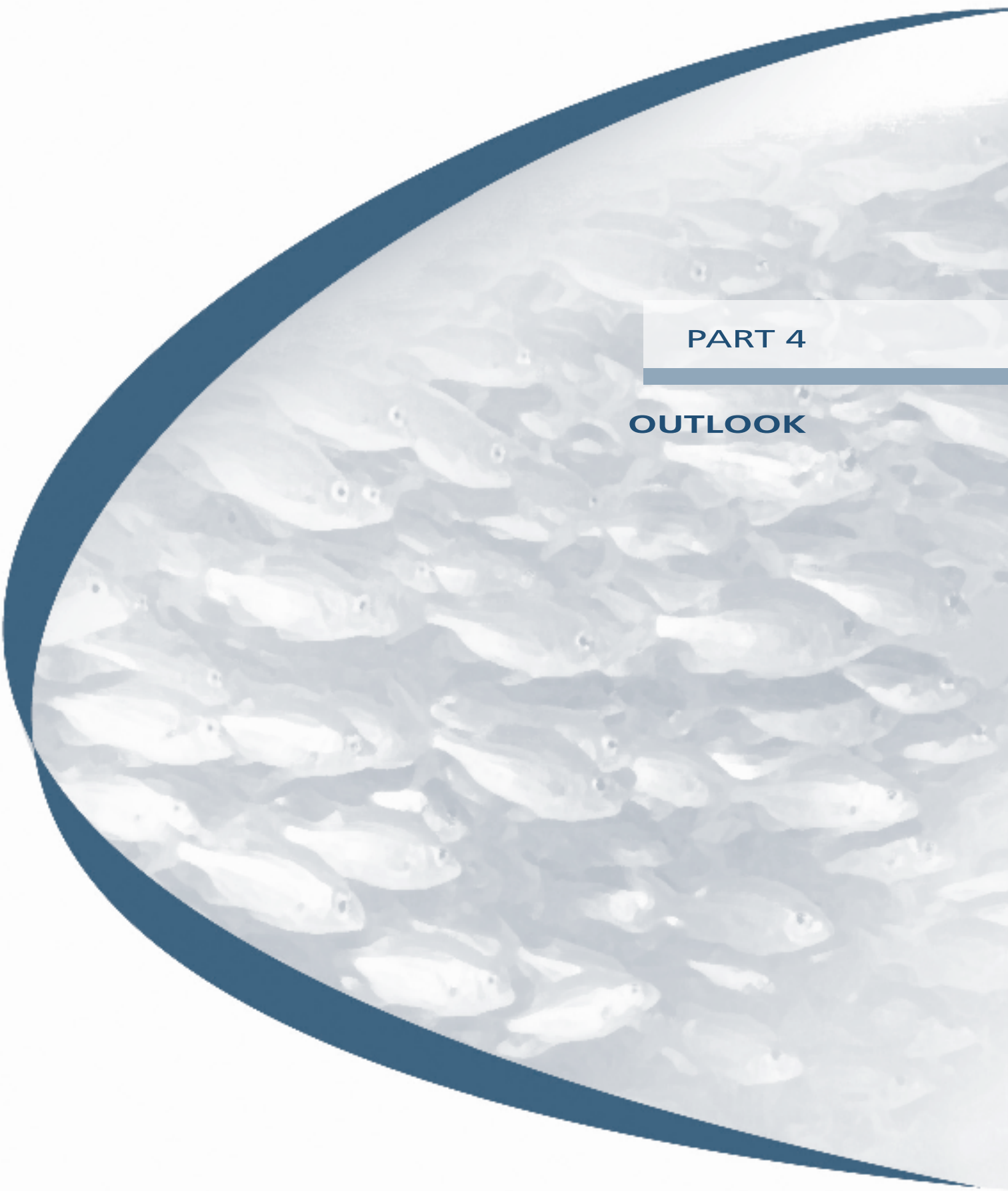

PART 4

OUTLOOK

OUTLOOK

INTRODUCTION

Will capture fisheries suffer from "implosion" – a drastic reduction in the quantity and quality of fish harvested – because fishers cannot be sufficiently restrained in their search for and capture of wild fish? Or will governments, fishers and other stakeholders manage to stop the race for fish where it still continues? Will aquaculture be stopped in its tracks because society as a whole considers its repercussions on the environment too damaging? Or, on the contrary, will "technology fixes" by aquaculture entrepreneurs and scientists remove these adverse impacts and ensure a continued rapid spread and growth of aquaculture?

No one has the exact answers. No one can predict with precision what will happen to capture fisheries or aquaculture, particularly when the question is projected several decades into the future. But, as there is inertia in human activities and evolution in nature is marked by recognizable patterns, reasonable predictions can be made – at least for the short term. In fact, those who are interested in the sector continue to produce predictions and scenarios for the future of both capture fisheries and aquaculture.

This outlook section will first discuss the next decade (the short term) and then what might happen thereafter (the medium-to-long-term perspective).

For the short term, we will review global changes in attitudes towards the production and consumption of fish and discuss their influence on the known short-term trends set by growth in population and income and by the state of marine resources.

The discussion concerning the medium-to-long term will be anchored in two computer-based simulations of the future for global fisheries and aquaculture towards the years 2010, 2015 and 2020.

THE COMING DECADE: CONSTRAINTS AND OPPORTUNITIES

Capture fisheries and aquaculture develop as fishers and fish farmers react to a continuous evolution of commercial and technical opportunities, on the one hand, and of legal and environmental constraints, on the other. The opportunities evolve as a result of modifications, *inter alia*, in the demand for fish, access to natural resources, the state of living aquatic resources, and governance and sector policies. The reactions of fishers and fish farmers will be displayed in aquaculture development strategies and in adaptations developed in a maturing capture fisheries sector. Possible trends in opportunities, constraints and the way in which fishers and fish farmers respond to them are discussed in some detail below.

Demand for fish

Demand expands as the number of consumers grows and as their incomes increase. However, demand is also modified – either increased or decreased – as consumers change their view of fish as food and modify their fish consumption patterns. Such changes occur for different reasons: they may be stimulated by commercial advertisements or occur as a result of increased knowledge of the characteristics of fish as food, or because the consumer may link consumption with environmental sustainability.

It is clear that in the short-to-medium term, demand for fish will expand as populations and incomes grow. However, this increase will be relatively slow in developed countries, probably less than 1 percent per year (in terms of quantity of fish), because populations stagnate or increase only very slowly, per capita consumption is already relatively high and consumption does not increase significantly as disposable income increases.

In developing countries, the growth will be faster because populations increase more quickly and in some countries per capita consumption figures are very low.

Growth – again in terms of quantity – could easily be double or triple that projected for the developed countries.

These trends in demand for and consumption of fish imply stability. However, this image of stability is false. The moment "fish" is no longer considered as a homogenous product, but broken down into species and types of product, records show that there have been – and are likely to continue to be – considerable short-term changes in demand for and consumption of individual species and products (see p. 38 in Part 1). Most of these changes constitute responses to short-term modifications in the availability of the fish on the market, following changes in the quantity of fish biomass available for fishing.

Discerning shifts in demand in what constitutes a complex picture of year-to-year fluctuations is complicated. However, there seems to be a consensus that some consumers, particularly in developed countries, are changing their attitudes to fish. New perceptions of the value of fish include: (i) fish is not only something to eat but something that can improve your health – a health food; (ii) eating the "correct" fish can help preserve the aquatic environment – it is an "environmentally safe" food; and (iii) fish is a luxury worth eating occasionally, in small quantities and at high prices.

These shifts in consumer attitudes do not all lead to an overall increase in the quantity of fish consumed. Their effects on consumption are not one-way. For example, new attitudes may result in an increase in the demand for fish that is considered environmentally safe, or healthy, but at the same time may also lead to reduced demand for fish that are not considered as such.

In this context modifications in the conditions governing international trade in fish are important. The progressively greater liberalization of the market is likely to add significantly to the pressure exerted on developing countries' wild fish stocks, particularly of species for which there is a high demand in the international market. As exports of such species increase, the exporting countries are likely to resort to imports of cheaper fish; as a result there will be increasing pressure not only on high-value species, but also on lower-value species in both tropical and temperate waters – globally in fact.

Access to natural resources

The trend is reasonably clear with respect to access. For fishers, access is being reduced as limitations are imposed. Imposing access limitations takes several forms in capture fisheries. Among those that are becoming increasingly common are the development and allocation of use rights (which are useful when there is not sufficient room to fish for all who want to), the imposition of access fees or equivalent, the creation of marine protected areas or equivalent, and a shift from commercial to non-consumptive users in the granting of access.

Access limitations are spreading also in aquaculture and will continue to do so. Licensing requirements, including environmental impact assessments for new facilities, will become common also in developing countries. Commercial farms for high-value finfish and crustaceans, no matter where they are located, will increasingly be faced with the limitations imposed by an almost fixed supply of low-value fish (for fattening operations), fish oil and fishmeal.

Aquatic resources

The increase, albeit slow, in the percentage of stocks recovering (whether due to improved management or climatic conditions) is encouraging, but the phenomenon is too recent for any reliable conclusions to be drawn. Improvements in governance during the last decade and the decline in long-range fleets have not yet been reflected in the global state of stocks, even though local signs in some countries indicate that improvement is possible.

Observed trends of many exploited stocks suggest a grim picture, yet the pressure on fishery resources continues to intensify (see also the section on the status of marine

fisheries in Part 1, p. 28). Analysis of trends in the average trophic levels of FAO capture fisheries production statistics revealed declining trends in most regions of the world, especially in the Northwest Atlantic. The same trends were also reflected in inland capture fisheries. Examination of the ratio of landings of predatory fish (piscivores) to landings of fish that feed on plankton (planktivores), to detect similar changes, identified the Northeast Atlantic as an area of major concern and, with the possible exception of the Eastern Indian Ocean and the Western Central Pacific, the indicators showed fully exploited ecosystems with little room for manoeuvre in all areas. It cannot be excluded that, in the coming decade, the already notable pattern of "fishing down the food chain", may worsen also in other areas of the oceans.

With regard to the potential of non-conventional species, it is evident that unless new energy-efficient methods are found to catch oceanic squid (or the international ban on large-scale pelagic driftnet fishing is lifted), most oceanic squid will remain inaccessible. It is also apparent that unless there is a substantial and sustained increase in the world price of fishmeal and fish oil, a fishery for mesopelagic species will not develop. The deliberate strategy of exploiting the lower levels of the ecosystem's trophic chain (including krill) for further fisheries expansion (to provide a doubling of the world potential harvest) implies high technology development costs and faces public concern about human competition with large cetaceans. Deep-water demersal resources, whether in exclusive economic zones or on the high seas, are unlikely to contribute substantial and sustainable catches.

Monitoring and diagnosis of the state of stocks and elaboration of management advice will continue to be blurred by exacerbated natural oscillations and climate change. Management systems will become increasingly competent in predicting change over time but, except in a few leading countries, the industry does not seem to be developing the type of responsiveness needed to adjust to systematic forecasts. As a consequence, until the ability to tune fishing capacity and removals to an oscillating environment is acquired, a proportion of stocks is bound to be accidentally overfished at all times unless management systems become highly precautionary – which represents a costly and unlikely scenario, at least in the coming decade.

The officially declared marine fisheries landings total around 80–90 million tonnes, a volume that was reached some time ago (see also the section on the status of fishery resources in Part 1, p. 28). There has been widespread agreement for some time that, taking into consideration the estimated discards (presently less than 7 million tonnes per year), the amount likely to be caught by IUU fishing and the impossibility that the production of all species can be optimized simultaneously, the most likely potential of conventional marine species remains at the same figure of 80–90 million tonnes. Recent records of catches and aquatic resource assessments do not indicate that this consensus needs to be revised.

Governance and specific sector policies

During the next five to ten years, policies specific to the fisheries sector will probably result in the continued spread of individualized use rights of fish stocks, leading to the elimination of marginal fishing enterprises. This will occur mainly in the developed economies. In addition, economic policies *vis-à-vis* the fisheries sector will become less lenient: subsidies directly linked to fisheries capacity and effort will be severely curtailed and an increasing proportion of fishers will be asked to pay for government services and possibly also to pay specific fees for the right to fish. The costs of fishing will thus increase. This will tend to eliminate marginal fishing enterprises, contribute to increases in the real price of fish and stimulate aquaculture production.

In tropical small-scale fisheries, use rights will tend to be communal – rather than individual – and associated with comanagement arrangements. This situation will constitute a governance structure that should permit the control of access in the fisheries concerned and therefore provide the legal foundation for an increase in

labour productivity (without increasing overall catches), which is needed for the sector to progress at the same pace as other sectors of the economy. Small-scale fisheries in South and Southeast Asia, and China, are likely to experience significant changes, with decreasing employment and fewer fishing vessels but increased productivity (in economic terms) for those fishers that remain. Similar developments will also start to take place during the coming five to ten years in those parts of Africa that do not suffer from civil strife.

RFBs are likely to be strengthened through the gradual delegation of members' decision-making powers in an effort to strengthen governance for the purpose of rebuilding depleted stocks, containing the overcapacity of fishing fleets and, most importantly, combating IUU fishing. They are also likely to become prime movers in extending the conventional fisheries management focus from single stocks to ecosystems (by applying the "ecosystem approach"), particularly for shared or high seas resources. Management bodies will need to understand, *inter alia*, the effects of fisheries and climatic changes on habitats and marine communities and to develop a clearer understanding of ecological interactions and the effects of discarding. As meeting these requirements will expand the need for monitoring and research, the RFBs that deal with high-value stocks, high-value fisheries or particularly vulnerable resources (e.g. coral reefs, endangered species) may be those for which the issue will take the highest priority.

Aquaculture producers worldwide will have to adjust to an increasing number of standards. These will have two principal aims: to ensure that products are good for the health of the consumer and to minimize the environmental impacts of the production technologies used. The rules, or guidelines, will be harmonized in order to facilitate international trade. In return, the aquaculture sector will obtain stronger legal recognition.

With regard to a legal framework for controlling and limiting environmental impacts, the coming decade will probably see increasing and stronger attempts to limit the introduction of exotic species. Also, stakeholders will develop policy frameworks to guide the use of genetically modified aquatic organisms. As aquaculture becomes more prevalent, countries will find that they need to develop integrated aquatic animal health programmes that are able to provide routine fish health services to the aquaculture industry.

Adaptations to obstacles and opportunities in capture fisheries

Capture fisheries are no longer expanding in terms of number of fishers and vessels. The industry is consolidating and maturing as obstacles grow and opportunities diminish. For many fishers, the main obstacle is reduced access to resources. Most countries have completed the domestication of fisheries in their exclusive economic zones, which means that there are now few new frontiers to conquer for fishery entrepreneurs. High seas fisheries are capital-intensive and, for species other than pelagic species, their sustainability is far from certain. So most fishers and fishing enterprises are faced with fisheries that have reached exploitation levels at, or even beyond, what is sustainable. In order to improve their earnings, therefore, they need to catch the same quantity of fish but incurring lower costs or selling to markets that pay better; alternatively, they need to catch more fish, but by doing so will then displace other fishers.

At the same time, the industry is aging – particularly in developed countries. In OECD economies, the average age of fishers is increasing, largely because old fishers are leaving the profession more quickly than they are being replaced. There seem to be several reasons for this: unattractive working conditions, the high level of exploitation of stocks and the associated possibility that the authorities will enforce policies leading to fewer actively employed fishers.

However, a declining number of fishers, coupled with growth in productivity per fisher, are in fact preconditions for the continued economic viability of capture fisheries

in advanced economies. So although the average age of fishers and vessels may still remain high and may even increase further, the continued viability will make possible an inflow of new vessels and younger fishers (an increasing share of these will be migrant labour), permitting fisheries to continue producing at present levels also in developed economies during the coming decade. In number terms, this inflow of new fishers and vessels will not compensate for the decommissioning of old vessels and existing fishers going into retirement.

This development is illustrated by what is happening to the fleet above 100 GT (or 24 metres LOA), which totals 24 000 vessels. In 2004, the vessels that were more than 30 years old accounted for 35 percent of the fleet, or slightly more than 8 700 vessels, up from 6 percent or 1 400 vessels in the early 1990s. Most of these 8 700 vessels are likely to cease operating within the next ten years (an average of 870 vessels per year). Constructions of new large vessels were taking place at the rate of 300 vessels per year at the beginning of this decade. If vessels lost in accidents are also taken into account, it seems likely that the fleet of vessels larger than 100 GT could decrease by some 600 vessels per year in the short term. However, because new vessels, even at equal size, are so much more efficient than the vessels they replace, it is certain that the fishing capacity of the fleet will not decline at the same rate.

In developing economies, economic growth will create an opportunity for artisanal and small-scale fishers to specialize and graduate from a subsistence mode of operation to one that is entrepreneurial. This will occur as markets and employment opportunities change. Economic growth will generate more urban and third-sector employment, which will lead to a reduction in the number of individuals who engage in part-time and occasional fishing, so leaving more resources for the full-time fishers to exploit. As comanagement develops and becomes increasingly common, the incidence of overexploitation will decrease and fisheries will become sustainable. Urban growth will generate a larger market for fish. This will lead to increased internal sales, growing imports of cheaper frozen and canned products, as well as imports of highly priced fish.

Adaptations to opportunities and obstacles in aquaculture

As real wages increase in China, and in South and Southeast Asia – where some 90 percent of world aquaculture output (in terms of quantity) is now produced – aquaculture production, and associated capital and technical know-how, will spread to Africa and Latin America in search of lower overall costs of production.

Fish constitute a significant part of world food supplies, accounting for some 16 percent of all animal protein consumed. However, as mentioned earlier, fish is made up of a very large number of species and products. This presents both opportunities and obstacles for aquaculture development.

It is an opportunity for the entrepreneur who is willing to develop a new "aquaculture" product. As so many markets exist for different fish products, all he or she has to do is to select one of these and produce the product through culture rather than through capture. The obstacle in this case is that once the entrepreneur has entered the market there will be natural limits to that market. It will be difficult to sell cultured quantities that are several times those of the traditional capture fisheries market without having an impact on price.

Thus the search for new – preferably high-value – species to culture will continue and no doubt some successes will be achieved before 2015.

Strategies aiming to promote offshore aquaculture will also continue. It is natural that such culture methods will be developed in industrialized economies where labour is costly and environments strongly protected. In those developing countries that do not already have well-established aquaculture sectors it is likely that aquaculture will start, as it has in most countries, by the spread of inland fish culture subsequently followed by coastal aquaculture.

2015 AND BEYOND: FUTURE SCENARIOS FOR WORLD FISHERIES AND AQUACULTURE

This section will briefly describe and compare two recently completed studies of the future for world fisheries and aquaculture. The two studies, undertaken by FAO and by IFPRI,[90] use quantitative computer-based simulations to project the future in 2015 and 2020. These quantitative projections will then be compared with projections reported in *The State of World Fisheries and Aquaculture 2002*.

Future prospects for fish and fishery products: medium-term projections to the years 2010 and 2015 (FAO study)

The FAO study has three analytical steps: it projects demand for fish based on specific assumptions for population and macroeconomic growth and assumes constant relative prices among substitutive commodities; it projects supply also on the basis of unchanged real prices; and it then makes world supply and demand meet by modifying prices.

Demand for fish as food and feed

World total demand[91] for fish and fishery products is projected to expand by almost 50 million tonnes, from 133 million tonnes in 1999/2001 to 183 million tonnes by 2015. This represents an annual growth rate of 2.1 percent compared with 3.1 percent during the previous 20 years. Demand for food would account for 137 million tonnes. The world average per capita demand for all seafood could amount to 18.4 kg in 2010 and 19.1 kg in 2015, compared with 16.1 kg in 1999/2001. This increase in demand implies an 18 percent increase over the next 15 years compared with a 40 percent increase over the previous 20 years. Per capita demand for finfish would account for 13.7 kg in 2010 and 14.3 kg in 2015, respectively, while demand for shellfish and other aquatic animals would be 4.7 kg and 4.8 kg, respectively.

Of the total increase in demand for food (some 40 million tonnes) about 46 percent would result from population growth, while the remaining 54 percent would be caused by economic development and other factors.

World fishmeal and oil demand is projected to grow by only 1.1 percent (from 2000 to 2010) and 0.5 percent (from 2010 to 2015) annually.[92] While the demand for fishmeal in developed countries is projected to decrease annually by 1.6 percent, the yearly growth of demand for fishmeal in developing countries would be 2.6 percent until 2010 and 1.4 percent thereafter. The amount of fish required to meet the global demand for fish for reduction to meal and for other non-food uses would total some 45 million tonnes in 2015.

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[90] FAO, 2004. *Future prospects for fish and fishery products: medium-term projections to the years 2010 and 2015*. FAO Fisheries Circular FIDI/972-1. Rome. (In press); IFPRI. 2003. *Fish to 2020: supply and demand in changing global markets*, by C. Delgado, N. Wada, M. Rosegrant, S. Meijer and M. Ahmed. International Food Policy Research Institute (IFPRI), Washington, D.C.

[91] Owing to a generalized lack of data, it was not possible to include prices directly in the determination of future demand levels because medium/long-term price projections for fish and other competing commodities are not available. The FAO Food Demand Model (FDM) was used to make projections on the initial assumption of constant relative prices. Implications for price changes were derived by comparing the constant-price projections of supply and demand using a simple market-clearing model. The FDM makes projections of per capita and total demand for all commodities entering a country's diet, starting from basic assumptions on the growth of population and the gross domestic product (GDP), as a proxy for disposable income. The population forecasts for individual countries are based on the latest UN population projections (medium-fertility variant). The assumptions on GDP growth are those used for the FAO study *Agriculture: towards 2015/2030,* which, in turn, are based on the latest UN economic forecasts extrapolated to the year 2015. It should be noted, however, that the currently prevailing international conditions may slow down the rates of economic growth for many countries at least during the initial years of the projection period.

[92] Demand projections for fishmeal are based on the foreseen expansion of aquaculture and of the broiler and pig weaning industries (derived from the most recent FAO projections) as well as on expected change in the price ratio between fishmeal and its close substitutes.

Prospects for fish production

Total world fish production would increase from 129 million tonnes in 1999/2001 to 159 million tonnes by the year 2010 and to 172 million tonnes by the year 2015.[93] This means that growth in global world fish production is projected to decline from the annual rate of 2.7 percent of the past decade to 2.1 percent per year between 1999/2001 and 2010 and to 1.6 percent per year between 2010 and 2015. World capture production is projected to stagnate, while world aquaculture production is projected to increase substantially, albeit at a slower rate than in the past.

Out of the expected increase of 43 million tonnes in global fish production from 1999/2001 to 2015, 73 percent would come from aquaculture, which is projected to account for 39 percent of global fish production in 2015 (up from 27.5 percent in 1999/2001).

The share of pelagic species in total fish output would decline from 30.8 percent in 1999/2001 to 24.5 percent by 2015. Similarly, the share of demersal fish would shrink from 16.2 percent to 12.7 percent. By contrast, the share of freshwater and diadromous fish would increase from 23.7 percent in 1999/2001 to 29.3 percent by 2015, and that of crustaceans, molluscs and cephalopods would rise from 20.5 to 25.6 percent during the same period.

Prospects for trade and implications for prices

A comparison of the supply and demand projections for fish and fishery products shows that demand would tend to exceed potential supply. The deficit for all types of fish combined would amount to 9.4 million tonnes by 2010 and to 10.9 million tonnes by 2015. The deficit will not materialize as the market will be re-equilibrated, on the one hand through relative price rises and shifts in demand among different types of fish and fish products and, on the other, through shifts in demand towards alternative protein foods.

To simulate the market-clearing effect of price changes, the World Price Equilibrium Model was applied.[94] According to the projections, the prices for all types of fish would increase in real terms by 3.0 percent and 3.2 percent by the years 2010 and 2015, respectively. Increases in real prices will have severe effects on low-income consumers. As a result of the price rise, world consumption of all types of fish would be 165.2 million tonnes by 2010, which is 3.1 million tonnes lower than the projected demand at constant relative prices. Similarly, overall consumption of fish by 2015 would be 179.0 million tonnes, corresponding to a reduction of 3.8 million tonnes in demand. On the other hand, world supply of all types of fish, stimulated by higher prices, would increase by 6.3 and 7.1 million tonnes, respectively, at the end of the two projection periods.

The study indicates that developing countries as a whole would increase their net exports of fish and fishery products from 7.2 million tonnes in 1999/2001 to 10.6 million tonnes by 2010, but they would slightly reduce their net exports to 10.3 million tonnes by 2015, mainly in response to increased domestic demand. On a regional basis, Latin America and the Caribbean would continue to be large world net exporters of fish and Africa, which was a marginal net importer of fish in 1999/2001, would become a net exporter by 2010. Asia is expected to reduce slightly its net imports from 5.1 million tonnes in 1999/2001 to 4.8 million tonnes by 2015. In contrast with this trend, China, projected to be a net importer at constant relative prices, is expected to become an exporter of fish by 2015, mainly because of the continuing expansion of its aquaculture output.

[93] The production projections were made for each country or group of countries fitting different types of regression functions to the historical data for 1980–2001 separately for capture fisheries and aquaculture and for major species groups.

[94] The model assumes that a world average market price exists for all types of fish and that its movements are transmitted to domestic prices. This effect is simulated through the application of selected price elasticities of supply and demand for each country or group of countries. The model eliminates imbalance between supply and demand through a market-clearing iteration process (Newton method), which determines the price level at which supply and demand are in equilibrium. At the country level, the difference between supply and demand represents net trade. Changes in world market prices are in turn transmitted to domestic prices.

Developed countries would reduce their current net imports of fish and fishery products from 11.3 million tonnes in 1999/2001 to 10.6 million tonnes by 2010 and to about 10.3 million tonnes by 2015. On a regional basis, North America is likely to increase its net imports from 1.7 million tonnes in 1999/2001 to 2.4 million tonnes by 2015. Western Europe is predicted to reduce its net import from the current level of 2.6 million tonnes to about 0.2 million tonnes by 2015. Other developed countries, notably Japan, are projected to maintain approximately their current level of fish imports.

Conclusions: supply and food consumption

According to the projections there would be a global shortage of supply of fish in future. Although the severity of the shortage would differ among countries, the overall effect would be a rise in the price of fish. Prices for all types of fish would increase in real terms by 3.0 and 3.2 percent by the years 2010 and 2015, respectively.

At world equilibrium prices, growth in world fish production is projected to slow down from the rate of 2.9 percent per year recorded during the past two decades to 2.1 percent per year between 1999/2001 and 2015. Global fish production in developing countries is projected to grow at 2.7 percent per year during the projection period, which is at half the rate recorded, on average, during the past two decades. In these countries, capture fisheries are expected to grow at only 1 percent per year. Therefore, most of the increase would come from aquaculture, which is expected to grow at 4.5 percent per year. The share of developing countries in world fish production is expected to increase from 75 percent in 1999/2001 to 81 percent by 2015. Total fish production in developed countries would only grow at 0.3 percent per year; this, however, represents an improvement with respect to the negative growth experienced during the past two decades. As a result, the share of developed countries in total world fish production is expected to fall from about 25 percent to 19 percent by 2015. Capture fisheries production in developed countries is expected to stagnate or even decline in absolute terms during the projection period.

On average, people will be consuming more fish in 2015, but increases henceforth are likely to accrue more slowly than in the past two decades. At equilibrium prices, global per capita fish consumption would increase at an annual compound rate of 0.8 percent from 1999/2001 to 2015, down from the rate of 1.5 percent achieved over the past 20 years. Developing countries would lead with per capita demand growth projected at 1.3 percent per year, while per capita demand would decrease yearly, on average, by 0.2 percent in developed countries.

Fish to 2020: supply and demand in changing global markets (IFPRI study)

The IFPRI study projects supply, demand and trade of fish from 1997 to 2020 in response to different policy and environmental scenarios for the fish sector. The study, which draws on FAO statistical databases, was carried out under six scenarios,[95] using IFPRI's IMPACT model[96] modified to deal with food fish. This summary discusses two of these scenarios: the baseline scenario and the one described as "ecological collapse".

Fish production

Food fish production is projected (under the base scenario) to increase globally by 40 percent to 130 million tonnes by 2020, at an average annual rate of 1.5 percent (1.8 percent in developing countries, including China, or 1.6 percent excluding China; 0.4 percent in developed countries). The average annual growth rate for capture

[95] (1) Base scenario with most plausible assumptions about population and income, policy decisions, technology, and other factors; (2) aquaculture expansion 50 percent faster than baseline scenario; (3) lower Chinese production; (4) fishmeal/oil conversion efficiency increasing twice as fast as in base scenario; (5) slower aquaculture growth (technological advance 50 percent of baseline scenario); (6) ecological collapse (exogenous declining trend of 1 percent applied to wild commodities, including fishmeal and fish oil).

[96] International Model for Policy Analysis of Agricultural Commodities and Trade.

fisheries and aquaculture are projected to be 0.7 and 2.8 percent, respectively, with a lower rate of growth (0.7 percent) for capture fisheries in developed countries, compared with developing countries (1.0 percent). About 73 percent of the total increase in food fish production by 2020 will come from developing countries (compared with 73 percent in 1997). Aquaculture will contribute 41 percent of food fish supplies (54 million tonnes), and the share of low-value food fish in total food fish production will remain stable at 48 percent. Increased investment in aquaculture and its accelerated pace of expansion will significantly increase production. Under the ecological collapse scenario, increased aquaculture production moderates the decline in production of food fish to 17 percent.

Fish consumption

Consumption of low- and high-value commodities will increase in developing countries (in the baseline scenario) by 1.9 percent annually, or by 2.0 percent if China is included, while remaining static in developed countries (0.2 percent) and sub-Saharan Africa. In this scenario, the global annual rate of increase in consumption, during the period 1997–2020, is projected to be about 1.5 percent. Per capita consumption of molluscs and crustaceans would increase most rapidly (1.0 and 0.7 percent annually, respectively), while that of high-value finfish is projected to decrease. Lower production by China reduces consumption by 1 kg, mainly due to the impact within China, with little effect on consumption and world prices of fish outside the country. Faster expansion of aquaculture would increase per capita food fish consumption by 1.9 kg in the baseline scenario. Under the ecological collapse scenario, per capita consumption would decline only from 17.1 kg (with the baseline scenario) to 14.2 kg, due to the moderating influence of higher prices on demand pressure, and of increased aquaculture production on supply.

Fish prices

The study indicated that fish prices would probably continue to increase during the coming two decades. Under the more likely baseline scenario, increases of 15 percent are projected for high-value finfish and crustaceans and 18 percent for fishmeal and fish oil, while molluscs and low-value fish are forecast to have significantly lower but still positive (4 percent and 6 percent, respectively) real price appreciation. This is in contrast with other food commodities, which show almost uniform price declines. Fish is projected to become 20 percent more expensive than other meat sources. Fishmeal and fish oil prices increase under several of the scenarios, more than doubling (+134 and 128 percent, respectively) under combined ecological collapse and increased demand from aquaculture. Rapid aquaculture expansion, while putting pressure on fishmeal and fish oil prices (+42 percent), is projected to reduce real prices of low-value food fish (–12 percent), suggesting that investment in the efficiency of related production systems would put these commodities within the reach of more poor people. Predictably, improved conversion efficiency would reduce the price of fishmeal (–16 percent) and fish oil (– 6 percent), implying that the culture of carnivorous species would benefit from research to this end. Slower aquaculture growth would lead to significant price increases for all food fish commodities (+19–25 percent range), underlining the market impact of aquaculture in the face of level supplies from capture fisheries.

World trade

With regard to net international trade, the growth rate of consumption (under the base scenario) will exceed that of production by 0.2 percent per year to 2020 in developing countries (0.3 percent excluding China), resulting in reduced net exports from developing countries (excluding China) to developed countries (5 percent of food fish production, compared with 11 percent in the late 1990s). China, India and Latin America are projected to be net exporters, but only Latin America will export a significant portion of its production. Developing countries will continue to be net

importers of low-value food fish and net exporters of high-value food fish, although many will begin to import high-value commodities also, thus driving a likely increase in South–South trade.

Conclusions

The quantitative outlook developed in the IFPRI study reinforces five major structural shifts that are already underway, but will become more pervasive between now and 2020.

1. Developing countries (particularly Asian countries) will dominate food fish production, from both capture fisheries and aquaculture. Stocks that are not fully exploited will be fished more heavily.
2. South–South trade will increase with the emergence of urban middle classes. Domestic producers in developed countries will gradually leave the sector, and policy in these countries will probably come to favour import-friendly regimes for fish. Fish will become an increasingly high-value commodity and the shift, in traded products, from frozen low-grade whole fish to value-added products will continue.
3. Environmental controversy will continue: sustainability concerns will increase and motivate environmental regulations and institutions, first in developed countries and then in developing countries. Overfishing will remain a major

Box 12

Fish consumption to 2030[1] in the European Union

FAO has commissioned a study on the long-term projections for fish consumption in the EU. The study indicates that, compared with 1998, per capita fish consumption[2] in the EU-25 countries[3] during the period 2005–30 will show an increasing trend (varying from 1 to 12 percent) in 19 countries[4] and a decreasing trend (from 1 to 4 percent) in 6 countries.[5]

General consumption trends for the pre-2004 EU-15 countries reflect an increase in the consumption of seafood products. This rise is supported by an increase in the consumption of convenience products. Frozen products tend to be on a downward trend, while the consumption of fresh fish will stagnate or decrease. The rising share of supermarkets in the retail of seafood products will also increase their availability, leading to increased consumption, while growing consideration of the health benefits of seafood may further fuel the positive trend in consumption.

Improvement of economic conditions is the main force behind the increased per capita consumption in the new member countries. Frozen fish still represents the bulk of fish consumption but the variety of species in this group will increase, with small pelagic species losing ground to demersal or other more exotic species such as crustaceans, molluscs or cephalopods. Freshwater fish will gradually be replaced by marine species, as the latter are often easier to prepare, offer wider variety in terms of taste and are becoming increasingly available owing to the spread of supermarkets.

The increase of the net supply will be possible because of a rise in imports from third countries (mainly Asian, African and South American countries) and an increase of aquaculture production in some countries

concern, and the use of pelagic stocks for fishmeal and fish oil will become an important policy issue. The link between pollution and food safety in the fish sector, including pollution sources outside the sector, will receive more attention worldwide.

4. Fisheries and aquaculture technology will address new challenges in both the North and South: reducing fishmeal and fish oil requirements in aquaculture; reducing and mitigating the environmental impacts of intensive aquaculture; finding alternatives to food safety regulations requiring capital-intensive, scale-sensitive approaches to compliance; and utilizing information technology for improved fisheries management.
5. Institutional development in the sector will be necessary for reducing poverty through fisheries and aquaculture development, as it will be for improving environmental sustainability and food safety.

Comparison of the IFPRI and FAO studies and earlier projections

Do the two studies discussed above point towards the same future for fisheries and aquaculture? The answer is yes, but there are significant differences.

The differences relate to the total volume produced and consumed, to the relative roles of capture fisheries production and aquaculture and to the trend in real prices for fish.

(Greece, Spain, Norway and the United Kingdom). The addition of new countries to the EU will increase intra-European trade: firstly, because a large proportion of external European trade is currently between Western countries and Eastern and Northern countries; secondly, as a consequence of the relocation of Western plants to newly joined Eastern countries such as Poland or the Baltic States; and, thirdly, because of a reduction of re-export mechanisms among Western countries. In the same vein, decreasing trade barriers and improvements in the quality of processed fish products from developing countries will lead to restructuring within the European processing industry.

[1] The projections of future fish consumption are based on assumptions derived from past trends, literature review and expert consultations. More than 1 200 assumptions were made for growth rates in capture fisheries, aquaculture, commodity production, and imports and exports of commodities. For capture fisheries, it is likely that the European vessel production will face zero growth up to 2030. Aquaculture is growing at a substantial rate for salmon, sea bass and sea bream, but environmental constraints, coastal zone occupation choices by civil society and health regulations will not allow fish farming to continue its exponential trends in the future.

[2] Total apparent consumption (net supply for human consumption) divided by the number of inhabitants of a country.

[3] Austria, Belgium-Luxembourg, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

[4] Austria, Belgium-Luxembourg, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Malta, the Netherlands, Poland, Slovakia, Slovenia and the United Kingdom.

[5] Cyprus, Estonia, Ireland, Portugal, Sweden and Spain.

The FAO study is more optimistic in terms of fish supplies and consumption. It foresees total production to have reached 179 million tonnes in 2015, while the IFPRI study in its base scenario foresees a lower production – 170 million tonnes – by 2020. It is only to be expected, therefore, that the FAO study foresees a lower increase in real prices (about 3.2 percent by 2015) than does the IFPRI study (between 4 and 15 percent, dependent upon species category, by 2020).

Also, the IFPRI study expects capture fisheries landings to expand significantly, while the FAO study is much more cautious in this respect. The IFPRI study foresees capture fisheries production amounting to 116 million tonnes in 2020, while the FAO study only expects capture fisheries to contribute some 105 million tonnes in 2015.

The most dramatic difference, however, is with respect to aquaculture production. IFPRI expects only about half the growth foreseen in the FAO study. By 2020, IFPRI expects aquaculture to contribute – under its base scenario – 54 million tonnes (an increase of 18 million tonnes over the amount provided in 2000), while the FAO study expects a contribution of 74 million tonnes already by 2015 (38 million tonnes more than produced in 2000).

The models used by FAO and IFPRI to simulate future scenarios have important similarities. They both use international trade as the mechanism through which to equalize world supply and demand for fish, and they both consider plausible developments in industries producing close food substitutes. The fundamental reasons for the differences in results, therefore, are most likely to be found in the basic assumptions used. Three seem to be of particular importance: they concern sensitivity to prices, the physical possibility of increasing capture fisheries production and the "reactivity" of aquaculture to developing opportunities.

The FAO study assumes that consumers will respond immediately (elastic demand) to small increases in real prices by reducing their consumption. However, as aquaculturists are quick to respond to the opportunities created by price increases – and growing demand even at unchanged prices – in the FAO study, consumers will not be forced by the market to reduce their fish consumption much below the quantity they would have wished to consume under unchanged real prices. The study does not assume that capture fisheries will be in a position to deliver major increases in output.

The IFPRI study is much more cautious about the possibility of aquaculture increasing production rapidly. Therefore, it also does not expect that the fisheries sector as a whole will be able to expand output as rapidly as does the FAO study, in spite of the fact that the IFPRI study is much more optimistic about the increase in landings from capture fisheries.

The forecast contained in *The State of World Fisheries and Aquaculture 2002* (SOFIA 2002) falls within the range of forecasts of the IFPRI study. The SOFIA 2002 production forecasts for 2020 (total, used for human consumption, and aquaculture) are at the high end of the forecasts contained in the IFPRI study, that is the SOFIA 2002 forecasts fall between those of the FAO study (summarized and commented on above) and the IFPRI study. As can be expected, SOFIA 2002 is also more pessimistic regarding capture fisheries production than is the IFPRI study (Table 16).

A common denominator for these studies is that the world should not have to face any shortage of fish supplies in the next three decades and the impact on prices will be minimal. In concrete terms, this means that per capita supplies will be maintained, and are even likely to grow. Supplies will increase substantially thanks to sustainable aquaculture development combined with sustained capture fisheries production, mainly from the oceans.

The simulations provide an image of gradual and uniform evolution of the sector. Unfortunately, this is not likely to be an accurate reflection of the future for world fisheries and aquaculture. Despite the tendency of globalization to lead to uniformity, the future fisheries world could be expected to remain diversified in terms of performance, within the range outlined below.

1. Areas of significant progress in countries with sufficient economic and institutional capacity (policy-reformed countries). Fishing capacity will be

Table 16
Comparisons of simulation results

Information source	Simulation target year					
	2000	2010	2015	2020		2030
	FAO statistics[a]	SOFIA 2002[b]	FAO study[c]	SOFIA 2002[b]	IFPRI study[c]	SOFIA 2002[b]
Marine capture	86	87		87	–	87
Inland capture	9	6		6	–	6
Total capture	95	93	105	93	116[2]	93
Aquaculture	36	53	74	70	54	83
Total production	131	146	179	163	170[3]	176
Food fish production[1]	96	120		138	130	150
Percentage used for food	73%	82%		85%	77%[4]	85%
Non-food use	35	26		26	40[5]	26

Note: All figures – other than percentages – are in million tonnes and rounded.
[1] Aquatic animals other than reptiles or mammals, excluding quantities reduced in fishmeal and oil.
[2] Calculated by the authors from total production minus aquaculture.
[3] Calculated by the authors by adding food fish to fishmeal production.
[4] Calculated by the authors by comparing food and non-food use.
[5] Calculated by the authors by multiplying fishmeal production forecasts by five.
Sources:
[a] Based on latest statistics of the FAO Fishery Information, Data and Statistics Unit.
[b] FAO. 2002. *The State of World Fisheries and Aquaculture 2002*. Rome.
[c] Op. cit., footnote 90, p. 146.

reduced significantly, stocks will rebuild (although not always as planned) and environmental impacts will be reduced. Catches will decline in weight but increase in value. A number of fishers will be redirected to other forms of livelihood.

2. Areas of stagnation or "controlled" degradation, where economic means and political will follow the "too little, too late" principle. Rebuilding will be uncertain and chaotic, and strongly dependent on natural oscillations. Overcapacity will remain rampant. Catches will stagnate or drop progressively (with some possible collapses) and the catch quality and value will continue to decrease. Fishers' livelihoods will hover around non-sustainability, with acute crises and temporary periods of remission.
3. Areas of governance collapse, where for reasons largely external to fisheries (e.g. droughts, wars) pressure on resources will escalate, pushing more fisheries towards rapid decline and, possibly, collapse. Catches will definitively decline in quality and value. Fishing communities will face repeated crises and the disappearance of their livelihoods.

THE STATE OF WORLD FISHERIES AND AQUACULTURE

2004

Fisheries continue to receive increasing attention not only because they represent an important source of livelihoods and food but also because of their contribution to increasing our understanding of the vast aquatic ecosystem – a strong concern of civil society at large. *The State of World Fisheries and Aquaculture 2004* concludes that developments in world fisheries and aquaculture during recent years have continued to follow the trends that were already becoming apparent at the end of the 1990s: capture fisheries production is stagnating, aquaculture output is expanding and there are growing concerns with regard to safeguarding the livelihoods of fishers and the sustainability of both commercial catches and the aquatic ecosystem from which they are extracted.

The report provides a comprehensive overview of these develop-ments and discusses several issues confronting fishers and fish farmers worldwide: the recovery of marine fish stocks, the man-agement of deep-water fisheries and the sustainability of capture-based aquaculture. Other questions of global significance are raised in the report, *inter alia*, the impact of trawling on benthic habitats, the amount of fish discarded in marine fisheries globally, and the measurement of fishing capacity. Consideration is also give to how freshwater fisheries in southern Africa could be managed sustainably while respecting the social and economic importance of these fisheries. *The State of World Fisheries and Aquaculture 2004* concludes with some views on the potential for fisheries and aquaculture as a source of food in the coming three decades.

Includes the third edition of the *FAO World Fisheries and Aquaculture Atlas* CD-ROM, a comprehensive and global view of both capture fisheries and aquaculture (available in English).

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