Food Outlook,[1] fish is for the first time receiving similar coverage to the main groups of terrestrial food products.

FAO has long been publishing price indices on non-fish food commodities, such as wheat, grains, corn, rice, livestock, dairy products, poultry and pork. With the development of a similar index also for fish, world policy-makers now have access to an additional tool in the planning and management of current and future food supply. Specifically, the FAO Fish Price Index creates a new tool for the analysis of global seafood production from capture fisheries as well as from aquaculture, and from different species groups and regions. The index has been developed in collaboration between FAO, the University of Stavanger (Norway) and the Pontifical Catholic University of Peru, with data support from the Norwegian Seafood Export Council.

The FAO Fish Price Index starts its coverage with 1994 (see accompanying figure); in its current version, it represents about 57 percent of all fish traded internationally. Given the market interactions and substitution effects between traded and non-traded fish, the index can be expected to provide guidance on fish price development and also on domestic markets for many non-traded products. Separate underlying indices are generated for the most important commodities as well as for capture fisheries and for aquaculture.

Trends in the FAO Fish Price Index and underlying indices



Note: 1998–2000 = 100.

The fishery industries of developing countries rely heavily on 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 2008, in value terms, 75 percent of the fishery exports of developing countries were directed to developed countries. A growing share of these exports consisted of processed fishery products prepared from imports of unprocessed fish to use as raw material for further processing

The main objective of the FAO Fish Price Index is to indicate long-term price trends, reflecting global demand and supply changes in international seafood trade. With this in mind, the index uses international import data from the world's largest importing countries – as these data are easily accessible, qualitatively reliable and fairly up-to-date. This means that, in theory, fish that is not traded internationally (e.g. a large part of freshwater aquaculture production in Asia is destined for domestic markets) is not covered. However, in reality, there are clear interactions between traded and non-traded products, as consumers choose protein from different sources based on availability, price, quality, origin, etc., with domestic non-traded products competing with imported products. This makes the index relevant for both traded and non-traded products.

The basis for the index is a so-called Fisher price index, a weighted index of the Laspeyres and the Paasche indices. The base period is 1998–2000 and the values used are quantities and nominal import prices (unit values) for a number of species groups converted into US dollars. Variation in the index is caused by actual price changes (trends and seasonal volatility) and compositional effects.

The FAO Fish Price Index will play a role in the joint work by the Organisation for Economic Co-operation and Development and FAO on supply and demand projections for food (the Aglink-CO.SI.MO. system) and the planned inclusion of fish in their joint *Agricultural Outlook* publication. In addition, the growing role of aquaculture and the interactions between farmed and non-farmed species, as well as with other food sectors, are highlighting the utility of an index in making comparisons and projections. The FAO Fish Price Index will also facilitate the work of documenting the linkages of fishmeal and fish oil with other non-fish commodities.

One interesting aspect highlighted by the FAO Fish Price Index is the emerging divergence in price trends for capture and aquaculture products since about 2000. The main causes for the different price developments appear to be on the supply side and in the respective cost structures. Aquaculture has benefited to a greater degree from cost reductions through productivity gains and economies of scale, whereas capture fisheries have at times suffered from rising energy costs.

[1] Food Outlook is available at www.fao.org/giews/english/fo/index.htm.

Table 11
Top ten exporters and importers of fish and fishery products

	1998	2008	APR
	(US$ millions)		*(Percentage)*
EXPORTERS			
China	2 656	10 114	14.3
Norway	3 661	6 937	6.6
Thailand	4 031	6 532	4.9
Denmark	2 898	4 601	4.7
Viet Nam	821	4 550	18.7
United States of America	2 400	4 463	6.4
Chile	1 598	3 931	9.4
Canada	2 266	3 706	5.0
Spain	1 529	3 465	8.5
Netherlands	1 365	3 394	9.5
TOP TEN SUBTOTAL	23 225	51 695	8.3
REST OF WORLD TOTAL	28 226	50 289	5.9
WORLD TOTAL	**51 451**	**101 983**	**7.1**
IMPORTERS			
Japan	12 827	14 947	1.5
United States of America	8 576	14 135	5.1
Spain	3 546	7 101	7.2
France	3 505	5 836	5.2
Italy	2 809	5 453	6.9
China	991	5 143	17.9
Germany	2 624	4 502	5.5
United Kingdom	2 384	4 220	5.9
Denmark	1 704	3 111	6.2
Republic of Korea	569	2 928	17.8
TOP TEN SUBTOTAL	39 534	67 377	5.5
REST OF WORLD TOTAL	15 517	39 750	9.9
WORLD TOTAL	**55 051**	**107 128**	**6.9**

Note: APR refers to the average annual percentage growth rate for 1998–2008.

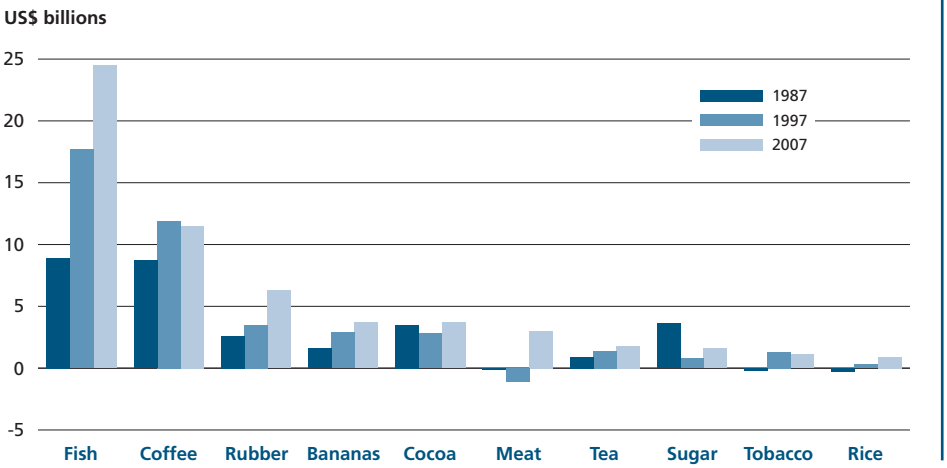
and re-export. In 2008, in value terms, 40 percent of the imports of fish and fishery products by developing countries originated from developed countries.

Net exports of fish and fish products (i.e. the total value of fish exports less the total value of fish imports) are particularly important for developing countries, being higher than those of several other agricultural commodities such as rice, meat, sugar, coffee and tobacco (Figure 23). They have increased significantly in recent decades, growing from US$2.9 billion in 1978 to US$9.8 billion in 1988, to US$17.4 billion in 1998, and reaching US$27.2 billion in 2008. Low-income food-deficit countries are playing an active and growing role in the trade of fish and fishery products. In 2008, their net export revenues were US$11.5 billion, while their fishery exports reached US$19.8 billion.

World imports of fish and fish products reached a new record of US$107.1 billion in 2008, up 9 percent on the previous year and up 95 percent with respect to 1998. Preliminary data for 2009 point to a 7 percent decrease, as a consequence of the economic downturn and the contraction in demand in key importing countries. Japan, the United States of America and the EU are the major markets, with a total share of about 69 percent in 2008. Japan is the world's largest single national importer of fish and fishery products, with imports worth US$14.9 billion in 2008, a growth of 13 percent compared with 2007. In 2009, its imports decreased by 8 percent. The EU is by far the largest market for imported fish and fishery products. However, it is

Figure 23

Net exports of selected agricultural commodities by developing countries



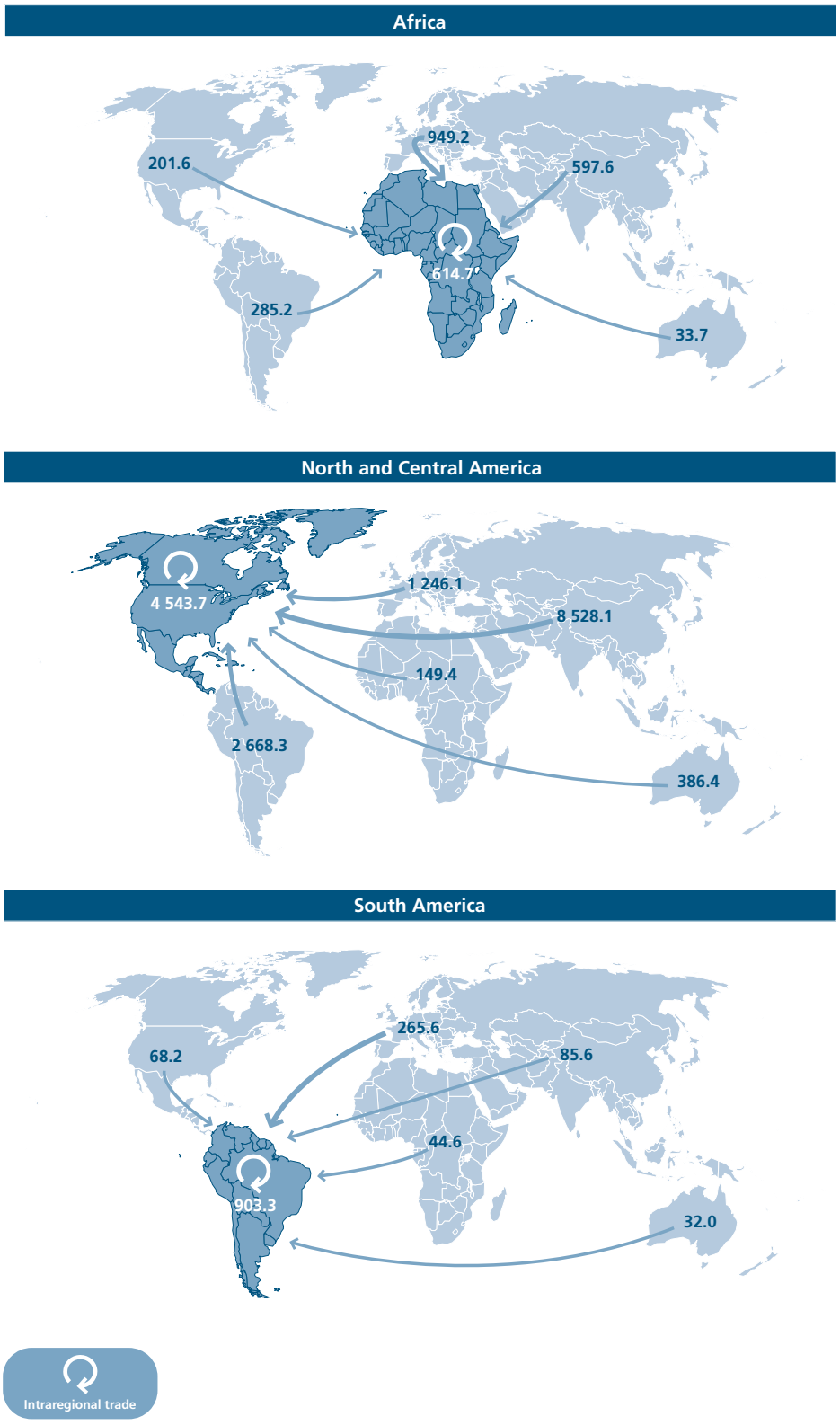
extremely heterogeneous, with markedly different conditions from country to country. In 2008, imports by the EU reached US$44.7 billion, up 7 percent from 2007, and representing a share of 42 percent of total world imports. However, if intraregional trade among EU countries is excluded, the EU imported US$23.9 billion from non-EU suppliers. This still makes the EU the largest market in the world, with about 28 percent of the value of world imports (excluding intra-EU trade). Figures for 2009 indicate a downward trend in EU imports, with a 7 percent decrease in value recorded.

Developed countries as a whole are now responsible for 78 percent of the total import value of fish and fishery products. In volume (live weight equivalent), their share is significantly less, 58 percent, showing the higher unit value of commodities imported by developed countries. Owing to stagnating domestic fishery production, developed countries have to rely on imports and/or on aquaculture to cover their increasing domestic consumption of fish and fishery products. This may be one reason for rather low import tariffs on fish in developed countries, albeit with a few exceptions, i.e. for some value-added products. As a consequence, in the last few decades, developing countries have been able to increasingly supply fishery products to developed-country markets without facing prohibitive custom duties. In 2008, about 50 percent of the import value of developed countries originated from developing countries. At present, the principal barriers facing developing countries in increasing their exports (beyond the physical availability of product) are the stringent quality- and safety-related import standards, together with the importing countries' requirements that production processes and products meet international animal health and environmental standards and social responsibility requirements. In addition, the rising power of large retail and restaurant chains in seafood distribution and sales is shifting negotiating power towards the final stages in the value chain, and retailers are also imposing more and more private- or market-based standards and labels on exports from developing countries. All the above are making it more difficult for small-scale fish producers and operators to penetrate international markets and distribution channels.

The maps in Figure 24 summarize trade flows of fish and fishery products by continent for the period 2006–08. It is important to mention that the overall picture presented by these maps is not exhaustive as data are not available for all countries, in particular for several African countries. However, the quantity of data available is sufficient to establish general trends. The Latin America and the Caribbean region continues to maintain a solid positive net fishery exporter role, as do the Oceania region and the developing countries of Asia. By value, Africa has been a net exporter since 1985, but it is a net importer in quantity terms, reflecting the lower unit value of

Figure 24

Trade flows by continent (total imports in US$ millions, c.i.f.; averages for 2006–08)



(Continued)

Figure 24 *(cont.)*

Trade flows by continent (total imports in US$ millions, c.i.f.; averages for 2006–08)

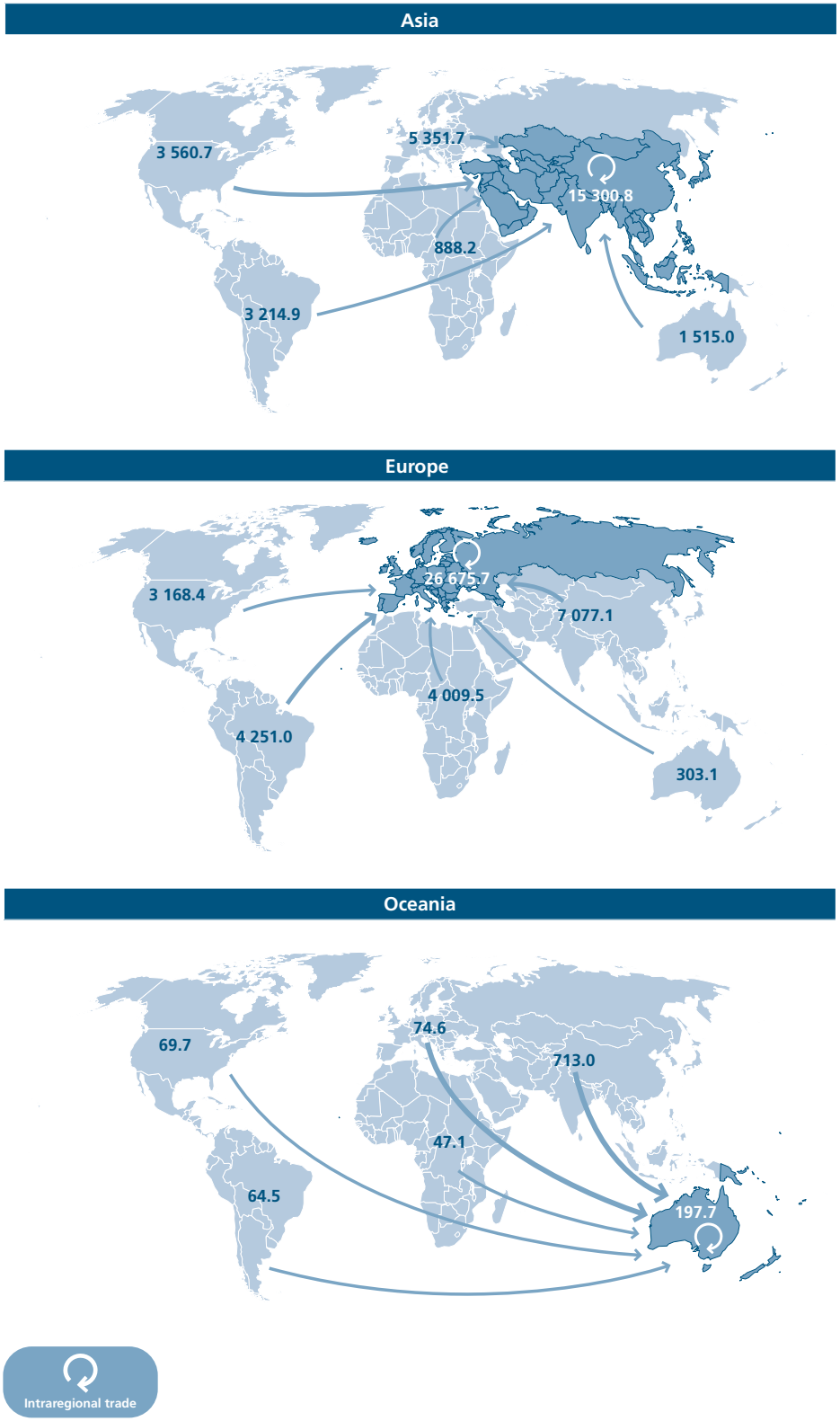
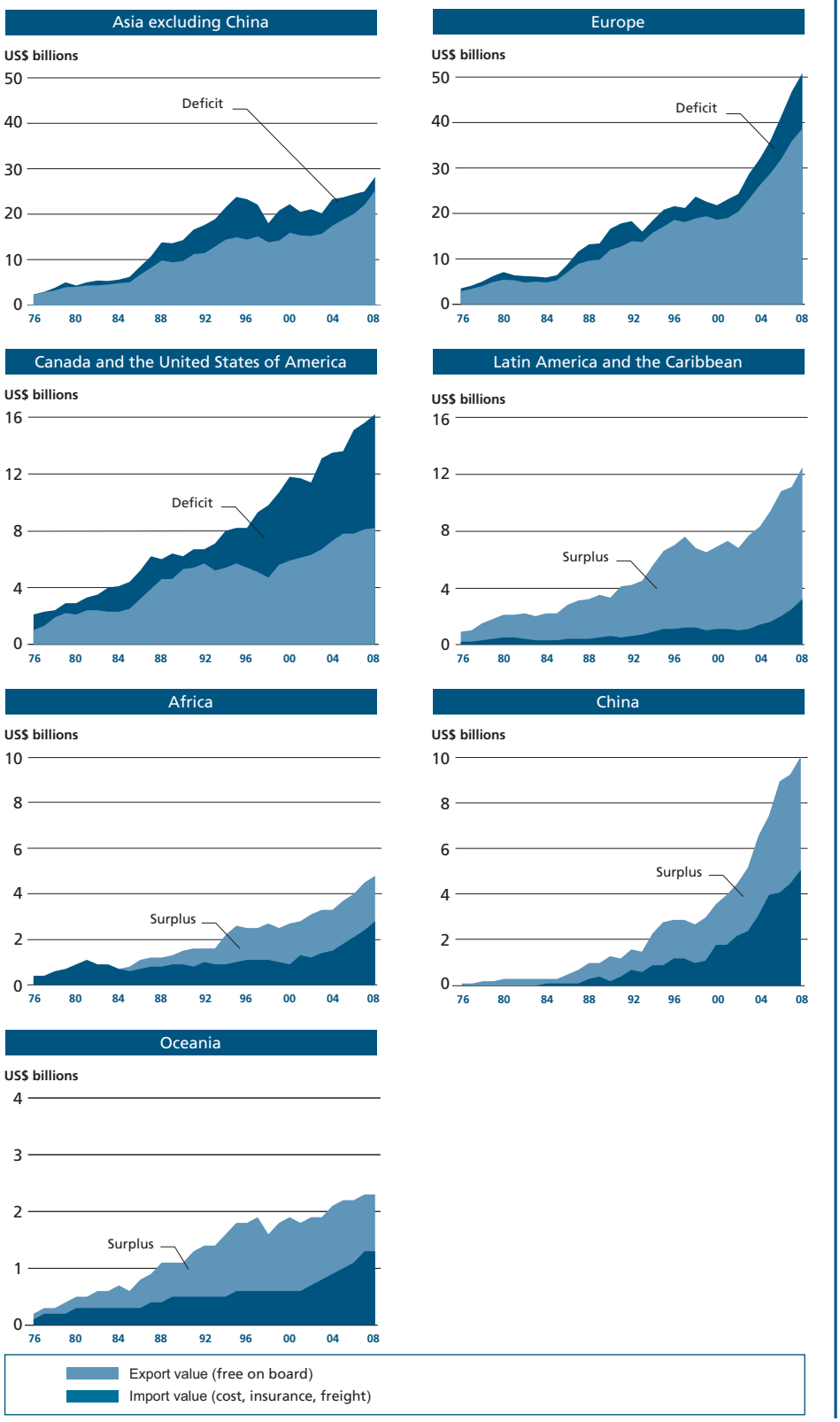


Figure 25

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



the imports (mainly small pelagics). Europe and North America are characterized by a fishery trade deficit (Figure 25).

In recent decades, there has been a tendency towards increased fishery trade within regions. Most developed countries trade more with other developed countries. In 2008, in value terms, some 85 percent of fishery exports from developed countries were destined for other developed countries, and about 50 percent of developed-country fishery imports originated in other developed countries. In contrast, the trade in fish between developing countries represents only 25 percent of the value of their fishery exports. Over time, the trade in fish and fish products between developing countries is likely to increase in the wake of the expansion of the middle classes in emerging economies, gradual trade liberalization and a reduction of the high 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.

Some of the major issues concerning international trade in fishery products in the past biennium, and which continue to affect international trade, are:

- the introduction of private standards, including for environmental and social purposes, and their endorsement by major retailers;
- certification of aquaculture in general;
- concern in exporting countries about the impact on their fish exports of the introduction in 2010 of new traceability requirements in EU markets to prevent IUU fishing;
- continuation of trade disputes related to catfish species and shrimp;
- the growing concern of the general public and the retail sector about overexploitation of certain fish stocks, in particular of bluefin tuna;
- the multilateral trade negotiations in the WTO, including the focus on fisheries subsidies;
- climate change, carbon emissions and their impacts on the fisheries sector;
- energy prices and the impact on fisheries;
- rising commodity prices in general and the impact on producers as well as on consumers;
- prices and margins throughout the fisheries value chain;
- the need for competitiveness compared with other food products;
- perceived risks and benefits from fish consumption.

Commodities

High-value species such as shrimp, prawns, salmon, tuna, groundfish, flatfish, seabass and seabream are highly traded, in particular as exports to more affluent economies. However, low-value species such as small pelagics are also traded in large quantities in the other direction to feed low-income consumers in developing countries. Products derived from aquaculture production are contributing an increasing share of total international trade in fishery commodities, with species such as shrimp, prawns, salmon, molluscs, tilapia, catfish (including *Pangasius*), seabass and seabream. Many of the species that have registered the highest export growth rates in the last few years are produced by aquaculture. Aquaculture is expanding in all continents in terms of new areas and species, as well as intensifying and diversifying the product range for species and product forms that respond to consumer needs. However, it is difficult to determine the extent of this trade because the classification used internationally to record trade statistics for fish does not distinguish between products of wild and farmed origin. Hence, the exact breakdown between products of capture fisheries and aquaculture in international trade is open to interpretation.

Accurate and detailed trade statistics are essential for monitoring the fishery sector and to help provide a basis for appropriate fisheries management. However, notwithstanding the improvements in the overall coverage of national trade statistics, many countries provide little breakdown of information by species in their reporting of

Box 3

Forensic technologies and fish species identification

When fish species cannot be identified with accuracy and there is a need for certainty, especially to investigate suspected illegal activity, forensic technologies are used with increasing frequency to test the authenticity of fishery products.

Forensic techniques are relatively commonplace today and are used in solving crimes involving humans and increasingly utilized in cases involving non-humans. The growth and applications of scientific and research techniques to law enforcement and monitoring, control and surveillance (MCS) work are likely to expand, and the use of chemical and genetic techniques in fisheries enforcement is following this tendency.

For identification purposes, these forensic tests might include DNA analysis. Species differ in their DNA sequences, and the unique portion of the sequences (likened to a DNA barcode) can be used to match individual specimens to species upon comparison of a sample with a known genetic reference. A number of genetic reference databases exist, such as the Barcode of Life Initiative, which contains a fish section known as FISH-BOL (www.fishbol.org) that currently includes barcoding for 7 700 fish species, and FishPopTrace (maritimeaffairs.jrc.ec.europa.eu/web/fishpoptrace/).

It is possible to sample fish catches or shipments, or extract biological materials from processed or mixed products, and then send samples to appropriately equipped facilities for testing. A number of countries have laboratories dedicated to fisheries issues. They work closely with investigative authorities and continue to develop procedures needed for successful applications.

Some enquiries are more difficult than others, and not all questions about all species can currently be answered, but the results of such testing have been successfully used as evidence in court cases. This forensic evidence has also been used to obtain admissions of guilt in advance of formal proceedings in court, which eliminates the need for a lengthy and costly trial. While portable test kits or online applications would be most useful for testing fish in the field, they are not yet available.

their international trade in fish. This is linked to the difficulties that customs authorities have in dealing with fish. On the one hand, they lack reliable methods for identifying species and, on the other hand, the standard classifications used to collect trade statistics are outdated – they do not provide opportunities to identify "new" species and products. However, technologies for species identification (Box 3) are being improved and a more appropriate classification scheme for internationally traded seafood items (Box 4) is being developed. These developments will improve the accuracy of the data that customs authorities provide on international trade in fish and fish products.

Owing to the high perishability of fish and fishery products, in quantity terms (live weight equivalent), 90 percent of trade in fish and fishery products consists of processed products (i.e. excluding live and fresh whole fish). Fish are increasingly traded as frozen food (39 percent of the total quantity in 2008, compared with 28 percent in 1978). In the last four decades, prepared and preserved fish have doubled their share in total quantity, going from 9 percent in 1978 to 18 percent

Box 4

Improved coverage of fish and fishery products in the Harmonized Commodity Description and Coding System: HS2012

Developed, introduced and maintained by the World Customs Organization (WCO), the Harmonized Commodity Description and Coding System, commonly referred to as the Harmonized System (HS), is used as a basis for the collection of customs duties and international trade statistics by more than 200 countries and economies. More than 98 percent of the merchandise in international trade is classified in terms of the HS. At present, about 130 six-digit codes cover fish and fishery commodities.

Fish is widely traded, and detailed trade statistics are important to help in monitoring the fishery sector and for the good management of fisheries. It is possible to pursue such aims only if the trade statistics are precise and show, to the extent possible, the specification of the species. This possibility is lacking in the current version of the HS as the codes for fish and fishery products do not provide sufficient details on the level of processing of the traded products or on the classification of species originating in developing countries or in the southern hemisphere. Neither do they provide satisfactory data on the level of processing of traded products. Therefore, many of these species are recorded in generic groups.

This deficiency was also communicated to FAO by several countries and, in 2003, the Twenty-fifth Session of the Committee on Fisheries gave clear instructions to FAO to work on improving the HS classification for fish and fishery products. The need to improve the HS classification for monitoring the entire agricultural trade was also emphasized by other Departments of FAO. Hence, in 2007, FAO submitted a joint proposal to the WCO for the revision of the codes related to agriculture, forestry and fishery products. After two years of intensive work and close collaboration between FAO and the Harmonized System Review Sub-Committee and the Harmonized System Committee of the WCO, 320 amendments on agricultural and fisheries commodities were made to the HS. The new version of the HS classification, HS2012, will enter into force on 1 January 2012.

The FAO modifications for HS codes of fish and fishery products try to improve the quality and precision of fish trade coverage through an improved specification for species and product form. Within the limits of the available codes, the classification has been restructured according to main groups of species of similar biological characteristics. About 190 amendments have been implemented and about 90 new commodities (species by different product form) have been introduced. The choice of the added species was based on their present and future economic importance as well as on the monitoring of potentially endangered species. Among the species introduced are turbot, hake, seabass, seabream, Alaska pollock, cobia, jack and horse mackerel, rays and skates, Norway lobster, coldwater shrimps, clams, cockles, arkshells, abalone, sea urchin, sea cucumber and jellyfish. Several splits by more product forms for several species have also been introduced, in particular for meat and fillets, as well as the introduction of shark fins in cured form, the separation of caviar from other substitutes, the separation of molluscs from other aquatic invertebrates, and the distinction between seaweeds for human consumption and for other purposes. This last introduction will be very useful in calculating the FAO Food Balance Sheets, which will now be able to finally take seaweeds into consideration.

in 2008. Notwithstanding their perishability, trade in live, fresh and chilled fish has also increased, representing a 10 percent share of world fish trade in 2008 (6 percent in 1978), reflecting improved logistics and increased demand for unprocessed fish. Trade in live fish also includes ornamental fish, which is high in value terms but almost negligible in terms of quantity traded. In 2008, 71 percent of the quantity exported consisted of products destined for human consumption. Much fishmeal and fish oil is traded because, generally, the major producers (South America, Scandinavia and Asia) are distant from the main consumption centres (Europe and Asia).

Shrimp

Shrimp continues to be the largest single commodity in value terms, accounting for 15 percent of the total value of internationally traded fishery products (2008). Cultured shrimp plays an important role in the market, but it experienced a decline in production in 2009 for the first time since it entered international trade in the 1980s. In 2009, shrimp trade was affected by the economic crisis. While export volumes remained stable, average shrimp prices declined substantially in the course of the year (Figure 26). In value terms, the major exporting countries are Thailand, China and Viet Nam. The United States of America continues to be the main shrimp importer, followed by Japan. Apart from Spain, all major European countries have experienced a stable or increasing trend for shrimp imports.

Salmon

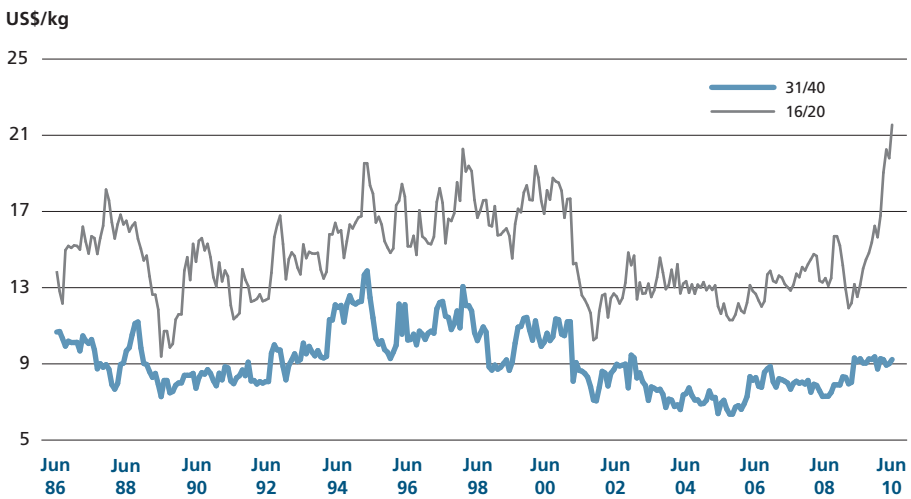
The share of salmon (including trout) in world trade has increased considerably in recent decades and now stands at 12 percent. However, 2009 was overshadowed by lower salmon production in Chile, owing to disease, resulting in a decline in cultured salmon output for the first time. Higher salmon output from Norway failed to offset this decline. Salmon prices reached record high levels in all markets.

Groundfish

Groundfish species represented about 10 percent of total fish exports (by value) in 2008. Groundfish prices went down in 2009 as a result of good supply from capture

Figure 26

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.

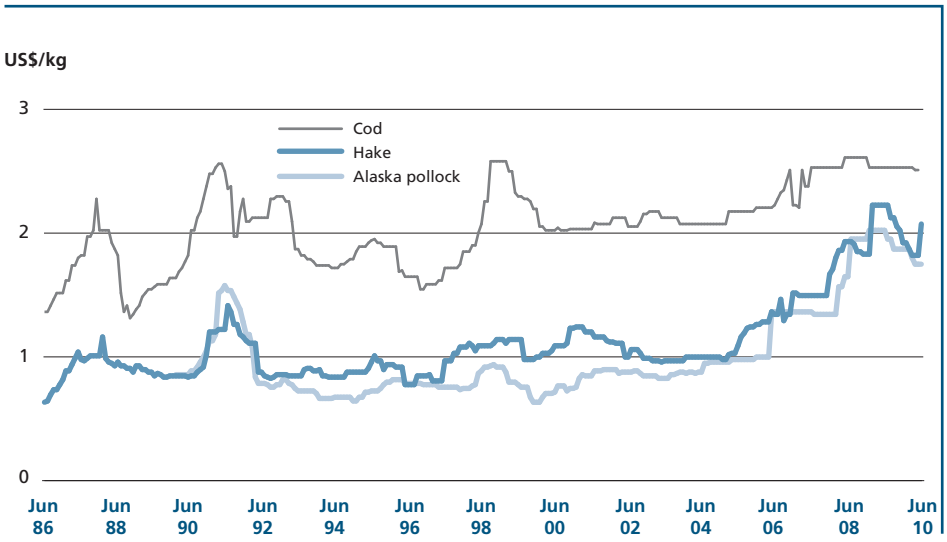
fisheries and strong competition from farmed species such as *Pangasius* on the market (Figure 27). Some marine fish stocks had recovered, and governments and regional fisheries commissions recommended higher catch quotas, which kept the market well supplied.

Tuna

The share of tuna in total fish exports in 2008 was about 8 percent. Tuna markets were rather unstable owing to large fluctuations in catch levels. Tuna prices were on average

Figure 27

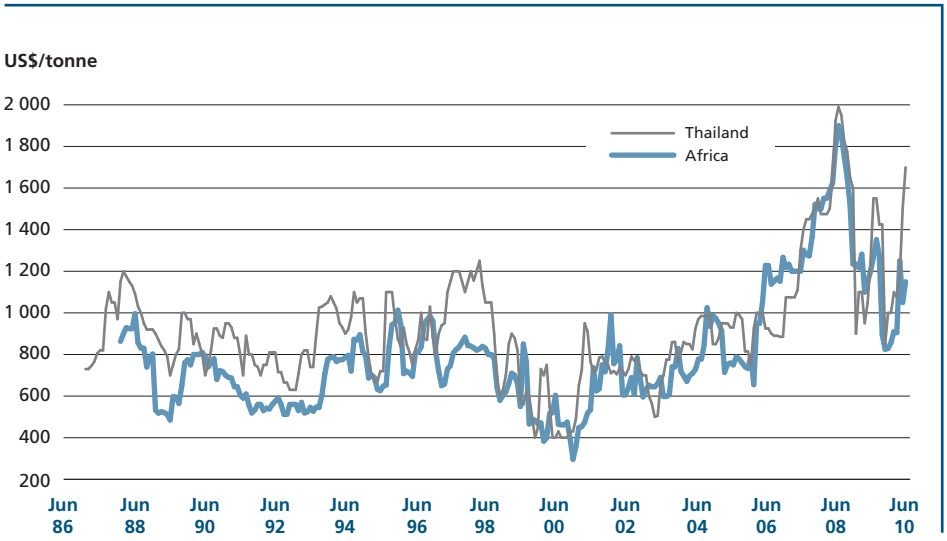
Groundfish prices in the United States of America



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

Figure 28

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.

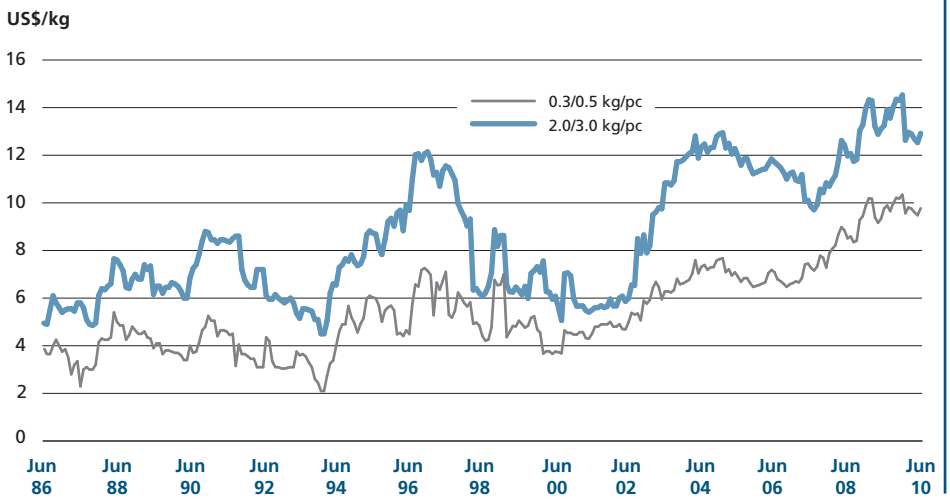
US$550/tonne lower in the course of 2009 compared with 2008. This was because of lower fuel prices and increased landings. As a result, canning became more profitable again after a difficult 2008 (Figure 28). Traders were able to lower prices, which led to stronger demand in the market during a challenging year with regard to consumer preferences.

Cephalopods

The share of cephalopods (squid, cuttlefish and octopus) in world fish trade was 4 percent in 2008. Spain, Italy and Japan are the largest consumers and importers

Figure 29

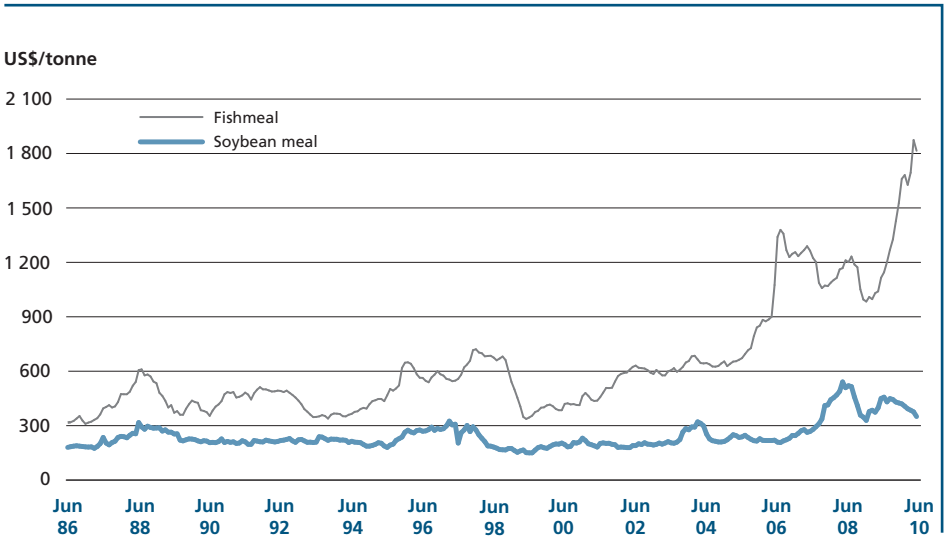
Octopus prices in Japan



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

Figure 30

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.

of these species. Thailand is the largest exporter of squid and cuttlefish, followed by Spain, China and Argentina, whereas Morocco and Mauritania are the principal octopus exporters. Low squid catches worldwide and increased prices characterized 2009. On the other hand, octopus was in good supply with reduced price levels (Figure 29).

Pangasius

Pangasius is a freshwater fish, and relatively new in international trade. However, with production of about 1.2 million tonnes, mainly in Viet Nam and all going to the international markets, this species is playing an important role as a source of cheap fish. The EU is the main market for *Pangasius,* with 215 000 tonnes imported in 2009, or one-third of total Vietnamese exports. Many countries report increasing imports of this species, displacing domestic fish production. *Pangasius* prices were very low in 2009, with no recovery foreseen for 2010.

Fishmeal

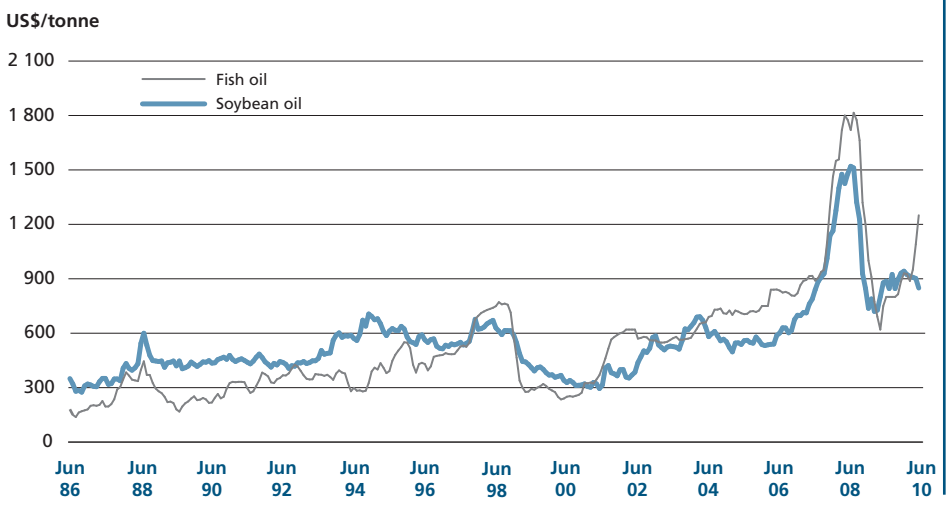
Catches for reduction purposes have been declining continuously in recent years. However, fishmeal production has remained stable as more fishmeal is produced from offal derived from the fish processing industry. Demand for fishmeal was strong in 2009, leading to sharply higher fishmeal prices in that year (Figure 30). China remains the main market for fishmeal.

Fish oil

In 2009, total fish oil production by the five main exporting countries (Peru, Chile, Iceland, Norway and Denmark) was 530 000 tonnes, a decline of 100 000 tonnes compared with 2008. Fish-oil prices reached US$950/tonne in March 2010, which was 50 percent higher than a year earlier (Figure 31). For fish oil, the share going to aquaculture is even greater than for fishmeal, with almost 85 percent of production being used as an ingredient in fish and shrimp feeds.

Figure 31

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.

FISH CONSUMPTION[11]

The fishery sector plays a key role in food security, not only for subsistence and small-scale fishers who rely directly on fishery for food, incomes and services, but also for consumers who profit from an excellent source of affordable high-quality animal protein. A portion of 150 g of fish[12] provides about 50–60 percent of the daily protein requirements for an adult. Fish is also a source of essential micronutrients, including various vitamins and minerals. With a few exceptions for selected species, fish is usually low in saturated fats, carbohydrates and cholesterol.

In 2007, fish accounted for 15.7 percent of the global population's intake of animal protein and 6.1 percent of all protein consumed (Figure 32). Globally, fish provides more than 1.5 billion people with almost 20 percent of their average per capita intake of animal protein, and 3.0 billion people with 15 percent of such protein (Figure 33). In terms of a world average, the contribution of fish to calories is rather low at 30.5 calories per capita per day (2007 data). However, it can reach 170 calories per capita per day in countries where there is a lack of alternative protein food and where a preference for fish has been developed and maintained (e.g. Iceland, Japan and several small island states).

Total and per capita fish food supplies have expanded significantly in the last five decades. Total food fish supply has increased at an annual rate of 3.1 percent since 1961, while the world population has increased by 1.7 percent per year in the same period. Annual per capita fish consumption grew from an average of 9.9 kg in the 1960s to 11.5 kg in the 1970s, 12.6 kg in the 1980s, 14.4 kg in the 1990s and reached 17.0 kg in 2007. Preliminary estimates for 2008 indicate a further increase in annual per capita consumption to about 17.1 kg. In 2009, as a consequence of uncertain economic conditions, demand remained rather sluggish and per capita consumption is expected to have remained stable.

The general growth in fish consumption has had different impacts among countries and regions. Countries that have experienced dramatic growth in their per capita fish consumption in recent decades diverge from those where consumption has remained static or decreasing, such as some countries in the sub-Saharan Africa region. In addition, the countries of the former Soviet Union in Eastern Europe and Central Asia experienced major declines in the 1990s. The most substantial increases in annual per capita fish consumption have occurred in East Asia (from 10.8 kg in 1961 to 30.1 kg in 2007), Southeast Asia (from 12.7 kg in 1961 to 29.8 kg in 2007) and North Africa (from 2.8 kg in 1961 to 10.1 kg in 2007). China, in particular, has seen dramatic growth in its

Figure 32

Total protein supply by continent and major food group (average 2005–2007)

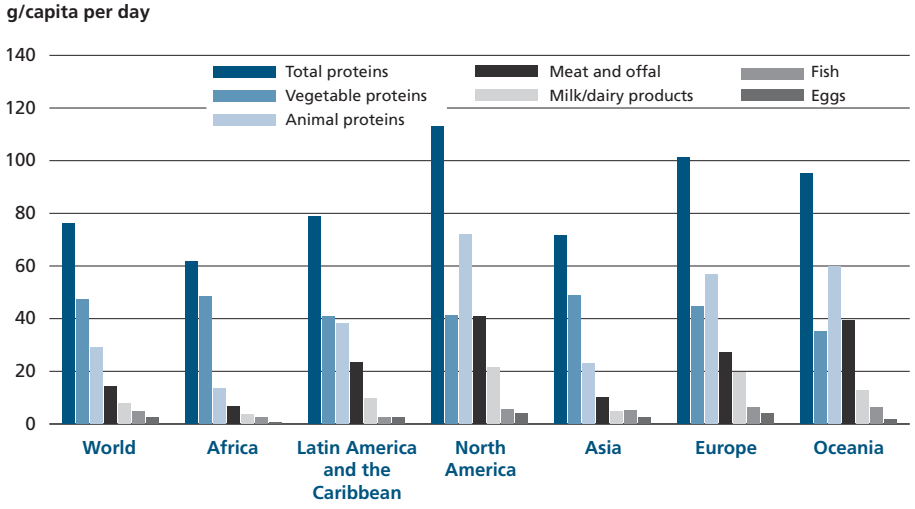
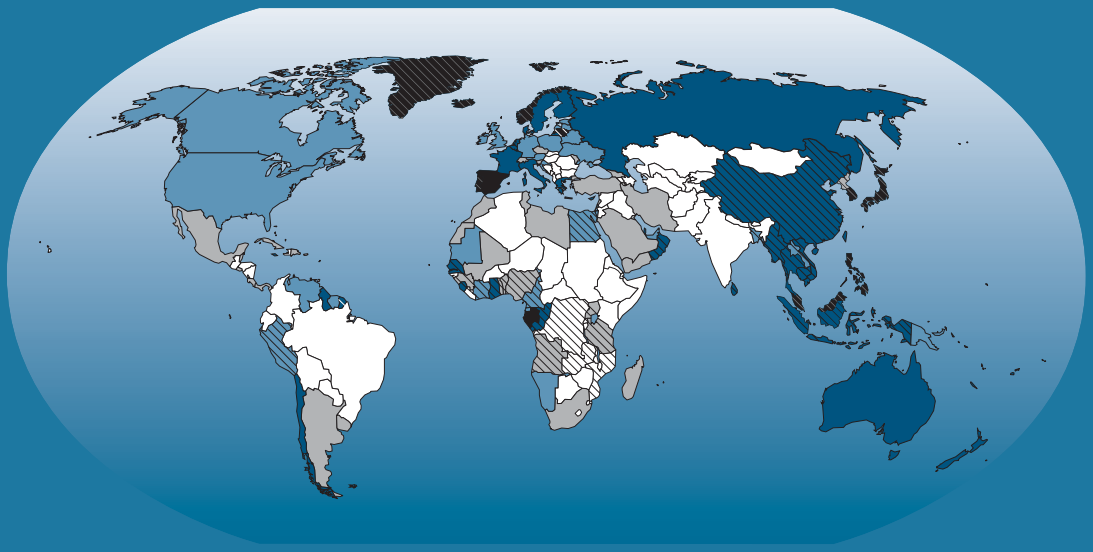


Figure 33

Contribution of fish to animal protein supply (average 2005–2007)



Fish proteins (per capita per day)

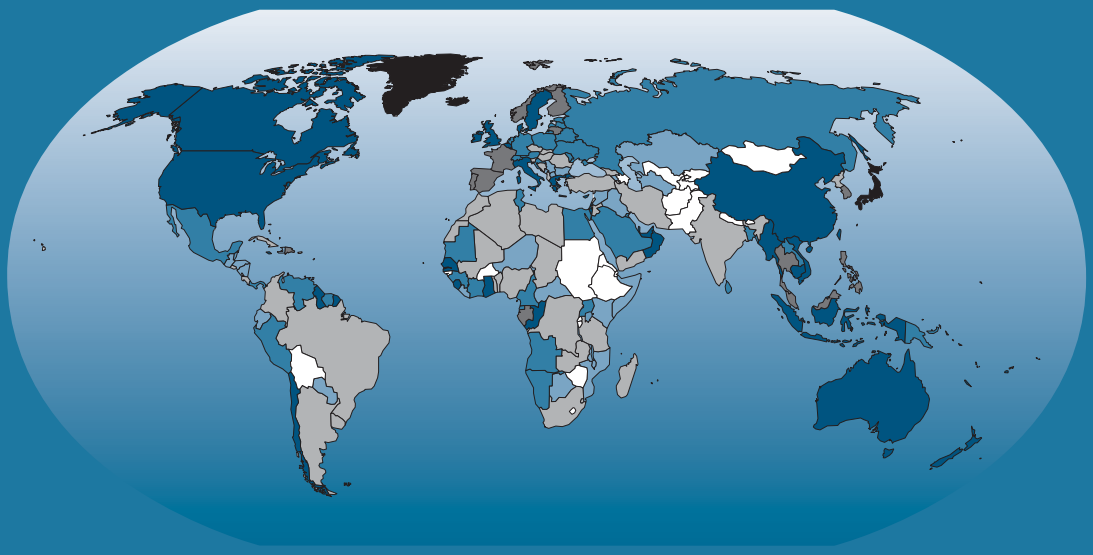
< 2 g
2–4 g
4–6 g
6–10 g
> 10 g

Contribution of fish to animal protein supply

> 20%

Figure 34

Fish as food: per capita supply (average 2005–2007)



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

per capita fish consumption, with an average growth rate of 5.7 percent per year in the period 1961–2007. China accounted for most of the global increase in per capita consumption owing to the substantial increase in its fish production, mainly from the growth of aquaculture. Its estimated share of world fish production grew from 7 percent in 1961 to 33 percent in 2007, when China's annual per capita fish supply was about 26.7 kg. If China is excluded, in 2007, annual per capita fish supply was about 14.6 kg, slightly higher than the average values of the mid-1990s, and lower than the maximum levels registered in the mid-1980s.

Table 12 summarizes per capita consumption by continent and major economic groups. The total amount of fish consumed and the species composition of the food supply vary according to regions and countries, reflecting the different levels of availability of fish and other foods, including the accessibility of aquatic resources in adjacent waters, as well as diverse food traditions, tastes, demand, income levels, prices and seasons. Annual per capita apparent fish consumption can vary from less than 1 kg in one country to more than 100 kg in another (Figure 34). Differences are also evident within countries, with consumption usually higher in coastal areas. Of the 111 million tonnes available for human consumption in 2007, consumption was lower in Africa (8.2 million tonnes, with 8.5 kg per capita), while Asia accounted for two-thirds of total consumption, with 74.5 million tonnes (18.5 kg per capita), of which 39.6 million tonnes was consumed outside China (14.5 kg per capita). The corresponding per capita consumption figures for Oceania, North America, Europe, Central America and the Caribbean, and South America were 25.2, 24.0, 22.2, 9.4 and 9.1 kg, respectively.

Differences in fish consumption exist between the more-developed and the less-developed countries. In developed countries, apparent fish supply rose from 16.7 million tonnes (live weight equivalent) in 1961 to 33.0 million tonnes in 2007. A significant share of this supply consisted of imported fish. Developed countries have become increasingly dependent on fish imports to satisfy their demand. Forecasts indicate that this dependence will grow owing to their decreasing fisheries production (down 16 percent in the period 1998–2008). Apparent fish consumption in developed countries grew from 17.2 kg per capita per year in 1961 to 24.3 kg in 2007. However, the share of fish to animal protein intake, after consistent growth up to 1984, declined from 13.3 percent in 1984 to 12.0 percent in 2007, while consumption of other animal proteins continued to increase. In 2007, for industrialized countries, apparent fish

Table 12
Total and per capita food fish supply by continent and economic grouping in 2007

	Total food supply	Per capita food supply
	(million tonnes live weight equivalent)	*(kg/year)*
World	**113.1**	**17.0**
World (excluding China)	78.2	14.6
Africa	8.2	8.5
North America	8.2	24.0
Latin America and the Caribbean	5.2	9.2
Asia	74.5	18.5
Europe	16.2	22.2
Oceania	0.9	25.2
Industrialized countries	27.4	28.7
Other developed countries	5.5	13.7
Least-developed countries	7.6	9.5
Other developing countries	72.6	16.1
LIFDCs[1]	61.6	14.4
LIFDCs (excluding China)	26.7	9.0

[1] Low-income food-deficit countries.

consumption was 28.7 kg per capita per year and the share of fish in animal protein intake was 13.0 percent.

In 2007, the average annual per capita apparent fish supply in developing countries was 15.1 kg, and 14.4 kg in LIFDCs. However, if China is excluded, these values become 11.3 kg and 9.0 kg, respectively. Although annual per capita consumption of fishery products has grown steadily in developing regions (from 5.2 kg in 1961) and in LIFDCs (from 4.5 kg in 1961), it is still considerably lower than in the more developed regions, even though the gap is narrowing. In addition, these figures may be higher than indicated by official statistics in view of the unrecorded contribution of subsistence fisheries. Despite these relatively low levels of fish consumption, the contribution of fish to total animal protein intake in 2007 was significant at about 18.3 percent for developing countries and 20.1 percent for LIFDCs. However, as seen for developed countries, also in developing countries and LIFDCs, this share has declined slightly in recent years owing to the growing consumption of other animal proteins.

In the last two decades, before the food and economic crises,[13] the global food market, including the fish market, experienced unprecedented expansion and a change in global dietary patterns, with a shift towards more protein. This change was the result of complex interactions of several factors, including rising living standards, population growth, rapid urbanization, increased trade and transformations in food distribution. A combination of these factors has driven demand for animal protein, especially from meat, milk, eggs and fish products, as well as vegetables in the diet, with a reduction in the share of basic cereals. Protein availability has increased in both the developed and developing world, but growth 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. Annual global per capita consumption of meat almost doubled in the period 1961–2007, rising from 23 kg to 40 kg. The growth was particularly impressive in the most rapidly growing economies of developing countries and LIFDCs. Having attained a high level of consumption of animal protein, more developed economies have been increasingly reaching saturation levels and are less reactive to income growth and other changes than are low-income countries. Developing countries increased their annual per capita meat consumption from 9 kg in 1961 to 29 kg in 2007, with the corresponding values for LIFDCs increasing from 6 kg to 23 kg in the same period.

In addition, world food markets have become more flexible, with new products entering the markets, including value-added products easier to prepare for the consumer. Before the global economic crisis, as a consequence of good economic conditions, many individuals ate more and better than previously. Growing urbanization is one of the factors modifying patterns of food consumption, which has also had an impact on demand for fishery products. People living in urban areas tend to eat out of the home more frequently, and larger quantities of fast and convenience foods are purchased. Supermarkets are also emerging as a major force, particularly in developing countries, offering consumers a wider choice, reduced seasonal fluctuation in availability and, often, safer food. Several developing countries, especially in Asia and Latin America, have experienced a rapid expansion of supermarkets, which are not only targeting higher-income consumers but also lower- and middle-income consumers.

In the last two decades, the consumption of fish and fishery products has also been considerably influenced by globalization in food systems and by innovations and improvements in processing, transportation, distribution, marketing and food science and technology. These have led to significant improvements in efficiency, lower costs, wider choice and safer and improved products. Owing to the perishability of fish, developments in long-distance refrigerated transport and large-scale and faster shipments have facilitated the trade in and, therefore, consumption of an expanded variety of species and product forms, including live and fresh fish. In addition, there has been a greater focus on marketing, with producers and retailers attentive to consumer preferences and attempting to anticipate market expectations in terms of quality,

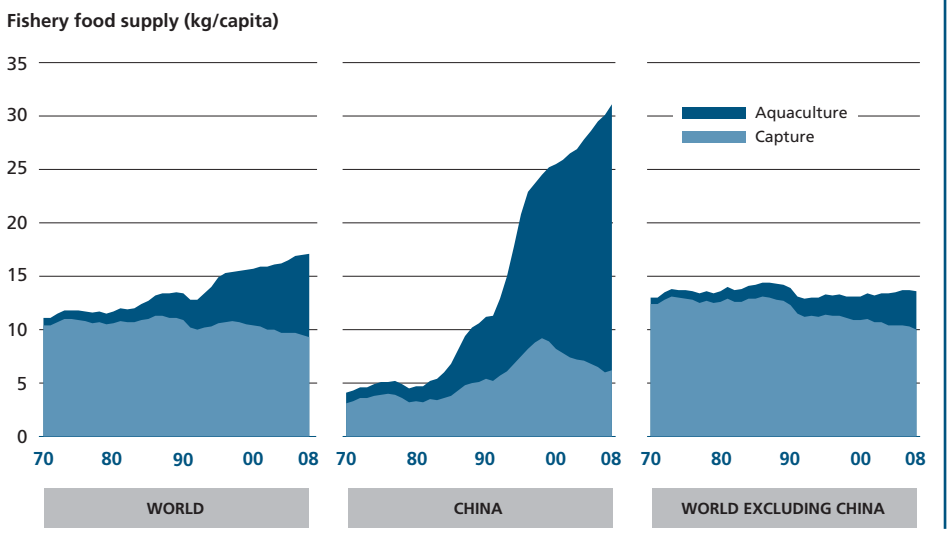
safety standards, variety, value addition, etc. Especially in the more affluent markets, consumers are increasingly requiring high standards of food freshness, diversity, convenience and safety, including quality assurances such as traceability, packing requirements and processing controls. Consumers demand guarantees that their food has been produced, handled and sold in a way that is not dangerous to their health, respects the environment and addresses various other ethical and social concerns. Health and well-being are among other factors increasingly influencing consumption decisions. Fish has a particular prominence in this respect, following mounting evidence confirming the health benefits of eating fish.

In the last decade, the surging demand for fish and fishery products has mainly been met by aquaculture production, as capture fisheries have been rather stagnant or even declining in some countries. In 2008, aquaculture contributed about 46 percent of the fishery output for human consumption (Figure 35). Aquaculture has pushed the demand for, and consumption of, species that 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, such as shrimps, salmon and bivalves, as well as tilapia and *Pangasius*. Aquaculture also has a role in food security, for the significant production of some low-value freshwater species, which are mainly destined for domestic production also through integrated farming.

The increasing production of species from aquaculture can also be seen by examining fish consumption by major groups. Consumption of crustaceans and molluscs, being high-priced commodities, tends to be concentrated in affluent economies. However, between 1961 and 2007, owing to the increasing production of shrimps, prawns and molluscs from aquaculture and the relative decline in their price, annual per capita availability of crustaceans grew substantially from 0.4 kg to 1.6 kg and that of molluscs (including cephalopods) from 0.8 kg to 2.5 kg. The increasing production of salmon, trouts and selected freshwater species has led to a significant growth in annual per capita consumption of freshwater and diadromous species, up from 1.5 kg in 1961 to 5.5 kg in 2007. In the last few years, no major changes have been experienced by the other broader groups. Consumption of demersal and pelagic fish species has stabilized at about 3.0 kg per capita per year. Demersal fish continue to be among the main species favoured by consumers in Northern Europe and in North America (8.5 kg and 7.0 kg per capita per year, respectively, in 2007), whereas cephalopods are mainly preferred by Mediterranean and East Asian countries. Of the

Figure 35

Relative contribution of aquaculture and capture fisheries to food fish consumption



17.0 kg of fish per capita available for consumption in 2007, about 75 percent came from finfish. Shellfish supplied 25 percent (or about 4.1 kg per capita), subdivided into 1.6 kg of crustaceans, 0.6 kg of cephalopods and 1.9 kg of other molluscs. Freshwater and diadromous species accounted for about 36.4 million tonnes of the total supply. Marine finfish species provided about 48.1 million tonnes, of which 20.4 million tonnes were pelagic species, 20.0 million tonnes were demersal fish, and 7.7 million tonnes were unidentified marine fish.

Notwithstanding the growth in the consumption of fish and food in general and the positive long-term trends in nutritional standards, undernutrition (including inadequate levels of consumption of protein-rich food of animal origin) remains a huge and persistent problem. This is especially the case in many developing countries, with the bulk of undernourished people living in rural areas. The number of undernourished people declined significantly in the 1970s, 1980s and early 1990s, in spite of rapid population growth. The proportion of undernourished people in the developing countries fell from one-third in 1970 to less than 20 percent in the 1990s and to 13 percent in 2004–06. However, the incidence of hunger and undernourishment in the world has been dramatically affected by the two successive crises – the food crisis first, with basic food prices beyond the reach of millions of poor, and then the economic recession. These crises have had very severe consequences for millions of people, pushing them into hunger and undernourishment. For the first time in decades, there has been an increase in both the absolute number and in the proportion of undernourished people. FAO's current estimate of the number of undernourished people in the world in 2008 is 1.02 billion people, which represents more hungry people than at any time since 1970.

At the same time, many people in countries around the world, including developing countries, suffer from obesity and diet-related diseases. This problem is caused by excessive consumption of high-fat and processed products, as well as by inappropriate dietary and lifestyle choices.

The outlook for the global food sector remains uncertain. It is facing various challenges related to the recovering economy and demographic issues, including growing urbanization. Since 2008, demand for food, including fish products, has remained sluggish compared with past years, but the long-term forecast for demand for food remains positive, also driven by population growth and urbanization. In particular, demand for fish products is expected to continue to rise in the coming decades. However, future increases in per capita fish consumption will depend on the availability of fishery products. With capture fisheries production stagnating, major increases in fish food production are forecast to come from aquaculture. Taking into account the population forecast, an additional 27 million tonnes of production will be needed to maintain the present level of per capita consumption in 2030. However, future demand will be determined by a complex interaction of several factors and elements. The global food sectors, including the fishery sector, will have to face several challenges stemming from demographic, dietary, climatic and economic changes, including reduced reliance on fossil energy and increasing constraints on other natural resources.

In particular, the future supply and demand of food commodities, including fisheries, will be affected by population dynamics and the location and rate of economic growth. The increase in world population is expected to slow in the next decade, in all regions and continents, with the fastest population increases continuing to be experienced by developing countries. According to the United Nations Population Division,[14] the world population is projected to reach 7 billion early in 2012, up from the current 6.8 billion, and exceed 9 billion people by 2050. Most of the growth will occur in developing countries, where the population is projected to increase from 5.6 billion in 2009 to 7.9 billion by 2050. In contrast, the population of the more developed regions is expected to change minimally, going from 1.23 billion to 1.28 billion, and would decline to 1.15 billion were it not for the projected net

migration from developing to developed countries, which is forecast to average 2.4 million people per year from 2009 to 2050.

Urbanization also plays a major role in changing patterns of food consumption. According to the United Nations Population Division,[15] 50.5 percent (3.5 billion people) of the world's population live in urban areas. Disparities in the levels of urbanization persist among countries and regions of the world, with highly urbanized countries having an urban share of up to 82 percent, in particular in North America, Latin America, Europe and Oceania, while others remain mostly rural (in particular in Africa and Asia) with a share of about 40 percent. However, in these latter countries, a vast movement of the population towards the cities is taking place. An additional 250 million to 310 million people are expected to become urbanized by 2015, with the bulk of the increase in urban areas expected in Asia and Africa. By 2050, the shares of urban population will be 62 percent in Africa and 65 percent in Asia, although this will still be significantly less than most other continents. The rural population is expected to decline in every major area except in Africa, where it is forecast to continue rising until 2040.

GOVERNANCE AND POLICY

Small-scale fisheries

Latest estimates indicate that small-scale fisheries contribute more than half of the world's marine and inland fish catch. Nearly all of this is used for direct human consumption. These fisheries employ more than 90 percent of the world's 35 million capture fishers (Box 5). Moreover, they support another 84 million people employed in jobs associated with fish processing, distribution and marketing.[16] There are also millions of other rural dwellers, particularly in Asia and Africa, involved in seasonal or occasional fishing activities. They often have few other alternative sources of income and employment, and they are not recorded as "fishers" in official statistics.

Almost half of the people employed in small-scale fisheries are women. The importance of the small-scale fisheries sector is of global reach. Its diversity in technology, culture and traditions is part of humankind's heritage. More than 95 percent of small-scale fishers and related workers in post-harvest sectors live in developing countries.[17]

In spite of their economic, social and nutritional benefits, as well as their contribution to societal and cultural values, small-scale fishing communities often face precarious and vulnerable living and working conditions. Poverty remains widespread for millions of fishing people, especially in sub-Saharan Africa and South and Southeast Asia.

Poverty is now better understood and recognized as a complex issue with socio-institutional factors generally being more important than pure economic or biological aspects. It is undeniable that overfishing and potential depletion of fishery resources constitute a real threat to many coastal livelihoods and small-scale fisheries. However, there are other conditions related to social structures and institutional arrangements that play a more central role in engendering poverty by the way they control how and by whom fishery and other resources can be accessed and used. Critical factors that contribute to poverty in small-scale fishing communities include: insecure rights to both land and fishery resources; poor or absent health and educational services; lack of social safety nets; vulnerability to natural disasters and climate change; and exclusion from wider development processes owing to weak organizational structures and inadequate representation and participation in decision-making.

These insights into the factors of poverty have important consequences for the governance of small-scale fisheries. It has become evident that addressing poverty requires that marginalized groups be included in the institutional processes related to resource management and that, in order to achieve this, new institutional approaches are needed. However, for new approaches to be effective, the wider facets of poverty need to be addressed first (or simultaneously with resource management) as fishing

Box 5

Improving information in small-scale fisheries

There is a general lack of coherent, reliable and accessible information on the small-scale fisheries sector. This hinders the formulation of relevant policies for the sector. Addressing these knowledge gaps, particularly in developing countries, can help justify additional efforts by policy-makers and planners to maintain and improve the contribution by the sector to food security, poverty alleviation and employment.

The severity of the situation has been recognized globally and in particular by the United Nations General Assembly, which in 2003 endorsed a global strategy for improving information on status and trends in capture fisheries. Subsequently, the World Bank, WorldFish Center and FAO started: (i) a global reassessment of employment and production of small-scale fisheries; and (ii) a critical review of data-gathering methods employed for small-scale fisheries.

Preliminary results from this study[1] show that 33 million people worldwide are employed as fishers full time or part time. Adding employment – full-time and part-time – in the post-harvest sector indicates that 119 million people are directly dependent on capture fisheries for their livelihoods. Some 97 percent of them live in developing countries (116 million) and more than 90 percent are involved in the small-scale fisheries sector. Inland water fisheries are particularly important in developing countries, and more than half (60 million) of those employed in fisheries in developing countries work in small-scale inland fisheries. In developing countries, almost 56 million jobs are held by women.

Reviews[2] of data gathering for small-scale fisheries indicate that both catches and employment in small-scale fisheries tend to be greatly underreported. The major reasons are:

- the dispersed characteristics of small-scale fisheries;
- in many developing countries, a poor institutional capacity;
- the adoption by developing countries of data collection approaches that originate in developed countries and are difficult to apply in the multispecies, multigear environment of small-scale fisheries.

Reviews also show that data gathering for small-scale fisheries requires new innovative approaches:

- A main priority is the sample frame. Data collection on small-scale fisheries will probably be cheaper and more robust if undertaken as part of statistical surveys carried out for other purposes, e.g. population size or agriculture production.
- Appropriate assessment methods need to be developed for data-poor fisheries.
- Once obtained, data and information should be easily available, and to this end international information-sharing arrangements should be strengthened and/or developed.

[1] The "Global Big Numbers Project", executed by FAO and WorldFish Center and sponsored by the World Bank in 2008.
[2] The FAO "FishCode-STF Project" (ongoing since 2004), funded by the Governments of Japan, Norway and Sweden.

people, facing the immediate daily challenge to meet their most basic needs, often lack the capacity and incentives to participate in resource management.

It is in this context, but also in its own right, that there is a call for the adoption of a human rights approach towards the sustainable development of small-scale fisheries.[18] The Global Conference on Small-Scale Fisheries (Bangkok, 2008) identified several critical ways forward for securing sustainable small-scale fisheries that integrate social, cultural and economic development, address resource access and use-rights issues guided by human rights principles, and recognize the rights of indigenous peoples. The conference reaffirmed that human rights are critical to achieving sustainable development.

The human rights approach stresses the importance of removing obstacles, such as illiteracy, ill health, lack of access to resources, and lack of civil and political freedoms, that prevent people from doing legitimate activities that they want to do. As an overarching governance framework, the human rights approach provides a strong basis for citizens to make claims on their states, and for holding states accountable for fulfilling their duties. At a fundamental level, in this case, it requires strengthening the capacity of fishing communities to be aware of and to claim and exercise their rights effectively. It also requires all duty-bearers, including states, to fulfil their human rights obligations.[19]

In welcoming the outcome of the Global Conference on Small-Scale Fisheries by the Twenty-eighth Session of the COFI, many Members expressed the need for an international instrument on small-scale fisheries that would guide national and international efforts to secure sustainable small-scale fisheries and create a framework for monitoring and reporting.[20]

Legislation is often crucial to promote human rights and ensure that specific economic and social rights are enshrined for small-scale fishers and fishworkers, and to ensure that such rights cannot be eroded through social, economic and political marginalization. Processes for legislative development are different in different countries. Better compliance can be fostered by legislation that involves all stakeholders in its development, permitting them to then claim ownership over such laws.[21]

At the sector level, the challenges of sustainable resource use in small-scale fisheries are not adequately addressed by the standard methods of management applied to large commercial fisheries. The difficulties often include, for example, widely dispersed landing sites, multispecies nature of resources, and fishery resources shared with other communities and sectors. The current trend is towards devolved management responsibilities and comanagement arrangements with strong involvement of local resource users together with the state. This would appear to be the appropriate governance approach for addressing the existing challenges. However, this approach requires not only human capacity at the local level but also legal, practical and community-based prerequisites in support of decentralized and shared management.[22]

There are generally high interdependences of small-scale fisheries with other sectors, usually best addressed through cross-sector planning and coordination processes and mechanisms. In fact, past experience[23] indicates that cross-sectoral integrated planning processes can be a very powerful means for raising the profile of small-scale fisheries in the policy arena, especially also in relation to the effective integration of fisheries into poverty reduction and food security initiatives.

Fish trade and traceability

The fisheries sector operates in an increasingly globalized environment. Nowadays, fish can be produced in one country, processed in a second and consumed in a third. The process of globalization has created substantial opportunities for the sector. However, hand in hand with the opportunities created by globalization are the risks inherent in such a widespread sector. For example, a common fraudulent practice is species substitution, which can be unintentional or intentional for tax evasion, for laundering illegally caught fish or for selling one fish species for a higher-priced species. Traceability systems are increasingly being used to mitigate these risks by establishing a tool to verify the integrity of the supply chain and to remedy failure when a supply chain's integrity is broken.

Traceability systems trace fish and fish products from the point of production to the consumer. Traceability is becoming an increasingly common feature in the fisheries sector, especially in the case of fish and fish products that are traded internationally. It is used for food safety purposes, to verify legal provenance of fish or to meet national security and public safety objectives. It is required by:

- importing markets to ensure that food safety and authenticity objectives are met. The United States of America and the EU have mandatory traceability requirements. Japan has no mandatory traceability requirements for seafood products, but it does have a number of other legal obligations that have the effect of requiring businesses to have effective traceability capacity.
- regional fisheries management organizations that have implemented documentation systems that enable contracting parties and cooperating states to verify that certain sensitive fish products have been caught in compliance with the requirements of the RFMOs and, therefore, should be granted access to international markets.
- the catch certificates required by the EU to verify that all wild caught fish and shellfish traded to the EU can be traced back to the vessel that caught it and that all vessels used to supply wild captured fish to the EU were legally authorized at the time of fishing. Chile is in the process of implementing similar legislation.
- ecolabelling schemes that certify products are sourced from well-managed fisheries. Ecolabelling schemes are mainly private although public ones are being developed.

Challenges

The implementation of traceability requirements has created challenges for exporting countries. Failure to meet these requirements may result in fish and fish products being denied market access. As traceability systems are generally not integrated, separate traceability systems need to be introduced to meet safety, legality and sustainability objectives. This is a challenge for developing countries that often lack the resources to meet such requirements. The introduction of traceability requirements has also created additional costs for the fishing industry.

Solutions

Technological developments. Technologies based on the application of unique product numbering, whether proprietary or compliant with transparent public standards, can enable businesses and regulators to track and trace products through the value chain. These technologies may be adopted to assist food suppliers to meet enhanced regulatory requirements, as for example proposed in the United States of America, requiring food suppliers to demonstrate the full provenance of their products at any point as they pass through the supply chain.

In recent decades, businesses have adopted standardized product numbering, using barcoding to identify goods for a variety of purposes as they move through supply chains from producer to consumer. Primarily used for inventory control purposes, barcoding provides a proprietary technical solution for delivering traceability.

More portable and secure technologies are available through the development of an international standard for electronic product coding and its application through radio frequency product identification (RFID), with unique traceability data encoded using an internationally standardized and secure system on products to enable their identification as they pass along the supply chain. Such proprietary systems require significant investment by companies in systems development and internal documentation. While the unit cost of applying a barcode or RFID tag is very small, the investment costs for infrastructure development, system development and internal controls, and related training can be high.

Producing official certificates electronically can also provide a greater level of assurance of document integrity – especially if the documents exist solely in cyber-space accessed only through secure access arrangements. The United Nations Centre for Trade Facilitation and Electronic Business has released a standard for electronic certification (eCert) that allows governments to exchange electronic

export certificates for agriculture and food commodities, including fish and fisheries products.

Another prominent area of research is species identification, especially using DNA-based techniques (Box 3). Advances in polymerase chain reaction methodology have reduced both the quantity of DNA needed for analysis as well as the time required for rapid testing. Specific genetic markers for fish, molluscs and other aquatic species enable species differentiation.

Integration. Traceability and fish identification have matured. What started as a programme to increase the safety, quality and legality of fish products has expanded to fish branding for marketing purpose. It is becoming a powerful economic tool that affects truthfulness in advertising as well as being part of a supply chain that ties the end consumer to the harvesting ground through the genetic code.

The integration of traceability systems may result in cost savings. However, care should be taken to ensure that the benefits of integration outweigh their costs. The integration of certification for different objectives with different information needs should be based on a platform that offers the greatest security or integrity. As noted above, this may run the risk of adding costs and barriers for some users to a greater extent than may be strictly necessary.

Private traceability standards should, to the extent possible, be adapted to official standards. This can offer cost savings to the businesses concerned, as compared with having to develop and implement duplicate proprietary systems.

Regional fishery management organizations

The role and obligations of regional fishery bodies (RFBs), and notably regional fisheries management organizations (RFMOs), in fisheries governance are growing steadily. Simultaneously, strengthening RFBs and their performance still remains the major challenge facing international fisheries governance. This is reflected in various international fora and in particular in the United Nations General Assembly and the COFI.

A recent FAO enquiry[24] shows that most RFBs consider IUU fishing (including effective implementation of MCS and overcapacity) as being the main challenge to their performance. Most respondents reported an inability to control IUU fishing and highlighted the impact that this has on undermining attempts at effective fisheries management. More encouragingly, three RFBs claimed to be addressing IUU fishing successfully: the Northwest Atlantic Fisheries Organization (NAFO), the North Atlantic Salmon Conservation Organization (NASCO) and the North East Atlantic Fisheries Commission (NEAFC). Indeed, the NEAFC noted that it was achieving considerable success in combating IUU fishing through IUU fishing vessel lists and a port state control system. Similarly, the NAFO also claimed to have a relatively effective MCS scheme that addresses IUU fishing through at-sea inspections, 100 percent observer coverage, a vessel monitoring system (VMS) and obligatory port inspections. The NASCO has noted a significant decrease in the level of unreported catches owing to improved surveillance and exchange of data.

A second commonly expressed fisheries management problem was difficulty in the implementation of the EAF. Other fisheries management problems reported by RFBs included bycatch (particularly of turtles, sharks and birds) and specific management issues in aquaculture and inland fisheries. Everywhere, there were problems of legal and illegal overcapacity leading to too much fishing effort. The need for more and better scientific data was noted by many RFBs.

Financial support for the RFB was cited as a primary issue of concern by a number of RFBs. Numerous RFBs also noted the need for greater cooperation between member states and the need to reform their legal and institutional framework.

Furthermore, RFBs are frustrated by their inability to promote economic development in member countries. This is important as the membership of many

Box 6

International Guidelines for the Management of Deep-sea Fisheries in the High Seas

The FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas[1] (the Guidelines) were adopted in 2008. They are a response to a request from the FAO Committee on Fisheries (COFI) at its twenty-seventh session (2007) to assist states and regional fisheries management organizations/arrangements (RFMO/As) in sustainably managing deep-sea fisheries and in implementing United Nations General Assembly Resolution 61/105 (2006). The Guidelines were developed owing to increased international concern regarding the management and potential impact of deep-sea fisheries on vulnerable marine ecosystems (VMEs) in the high seas, particularly regarding low-productivity species targeted by some of these fisheries and sensitive deep-sea habitats.

Although there is no standard definition of "deep sea" because of regional variations in habitat, fisheries and species, these fisheries are generally conducted at depths of more than 200 m, on continental slopes or isolated oceanic topographic structures such as seamounts, ridge systems and banks. Deep-sea fisheries *in the high seas* are relatively new. Although trawl fisheries for deep-sea species developed in the mid-1950s, they only began to expand into areas beyond national jurisdiction in the 1970s after the extension of national maritime claims.

The main objective of the management of these fisheries, according to the Guidelines, is "to promote responsible fisheries that provide economic opportunities while ensuring the conservation of marine living resources and the protection of marine biodiversity". As such, the Guidelines constitute a unique voluntary international instrument, adopted by more than 70 FAO Members, that combines recommendations for the management of fisheries while also focusing on the conservation of marine biodiversity. Although non-binding, the Guidelines are one of the few tools to assist those responsible for managing marine living resources, as well as protecting vulnerable marine ecosystems in the high seas – which is no easy task. Guidance is provided on topics vital to fisheries management, such as data and reporting, enforcement and compliance, and management measures. In addition, conservation-related aspects are included, such as criteria for the identification of VMEs and key components of an impact assessment.

These Guidelines, which were elaborated through a multistakeholder process, are now being implemented by RFMOs mandated to manage discrete deep-sea stocks in the high seas, as well as by some FAO Members. FAO is now in the process of producing technical support tools to assist RFMO/As, states, the deep-sea fishing industry and others to achieve full implementation of the Guidelines.

[1] FAO. 2009. *International Guidelines for the Management of Deep-sea Fisheries in the High Seas*. Rome. 73 pp.

Box 7

Marine protected areas

Closed areas in fisheries are nothing new. Various types of spatial measures, such as closed areas or areas with particular gear or other restrictions, have been used for centuries as traditional management measures in artisanal fisheries around the world. These measures are also an integral part of "conventional" fisheries management. However, the term "marine protected area" (MPA) is a more recent concept and is usually more directly associated with biodiversity conservation than fisheries management. The use of MPAs and international imperatives to reach targets for the establishment of MPAs have risen rapidly in the last decade or so. This has created much confusion as to what constitutes an MPA, which is also referred to as a closed area, marine reserve, no-take area, marine sanctuary or countless other types of spatially explicit areas that enjoy some form of protection within a restricted boundary. Confusion persists not only in regard to terminology, but also in relation to how such areas fit into fisheries management. In particular, there is also confusion as to what the potential fisheries management benefits and costs are. Owing to the conflicting and confusing information on MPAs in a fisheries context and the absence of adequate guidance on this topic, the FAO Committee of Fisheries, at its twenty-sixth session, requested FAO to develop technical guidelines on the design, implementation and testing of MPAs in relation to fishing.

Marine protected areas have an important role to play, not only within the conservation community but also within fisheries management, and particularly in an ecosystem approach to fisheries. Therefore, they can serve as a tool for helping to achieve multiple objectives from different sectors. As practices and interests between the communities converge – owing to an awareness among conservation groups that human needs and interests cannot be ignored in conservation, and a complementary awareness among fishery scientists and managers that sustainable fisheries are only possible in healthy ecosystems – such tools will become even more important to the management of aquatic systems. Nonetheless, it is also important to remember that MPAs, however defined, are one type of tool to achieve certain objectives and that they are not an end in themselves. It is vital that attention be focused on reaching overall goals and achieving effective management of resources.

The FAO MPA Guidelines[1] provide information and advice on MPAs in the context of fisheries management, but also discuss the implementation of MPAs with multiple objectives, i.e. when fisheries management is one, but not the only, objective. The MPA Guidelines seek to clarify the potential effects of MPAs on fisheries, the fishery resource and the ecosystem, including biological, physical and socioeconomic aspects. The importance of using spatial management tools such as MPAs within a reconciled framework (i.e. where fisheries management objectives exist in tandem with other sectoral objectives) and of their integration into overall policy frameworks is stressed. Guidance on MPA design, implementation, monitoring and adaptation is provided, and the main challenges and opportunities relevant to these processes are discussed.

[1] FAO. (forthcoming). *Fisheries management. 4. Marine protected areas and fisheries.* FAO Technical Guidelines for Responsible Fisheries No. 4, Suppl. 4. Rome.

RFBs consists solely or predominantly of developing states, and poverty clearly affects the ability to manage fisheries at all levels in society. In particular, it affects the ability to improve the livelihoods of subsistence and artisanal fishers.

A new generic area of concern for RFBs, compared with a previous FAO study,[25] is the environment. As areas of main concern, a large number of RFBs listed issues relating to climate change, habitat protection, including VMEs (Box 6), marine protected areas (MPAs, see Box 7) and seamounts, and the worldwide problem of depleted fish stocks.

New regional fisheries bodies

A new inland fishery body is in the process of development. The Central Asian and the Caucasus Fisheries and Aquaculture Commission was approved by the Hundred and Thirty-seventh Session of the FAO Council in October 2009. It will become active as soon as at least three countries ratify or accede to the Agreement.

Its objectives are to promote the development, conservation, rational management and best utilization of living aquatic resources, including the sustainable development of aquaculture. A five-year programme of work has been prepared and will be submitted for discussion and adoption by the Third Intergovernmental Meeting on the Establishment of a Central Asian and Caucasus Fisheries and Aquaculture Commission, which is scheduled to take place in late 2010.

The mandate of the new body includes the inland waters within the territorial boundaries of Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan and Uzbekistan. Management of fisheries in the transboundary water basins bordering these states will be undertaken in collaboration with the Interstate Commission for Water Coordination of Central Asia and with other RFBs, particularly the European Inland Fisheries Advisory Commission.

The international consultations on the proposed South Pacific Regional Fisheries Management Organisation concluded with the adoption of the Convention on the Conservation and Management of the High Seas Fishery Resources of the South Pacific Ocean in Auckland, New Zealand, in November 2009. The convention opened for signature on 1 February 2010 and will remain open for 12 months. It will enter into force 30 days after the deposit of the eighth instrument of ratification, accession, acceptance or approval (of which three must be coastal states and three non-coastal states). When the convention enters into force, it will close a gap that exists in the international conservation and management of non-highly migratory fish stocks and protection of biodiversity in the marine environment extending from the easternmost part of the South Indian Ocean through the Pacific Ocean towards the EEZs of South America.

Preparatory discussions are under way for the establishment of a regional fishery mechanism for the coastal states of the Red Sea and Gulf of Aden. Such discussions were requested at the Twenty-eighth Session of the COFI.

Regional Fishery Body Secretariats Network

Since 1999, RFBs have met biannually to share information of joint interest. At their fourth meeting in 2005, participants agreed that their meetings should be referred to as the Regional Fishery Body Secretariats Network (RSN).

The RSN met in March 2009 and reviewed a large number of subjects of joint interest. Among these were: decisions and recommendations relating to RFBs made by the COFI; IUU fishing; overcapacity; United Nations General Assembly Resolution 61/105; management of marine ecosystems; and the status of the Fisheries Resources Monitoring System and that of the Coordination Working Party on Fishery Statistics. The Secretary of the NEAFC was elected as the new Chairperson of the RSN.

The RSN also discussed RFMO performance reviews. It noted the many similarities in the procedures set up by the different organizations but also that each RFB is in a unique position with respect to the parties involved, their interaction with the RFB, the species managed, the NGO community and other stakeholders involved, and the nature

of its remit. However, provided that there is a real element of independent outside review of what the organization is achieving, or not achieving, the RSN concluded that the approaches to performance review needed to be flexible and it agreed that each performance review could have its own characteristics.

Management of tuna fisheries

The world's five tuna RFMOs[26] consult periodically. Following their first meeting in Kobe, Japan, in January 2007, the Second Joint Meeting of Tuna Regional Fisheries Management Organizations was held in San Sebastian, Spain, from 29 June to 2 July 2009. The meeting reviewed progress in performance reviews of RFMOs, scientific work programmes and cooperation in data collection, in particular how to avoid the creation of gaps in data series. Concrete actions to ensure that fishing capacity is commensurate with available fishing opportunities were also discussed. A number of immediate actions as well as a work plan for 2009–2011 were agreed.

Performance reviews of RFMOs

The Review Conference on the UNFSA held in New York, the United States of America, in May 2006 discussed the need to modernize the mandates of RFMOs in order that they can fulfil their functions as described in the UNFSA. At the conference, proposals were made for a systematic review and assessment of RFMO performance. In the course of the conference, states agreed specific measures to be taken by states individually and/or by RFMOs in order to strengthen international cooperation. Among the agreed actions were performance reviews of RFMOs.[27]

In 2007, the Committee for Fisheries of the Organisation for Economic Co-operation and Development (OECD) embarked on a review of the experiences of a number of RFMOs[28] that had undergone recent changes to their mandates and/or modes of operation. The objective of the review was to identify the key lessons from these experiences. In May 2009, the OECD Committee for Fisheries agreed to release the report[29] under the responsibility of the Secretary-General of the OECD.

By early 2009, six RFMOs had reported that they had already concluded performance reviews, and many others had started the process. At that time, the NAFO had finalized a comprehensive reform process and planned to review its performance after most elements of the reform had been implemented. The South East Atlantic Fisheries Organization conducted its performance review during its sixth Annual Meeting in October 2009.

The performance review of the NASCO was undertaken in 2004–05 by stakeholders and NGOs. During dedicated meetings, they gave feedback on their perception of how well the NASCO was performing in different areas. Opportunities were also provided to question contracting parties about implementation of, and compliance with, NASCO measures.

The NEAFC used an independent panel for its 2006 review. The review panel included representatives of NEAFC members and non-members. They conducted the performance review according to criteria agreed in advance. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) and the Indian Ocean Tuna Commission (IOTC) conducted their performance reviews using the method employed by the NEAFC.

FAO reform and regional fishery bodies

As part of the reform process, there has been a consensus that FAO statutory bodies, such as Article XIV fishery bodies, wishing to do so, should be encouraged to assume greater autonomy for their activities and finance, while remaining within the framework of FAO and maintaining a reporting relationship with it.

Despite positive developments with some Article XIV fishery bodies, many of them remain seriously challenged in terms of effectively carrying out their mandates. This situation is principally caused by ongoing and serious constraints in terms of financial, technical and human resources. Most of these bodies do not have dedicated secretariats and, as a consequence, in practice function as part-time organizations.

Dealing with IUU fishing

Illegal, unreported and unregulated (IUU) fishing continues to threaten the long-term sustainable management of world fisheries. This situation was reconfirmed by the COFI at its twenty-eighth session in 2009. Its position has since been substantiated with the publication of a study concerning the role and work of RFBs.[30] It showed, *inter alia,* that IUU fishing remained a priority concern and that most RFBs were struggling with it. The study reported that only a small number of RFBs were making headway in curtailing IUU fishing.

However, most RFBs are striving to implement measures to counteract IUU fishing. Measures being adopted and strengthened include: the promotion of awareness-building programmes, the creation and use of vessel lists, the implementation of catch documentation schemes, the implementation of port state measures, enhanced MCS, increased at-sea vessel inspection, complete fleet observer coverage, improved exchange of information, and the deployment of VMSs. Moreover, some RFBs reported that they had used their performance reviews to examine options to address IUU fishing.

The RFBs are at the forefront in the fight against IUU fishing. The tuna RFBs have demonstrated the benefits of more rigorous interregional collaboration and harmonization of activities to address IUU fishing. Further consolidation and intensification of their efforts is needed for the fuller implementation of agreed common measures and approaches. Cooperation among these RFBs provides a template for wider collaboration among non-tuna RFBs.

A notable and forward-looking development to stem the flow of IUU-caught fisheries product into the European market was taken on 1 January 2010 with the implementation of the certification scheme developed by the EU. Covering all imports of fishery products, it will require unprocessed products to have documents certified by the flag state of the fishing vessel, while imports of processed products require a statement issued by the processing company of the exporting country. This statement must include information establishing a connection between the processed product, the fish used as raw material and its origin.

Despite widespread publicity about the introduction of the scheme and the requirements that would have to be met, some countries have experienced difficulty in complying with the new EU requirements. While there has been a degree of flexibility in the introduction of the scheme in order to accommodate the concrete and specific situations of countries, the longer-term impact of the certification scheme should be positive. Generally, industry groups and authorized fishers have welcomed the scheme, although the increased bureaucratic workload for exporting countries is likely to be significant. In addition, the scheme could exert upward pressure on EU fish prices if it restricts import flows.

Civil society works to promote action against IUU fishing in many areas and at different levels. Generally, there is an increasing trend towards blending of interests among civil-society groups with respect to IUU fishing. Essentially, to satisfy a growing demand in the marketplace for sustainably harvested and non-IUU-caught product, industry groups have embraced sustainability and environmental goals, reducing the traditional demarcation among civil-society players. This convergence is having a positive effect on reducing IUU fishing as traders and processors opt not to purchase fish, irrespective of its source, that does not meet their self-imposed standards.

The 2001 FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing called for states to elaborate national plans of action (NPOAs) by mid-2004 and to review them every four years at least. There are fewer than 40 NPOAs on IUU fishing worldwide, and subregions have few if any. Information shows that the preparation of such NPOAs has stalled despite their undisputable value in promoting coherent and transparent national action against IUU fishing. Countries that have not elaborated NPOAs on IUU fishing find themselves at a disadvantage in addressing the problem because they lack a clear platform on which to base their operations.

Human resource development and institutional strengthening are high priorities in the fight against IUU fishing. Developing countries require assistance to enable them

Box 8

SADC mobilization against illegal, unreported and unregulated (IUU) fishing

The countries of southern Africa have been mobilizing in the fight against illegal, unreported and unregulated (IUU) fishing. In September 2007, a forum for national heads of operation of monitoring, control and surveillance (MCS) hosted by Mozambique, considered that illegal fishing should be raised at the highest level within the Southern African Development Community (SADC). Subsequently, the SADC held a ministerial conference on 4 July 2008 in Windhoek, Namibia, at which fisheries ministers from coastal states considered and signed a statement of commitment to stop illegal fishing. Among several resolutions, the ministers committed to closing their ports to all illegal vessels.

At the SADC ministerial conference, the Minister of Fisheries and Marine Resources of Namibia, Dr Abraham Iyambo, placed the issue in regional context: "It is not an exaggeration to state that the plague of illegal fishing is one of the largest environmental crimes of our time. In this context, we may well be the last generation of decision-makers with an opportunity to prevent this scandal and to bring to an end the troubling destruction of our oceans and the hardship it brings to our people."

Following the signing of the SADC statement of commitment, SADC countries took action with vessel arrests, revoking or reviewing some of the foreign fishing agreements, and enforcing measures on vessels flying their flag and fishing outside of their exclusive economic zones.

Regional cooperation in monitoring and surveillance increased significantly, with joint training at sea and operations between member countries of the Indian Ocean Commission (IOC) and the SADC. In a series of patrols along the coast of southern and east Africa, some countries were able to apprehend illegal fishing vessels for the first time and, through bilateral exchange of staff and advisors, proceed to prosecute the owners successfully and confiscate the vessels.

Early in 2009, Mozambique hosted a second regional forum of heads of operation of MCS, where the elements of an action plan against illegal fishing were identified, including the possibility of a regional MCS centre. With South Africa as chair, the SADC Fisheries Technical Committee finalized the action plan and set up several working groups ahead of negotiations on a global port state measures agreement that were scheduled for later in the year. At the negotiations, SADC members actively participated in a coordinated African approach to obtain concessions in relation to the special situation of developing countries and small island states.

The SADC action plan against illegal fishing was approved at a ministerial meeting in Zimbabwe on 16 July 2010. Mozambique will be hosting a global fisheries enforcement conference in 2011. The African Union (New Partnership for Africa's Development [NEPAD]) is proceeding to support similar initiatives by other regional economic communities in Africa.

Regional and international organizations and partners that have contributed to this southern African effort led by the SADC include: the Department for International Development (United Kingdom), FAO, the Indian Ocean Tuna Commission, INFOSA, the IOC, the NEPAD, the Norwegian Agency for Development Co-operation, the Pews Foundation, the South East Atlantic Fisheries Organisation, the Southwest Indian Ocean Fisheries Commission, Stop Illegal Fishing, and the Swedish International Development Cooperation Agency.

Box 9

FAO Agreement on port state measures to combat IUU fishing

Following a year of intense negotiations,[1] the FAO Conference in November 2009 approved the Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (the Agreement) as an Article XIV instrument under the FAO Constitution. Immediately following its approval, the Agreement opened for signature and it will remain open for one year. It will enter into force 30 days after the date of the deposit of the twenty-fifth instrument of ratification, acceptance, approval or accession with the Depositary, the Director-General of FAO.

The Agreement seeks to prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing through the implementation of port state measures as a means of ensuring the long-term conservation and sustainable use of living marine resources and marine ecosystems. The intention is that the Agreement will be applied by parties, in their capacities as port states, for vessels[2] not entitled to fly their flags. It will apply to these vessels when seeking entry to parties' ports or while they are in port. Certain artisanal fishing craft and container vessels will be exempt.

The real-time exchange of information is a key aspect of the Agreement. Indeed, its success will hinge, to a large degree, on the extent to which parties are prepared to, and capable of, exchanging information relating to vessels suspected of engaging, or found to have engaged, in IUU fishing. The Agreement specifies procedures for vessels to follow when requesting port entry and, conversely, for port states in relation to vessel inspections and other responsibilities such as the transmittal of inspection results. The annexes, an integral part of the Agreement, specify the advance information to be provided by vessels seeking entry to parties' ports as well as guidelines for inspection procedures, the handling of inspection results, information systems and training requirements.

Central to the Agreement is the article concerning the requirements of developing states. Focusing on the issue of capacity building, this article recognizes the need to ensure that all parties, irrespective of their geographic location and development status, have the human and material means to implement the Agreement. These provisions reflect a fundamental concern as lack of capacity among port states parties could seriously hamper the effectiveness of the Agreement in meeting its objectives.

The Agreement, on its own, cannot be expected to solve the world's IUU fishing problems. They must be addressed comprehensively and in different yet mutually reinforcing ways. However, blocking the movement of IUU-caught fish into ports and onto national and international markets, as well as making the operations of vessels engaged in IUU fishing more difficult, should cost-effectively reduce the incentive for fishers to take part in such fishing and related activities.

[1] FAO. 2009. *Report of the Technical Consultation to Draft a Legally-binding Instrument on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing*. FAO Fisheries and Aquaculture Report No. 914. Rome. 77 pp.

[2] The Agreement defines a "vessel" as any vessel, ship of another type or boat used for, equipped to be used for, or intended to be used for, fishing or fishing-related activities.

to develop, implement and improve policies and measures to combat IUU fishing. Moreover, they need more and accurate information about the negative effects on sustainability of flags and ports of non-compliance. While some countries need international support to develop strategies to stop the sale of flags as a revenue-raising activity, others may need assistance in order not to permit their ports to be used by vessels without appropriate entry and exit checks. However, in order to be effective,

Box 10

Flag state performance

A number of participants in the 2007 session of the FAO Committee on Fisheries (COFI) spoke about "irresponsible flag states". It was proposed that criteria be developed for assessing the performance of flag states and that possible actions against vessels flying the flags of states not meeting the criteria be examined. Following an Expert Workshop convened by Canada with the support of the European Commission and Iceland's Law of the Sea Institute, the matter of flag state performance was addressed again in 2009 by the COFI. As agreed by the COFI, an Expert Consultation was held in June 2009, to be followed by a Technical Consultation before the 2011 COFI session.

The task assigned to the Expert Consultation was quite ambitious. Participants used as a starting point and general reference a number of technical papers relating to the issues to be discussed as well as the outcomes of the Canadian Expert Workshop. In their deliberations, they were to consider and make recommendations on: criteria for assessing the performance of flag states; possible actions against vessels flying the flags of states not meeting the criteria identified; the role of national governments, regional fisheries management organizations, international institutions, international instruments and civil society in implementing the criteria and actions for flag state performance; and assistance to developing countries to help them in meeting the criteria, taking actions and fulfilling their respective roles as appropriate.

The Expert Consultation agreed to recommend to a technical consultation that international guidelines be developed on criteria for assessing the performance of flag states and possible actions against vessels flying the flags of states not meeting such criteria.[1] An assessment process would be an important part of such guidelines. Noting the basis provided by international law for such assessments, the Expert Consultation agreed on the need for two processes: one for self-assessment, and another for international or multilateral assessment. The latter assessment should be undertaken in a spirit of international cooperation, consistent with the 1982 United Nations Convention on the Law of the Sea. The Expert Consultation further agreed upon draft criteria for flag state performance, processes for conducting assessments, post-assessment actions, and assistance to developing countries to improve their performance as flag states. The experts considered that these criteria and actions should form an appropriate framework for review by a technical consultation.

[1] FAO. 2009. *Expert Consultation on Flag State Performance*. FAO Fisheries and Aquaculture Report No. 918. Rome. 94 pp.

capacity-building measures must be matched by the political will to address IUU fishing (Box 8) and by a willingness to rein in corrupt practices that both facilitate and feed off IUU fishing.

FAO is focusing considerable attention on IUU fishing and related activities. In 2009, in line with international calls to conclude negotiations, FAO finalized the 2009 FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal Unreported and Unregulated Fishing (Box 9) and commenced work, possibly to involve the development of guidelines, on the elaboration of criteria and follow-up action for flag state performance (Box 10). The broader, if not universal, application of the above agreement will serve to reduce the effects of IUU fishing, as will the specification of criteria to enhance flag state performance.

Emerging issue – international guidelines on bycatch management and reduction of discards

Notwithstanding the emphasis given to bycatch and discards by several intergovernmental organizations in the past, there remain significant concerns with respect to effective management of bycatch and reduction of discards in capture fisheries. Previous efforts to address these issues have included the development of international plans of action for seabirds and sharks[31] and guidelines to reduce sea turtle mortality in fishing operations.[32] However, problems persist with the high levels of unwanted and often unreported bycatch and discards in many fisheries around the world, including the capture of ecologically important species and juveniles of economically valuable species. Total global bycatch is difficult to quantify because of incomplete information and because different states define it differently. Nevertheless, the latest published estimate of global discards from fishing (a subset of bycatch under any definition) is of about 7 million tonnes (Box 11).[33] However, issues other than the actual tonnages of bycatch and discards are also important – such as the mortalities of rare, endangered or vulnerable species, and the socio-economic impacts of utilizing bycatch instead of decreasing its capture.

Calls for action on bycatch and discards have also been raised at the United Nations General Assembly. For example, at the sixty-third session of the United Nations General Assembly in 2008, states, subregional and regional fisheries management organizations and arrangements (RFMO/As) and other relevant international organizations were urged to reduce or eliminate bycatch, catch by lost or abandoned gear, discards and post-harvest losses, and support studies and research that will reduce or eliminate bycatch of juvenile fish.[34]

In 2009, at the Twenty-eighth Session of the COFI (COFI 28), it was noted that, in poorly managed fisheries, unreported and unregulated landings of bycatch, discards, and pre-catch losses are issues of major concern.[35] To respond to these concerns and those raised at the United Nations General Assembly, COFI 28 requested FAO to lead the development of international guidelines on bycatch management and reduction of discards through the process of an Expert Consultation[36] (held in late 2009) followed by a Technical Consultation (scheduled for December 2010).[37] The proactive stance proposed by COFI 28 was welcomed by the United Nations General Assembly.[38]

Aquaculture policy and governance

In the last two decades, aquaculture has recorded significant and rapid growth among the food-producing sectors and has developed into a globally robust and vital industry. However, this level of development has varied widely across nations, with a positive bias towards countries where entrepreneurs have been successful – an indication that this development has come about largely because of the private sector.

One of the reasons, and perhaps the most important reason, why entrepreneurs flourish in some jurisdictions but not others is governance.[39] In the past two decades, considerable progress has been made in addressing aquaculture governance issues. This progress has been made possible by an international corporate effort and by several nations that have pushed the aquaculture agenda forwards in an orderly and

Box 11

Monitoring and reporting on discards in the world's fisheries

Most fisheries professionals recognize that, despite three decades of excellent work by researchers and practitioners in developing technologies to reduce discards throughout the world, many problems persist with high levels of unwanted and often unreported bycatch and discards in many fisheries. Of particular concern are not only the capture and mortality of threatened species, like turtles, dolphins and seabirds, but the consequences of killing and discarding huge quantities of juveniles of economically valuable fish species.

In the fisheries context, "discard" means fish that are thrown away after being taken aboard the fishing vessel or slipped from the net in the water. However, quantifying fisheries discards on a global scale is not simple either, because of incomplete information for many fisheries and countries. Nevertheless, in 1994, global discards from fishing were estimated at about 27 million tonnes.[1] In 2004, this figure was updated and revised to 7 million tonnes.[2] However, these latest estimates suffer as comprehensive and accurate data on the world's capture fisheries are not available.

In the past decade or so, many countries have increased their efforts to collect information about discards and bycatch. Many countries collect discard information on an ongoing basis in varying formats and reporting styles, some by law, some voluntarily, and there exist unprecedented numbers of observer programmes of excellent quality (well accepted as the best way of gathering discard information). Moreover, while some countries do not have observer programmes, some are about to introduce them, and virtually all have an appreciation of the need to do so. Indeed, the experience generated by recent approaches to the collection of information on discards will probably help to develop the "International Guidelines on Bycatch Management and Reduction of Discards" that FAO is currently compiling at the request of the FAO Committee on Fisheries.

However, many observers believe that to account properly for the scale and complexity of fishery discards throughout the world, it is time to introduce a global, far-reaching process along similar lines to those used to assemble and collate capture fisheries landings data.

[1] D.L. Alverson, M.H. Freeberg, S.A. Murawski and J.G. Pope. 1994. *A global assessment of fisheries bycatch and discards*. FAO Fisheries Technical Paper No. 339. Rome, FAO. 233 pp.
[2] K. Kelleher. 2005. *Discards in the world's marine fisheries. An update*. FAO Fisheries Technical Paper No. 470. Rome, FAO. 152 pp.

sustainable fashion through good governance. Means and processes of governing the sector have varied with traditions and values, which precludes a universal template, but there are enough common features for an overall lesson.[40]

One feature is the common goal that countries have pursued with aquaculture governance – sustainability of the sector. Sustainability requires environmental neutrality and social acceptability of the industry. It also requires, for the industry as a whole, revenues that, on the one hand, provide compensation for risks associated with aquaculture and, on the other, ensure long-run profitability of aquaculture activities. In practice, the governance regimes followed by different governments to achieve

sustainability of the sector are fluid, with no clear-cut demarcation between them. However, analysis of the processes by which collective action is taken and decisions are implemented reveals three main types of aquaculture governance.

At one extreme is "hierarchical governance". This is a top-down, command and control of the sector development with little or no consultation with stakeholders. Often, the authorities facilitate and formulate policies for aquaculture management and development, but leave farmers to make production decisions. The danger with this approach is that, more often than not, enforcement will be inadequate and producers non-compliant. Thus, in many cases, there has been devolution to industry, with more self-regulation using voluntary codes of practice. Governance through voluntary codes of practice obviates the need for restrictive regulations; the incentive for compliance is mutual benefits. However, with these benefits come concerns about efficiency. There are prevailing arguments that, in the absence of mandatory legal obligations (especially those that regulate access to resources and ensure environmental safeguards), self-regulation by the aquaculture industry relying on voluntary codes of practice is an ineffective form of governance.

Some countries have also adopted a "market-driven" approach to governance. With this approach, government policy is to let the private sector largely lead aquaculture development, with the government adopting a *laissez-faire* attitude. This type of governance has resulted in impressive sectoral growth. However, as exemplified by early-movers in aquaculture in many places, such policies have resulted in environmental degradation, especially in mangrove destruction in many instances, and in the near collapse of some aquaculture industries around the world. Having learned from this experience, other countries with market-driven governance now accept the need to intervene to correct market failures. They use regulations on environmental protection, fish health, and safety of aquaculture products to mitigate these failures.

Governments also attempt to achieve sustainability in aquaculture through "participatory governance". Participatory governance extends from industry self-regulation, to comanagement of the sector by industry representatives and government regulators and to community partnerships. This form of governance is increasingly becoming the norm, be it at the local, national or regional level. At the local level, neighbouring and competing farmers would work together to coordinate environmental and production measures. Compliance is enforced by peer pressure. There are instances where the industry is self-managed although some aspects such as animal welfare are comanaged; the industry undertakes most inspections, with governments checking only periodically. At the national level, codes of practice also exist as part of industry self-regulation in many countries. While most of these codes are general in scope (incorporating feed, drugs and environmental protection aspects), many are issue-specific. The incentive for farmers' self-compliance with these codes is certification of quality. However, industry organizations also have the ability to exclude those who do not comply. At the regional level, there are associations of aquaculture producers. These usually have codes of practice that may cover environmental, consumer, husbandry and socio-economic issues as well as the public image of the industry.

Where aquaculture governance has proved fruitful, it appears that governments have followed four main guiding principles, namely: accountability, effectiveness and efficiency, equity, and predictability.

Accountability means the acknowledgment and assumption of responsibility for actions, decisions, policies and products by officials. It implies greater openness of administrations, so that officials are answerable to the public and to their institutional stakeholders for their actions. It also implies performance-based standards for officials, and mechanisms for reporting, auditing and enforcement. In practice, accountability would be reflected in timely decisions and would imply stakeholder participation in decision-making processes. It would also mean that, for example, decisions on licences to farm are open to appeal and that the criteria for their granting are transparent. This would increase predictability for aquaculture producers and other stakeholders.

In simple terms, effectiveness consists of doing the right thing; it is a measure of the quality and decency of actions undertaken. Efficiency is about doing things properly,

in a cost-effective way; it measures the speed and the cost at which things are done. Effective and efficient government services have played an important role in ensuring good governance in aquaculture. However, balancing the two has not always been easy for policy-makers; yet, this balance is crucial for the development of the industry.

Equity has been critical for sustainability. A society's well-being depends on ensuring that all its members feel that they have a stake in it and are a part of the mainstream of society. This requires that all groups, particularly the most vulnerable ones, have opportunities to improve or maintain their well-being. In practice, this will mean guaranteeing procedural fairness, distributional justice and participation in priority-setting and decision-making processes to men and women alike. The sharing of power leads to equity in resource access and use.

Predictability relates to fairness and consistency in the application of laws and regulations and in the implementation of policies. In many instances, governments have ensured predictability by making credible commitments and persuading the private sector that decisions will not ultimately be reversed because of political uncertainty. This has been done through participation. By giving stakeholders a voice, stakeholders have been able to express their preferences. With predictability, farmers have been protected from arbitrary decisions and have been able to retain their produce, while property owners or users have had the right to exclude others from the property. Moreover, with predictability, property rights have become fungible, easing access to loans because farmers can use property as collateral. Such security of tenure, whether freehold or usufruct, has become an important target for government policy also because it influences investment decisions. Predictability has also worked in the reverse direction; it has reduced the risk that property be subject to arbitrary confiscation and taxation. Grounds for expropriation of land, non-renewal of licences, and taxation have become transparent.

While there have been laudable efforts throughout the sector, aquaculture governance remains an issue in many countries. There are still: (i) conflicts over marine sites; (ii) disease outbreaks; (iii) negative public perception of aquaculture in certain countries; (iv) inability of small-scale producers to meet foreign consumers' quality requirements; and (v) inadequate development of the sector in certain jurisdictions despite favourable demand and supply conditions. This last issue is likely to become more important as the world strives to feed its ever-growing population.

Experts agree that most future aquaculture expansion will occur in the seas and oceans, certainly further offshore, perhaps even as far as the high seas. However, aquaculture governance is already facing serious limitations in marine waters under national jurisdiction. Should aquaculture operations be undertaken in the high seas, the problem is likely to become a challenge as existing relevant principles of public international law and treaty provisions provide little guidance on the conduct of aquaculture operations in these waters. There seems to be a regulatory vacuum for aquaculture in the high seas.

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