

## Chapter 8

# Fish and Seafood<sup>1, 2</sup>

## Market situation

The fish market is adjusting to recent supply and demand imbalances which have caused price fluctuations. The uncertain demand in many developed countries, representing the main importers of fish for human consumption, has encouraged exporters to develop new markets in a number of emerging economies that still show healthy demand. After a period of strong growth in 2011 and early 2012, the fish sector experienced a slower expansion. Preliminary data indicate that total fishery production continued to rise in 2012 setting a new record at 157 Mt, due to a 6% rise in aquaculture production over 2011. Subsequent to the 5% increase experienced in 2011, capture fisheries declined by more than 3% in 2012 due to lower catches of anchoveta in South America. These reduced catches also triggered a decline in fishmeal and fish oil production with subsequent strong price increases, negatively affecting poultry, pig and fish producers reliant on these products as feed ingredients.

During 2012, the value of trade set a new record at more than USD 129.3 bn, but it was only a modest increase over 2011 (+1.5%) as international prices of fish and fishery products for human consumption have been under downward pressure in 2012. This was due to farmed fish species, while prices of captured fish have increased. The price dip was the result of a reduced consumer demand in many key markets. These tendencies were reflected in the FAO Fish Price Index, which shows international fish prices sliding by almost 6% in 2012 compared to 2011 for total fisheries products, but by more than 17% if taking into account only farmed fish.

## Projection highlights

- The fish market outlook for the decade ahead reflects the response to growing production costs in a context of steady demand, particularly from developing countries. Higher nominal prices are expected for fish, fishmeal and fish oil.
- World fisheries and aquaculture production is expected to reach about 181 Mt by 2022, a 18% growth compared to the 2010-12 base period. Most of the production gains will come from aquaculture, which will increase by 35% over the Outlook period. However, aquaculture production growth is anticipated to slow to 2.4% p.a., compared to 5.9% for the previous decade.
- During the Outlook period, the annual growth rate of fish consumption will slightly decelerate (from 1.8% to 0.6%) due to higher fish prices and a slowing of population growth. Additional fish consumption expansion will mostly originate from developing countries, which will also continue to dominate production and exports.

## Market trends and prospects

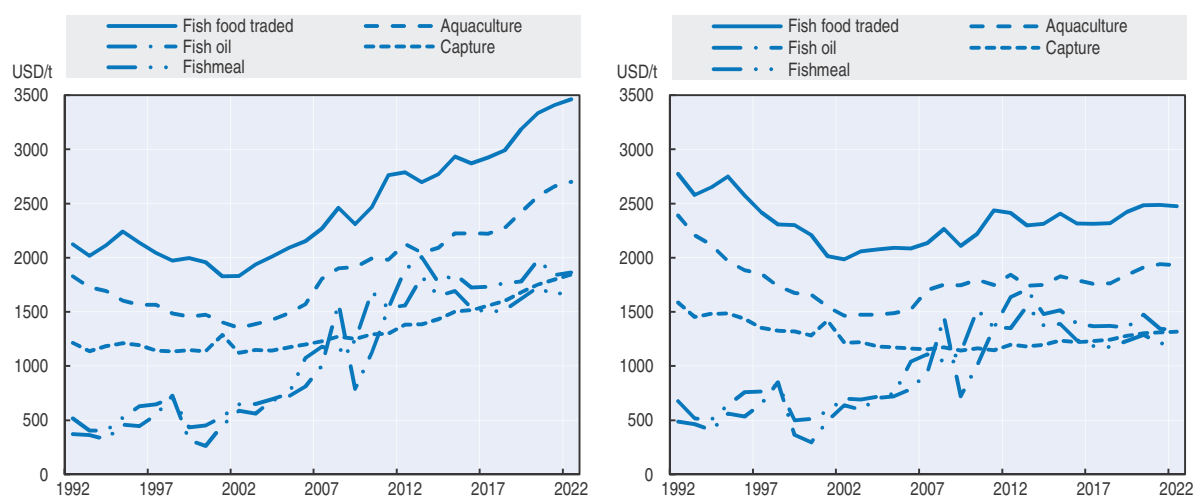
### Prices

The fish sector is expected to enter into a decade of higher prices and production costs, with fisheries prices projected to increase over the medium term in nominal and real

terms (Figure 8.1). This tendency will be the outcome of several factors affecting the underlying positive trend in demand, such as income and population growth, increasing meat prices and a generally weak US dollar. As well there are supply reducing factors such as, a limited potential for increased capture fisheries production and cost pressure from some of the most important input factors such as energy, fishmeal, fish oil and other feeds (crucial ingredients for fed aquaculture species). The average price for capture fisheries landings (excluding fish for reduction) should increase faster than for fish raised in aquaculture (39% versus 33%) during the Outlook period. However, the overall price of fish caught in the wild will remain lower than that for farmed fish, partially explained by the increasing share of lower value fish in overall catches.


Figure 8.1. **World prices in real terms expected to remain high**

Nominal (left figure) vs real (right figure) fish prices



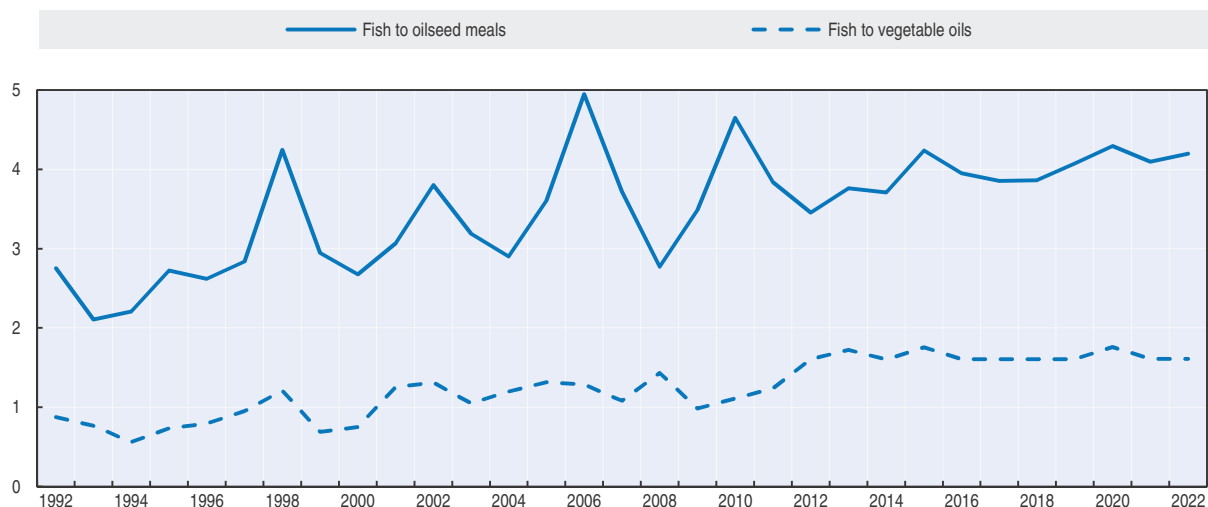
Note: Fish food traded: world unit value of trade (sum of exports and imports). Aquaculture: FAO world unit value of aquaculture fisheries production (live weight basis). Capture: FAO estimated value of world ex-vessel value of capture fisheries production excluding for reduction. Fishmeal: 64-65% protein, Hamburg, Germany. Fish oil: any origin, N.W. Europe.

Source: OECD and FAO Secretariats.


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Driven by stronger global demand than supply, prices of fishmeal and fish oil will continue to increase in nominal terms between the 2010-12 base period and 2022, by 6% and 23%, respectively. However, since prices of fishmeal are starting from very high levels, a small decline is expected in selected years of the Outlook. Real prices are expected to weaken, while remaining at a higher plateau in historical terms. The tight supplies of fishmeal and fish oil are expected to contribute to an increase in the price ratio between fish and oilseed products over the medium term. In the case of meal, the expected rise in the price ratio is due to the persistent preference for fishmeal in certain stages of animal rearing (e.g. for pigs and salmon). The price ratio of fish oil to oilseed oils is also expected to increase because of the growing demand for the omega 3 fatty acids contained in fish oil (Figure 8.2). This growth in the price ratios will be exacerbated in *El Niño* years (assumed in the model for 2015 and 2020<sup>3</sup>), which will further constrain supply and support higher prices. This climatic phenomenon reduces production of fishmeal and oil derived from anchoveta and other species in the affected region.

Figure 8.2. **Price ratios between fish and oilseeds expected to increase**  
Ratio



Source: OECD and FAO Secretariats.

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Coarse grains and fishmeal are both used as ingredients for raising fed aquaculture species. The price ratios of aquaculture species relative to those two important feeds have been on a downward trend at least since 1990. Before 2006 this was due to the strong growth in productivity of the aquaculture sector. After 2006 the decline was also due to the passage of feed prices to a higher plateau. This structural change affected the profitability of all animal raising activities and it is only recently that the supply of red meat has fallen sufficiently to reverse the trend. Since meats are strong substitutes to fish, the increasing ratio in meat is expected to contribute to a similar change in the price trend of the aquaculture sector at least in relation to coarse grains. The ratio of the price of fish raised in aquaculture to the fishmeal price will gradually stabilise over the projected period and should return to the levels before the *El Niño* of 2010 and the drought experienced in 2012.

The average price of traded fish products for human consumption will continue its increasing trend, growing by 30% during the *Outlook* period. It will also grow in real terms, while remaining below the levels reached at the beginning of the 1990s. For individual fisheries commodities, the price volatility could be more pronounced due to supply swings caused by changes in catch quotas, the cyclical production of certain species and/or disease outbreaks as well as fluctuations in feed costs. Over the next decade, as it comes to represent a larger share of total fish supply, aquaculture could have a stronger impact on price formation in the sector overall. Furthermore, high feed prices could alter the species composition in aquaculture, towards those requiring less expensive or no feed.

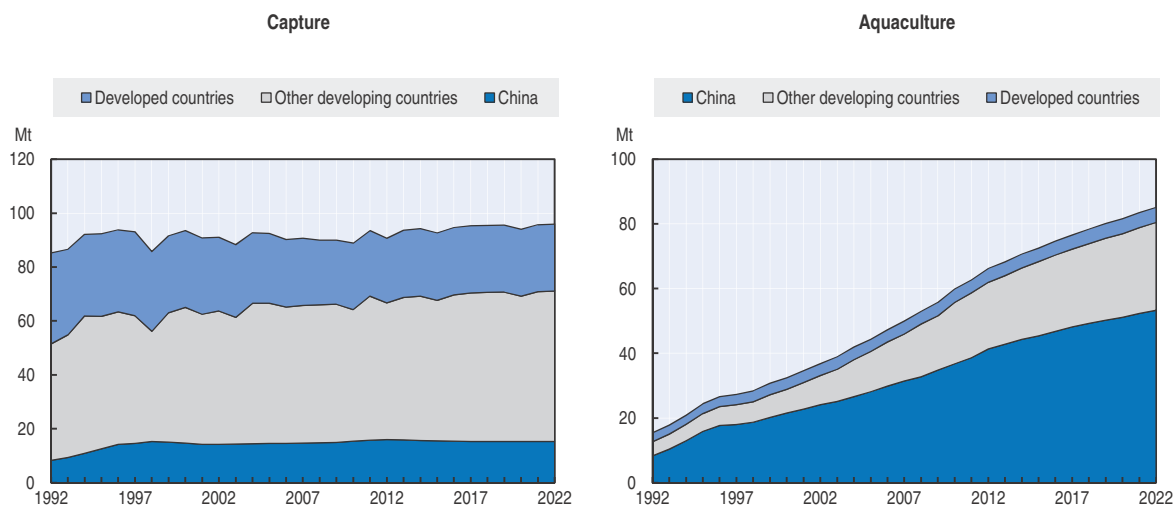
### Production

Under the set of assumptions used in this *Outlook* and boosted by higher demand for fish, world fisheries production is projected to continue expanding over the baseline period, reaching 181 Mt in 2022 (Figure 8.3), of which 161 Mt is destined as food for human consumption. This represents an increase of about 18% over the 2010-12 base period, at an annual growth rate of 1.2% p.a., a reduction compared to the 2.1% p.a. of the previous


decade. Notwithstanding the slower growth rate, total fishery production volume will continue to exceed that of the individual beef, pork or poultry sectors.

**Figure 8.3. Developing countries will continue to dominate fish production**

Fishery production in live weight equivalent



Source: OECD and FAO Secretariats.

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Capture fisheries production is projected to slightly grow by 5%, going from about 91 Mt to around 95 Mt over the next decade. Improvement is tied to stock recovery resulting from improved resource management. Other factors include some growth in the few countries not subject to strict production quotas and enhanced use of fishery production, including reduced discards, waste and losses as required by changes in legislation or stimulated by higher prices in the market. In 2015 and 2020, a 3-4% decline of capture fisheries is projected as a consequence of the *El Niño* phenomenon. The bulk of production will originate from Asian countries, which will slightly increase their share in world capture fisheries from 54% to 55% over the Outlook period, while the share of OECD countries is expected to decline from 29% to 27%.

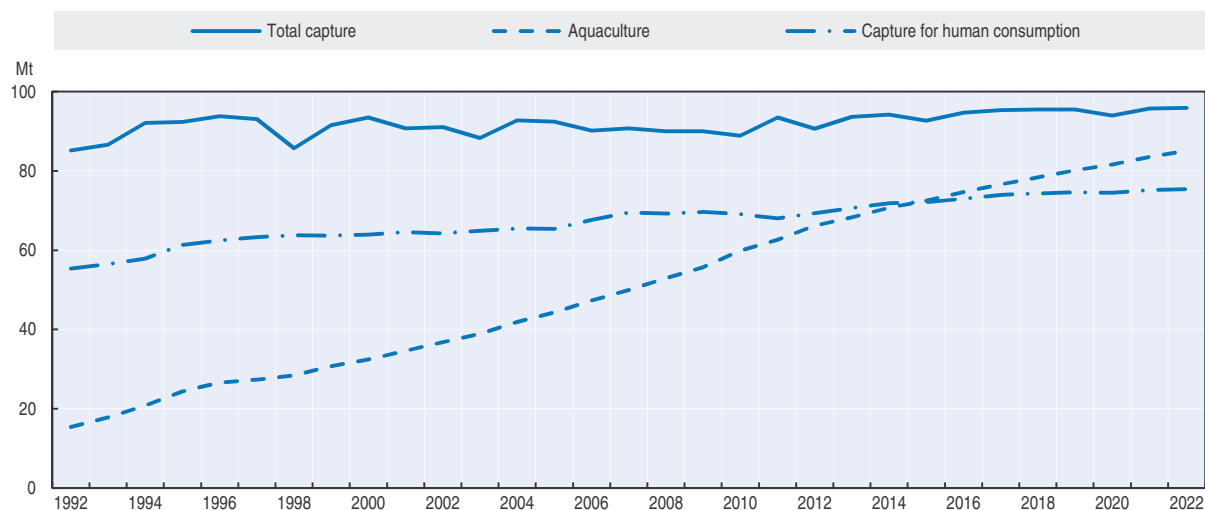
Additional growth in fishery production will originate predominantly from aquaculture, expected to reach 85 Mt in 2022, a 35% increase compared to the average level for 2010-12. Its average annual growth rate should decelerate from 5.9% in the previous decade to 2.4% going forward. This decreased growth will be mainly caused by water scarcity, less optimal production location availability and the high costs of fishmeal, fish oil and other feeds, as around 50%<sup>4</sup> of the global aquaculture is dependent upon the supply of external feed inputs. In spite of the slower growth rate, aquaculture will still remain one of the fastest growing food-producing sectors.

Aquaculture is projected to increase from 41% of total production in the 2010-12 base period to 47% in 2022. In terms of fish destined for human consumption,<sup>5</sup> aquaculture should surpass 50% of the total for the first time by 2015, and this share should reach 53% by 2022 (Figure 8.4). Products derived from aquaculture will also contribute to a growing share of international trade while continuing to play a key role in food security with significant production, obtained also through integrated farming, of low-value freshwater species, mainly destined for domestic consumption. Aquaculture is expected to continue


expanding in all continents in terms of new areas and species, as well as intensifying and diversifying the product range and forms in order to better respond to consumer needs. However, the global distribution of aquaculture production will continue to remain imbalanced, with China dominating world aquaculture production with an expected share of 63% in 2022. Through an alternative scenario, Box 8.1 examines the possible impact of a decelerated growth in Chinese aquaculture production. Asian countries, in particular China, India, Viet Nam and Indonesia, will produce 89% of world aquaculture volume, while OECD countries, with Norway and Chile as main producers, will have only an 8% share of the total in 2022.

Figure 8.4. **In 2015 aquaculture becomes the major source for human consumption**

Fishery production in live weight equivalent



Source: OECD and FAO Secretariats.

StatLink  <http://dx.doi.org/10.1787/888932860237>

Fishmeal and fish oil can be manufactured from whole fish, in particular small bony species including anchoveta, or from fish by-products resulting from processing such as heads, tails, bones and other offal. Due to the growing fish demand for human consumption and stricter management measures for anchoveta and other species, the portion of wild fish utilised to produce fishmeal and fish oil will gradually decline to around 16% by the end of the Outlook period. That share will be slightly smaller in the assumed years of *El Niño* due to reduced catches of anchoveta. In 2022, fishmeal and fish oil production should reach 7.0 Mt and 1.1 Mt, respectively, with an increase of 15% and 10% compared to the base period. About 95% of the additional gain for fishmeal will be obtained from fishmeal derived from fish by-products. Sustained demand and high prices for fishmeal, combined with reduced availability of raw material from whole fish and growing value-added fishery products for human consumption, will lead to more residues, which in the past were very often simply discarded, being used in fishmeal manufacturing. Fishmeal produced from fish by-products should represent 49% of world total fishmeal production in 2022 (Figure 8.5). This can affect the composition and quality of the resulting fishmeal with, in general, more minerals and less protein, which may hinder increased use in feeds. However, this issue is not something considered in the current Outlook baseline.

### Box 8.1. Possible impact of slower growth in China's aquaculture production

China plays a dominant role in the world fishery sector, being by far the largest producer, exporter and processor, as well as one of the major importers of fish and fishery products. In particular, China has significantly increased its aquaculture production during the last two decades and, at present, it produces more than 60% of world aquaculture production (excluding aquatic plants). In the past decades the focus for Chinese aquaculture has been on the expansion of farming areas and increasing output, more recently the focus has shifted to the structural adjustment of farmed species and quality enhancement.

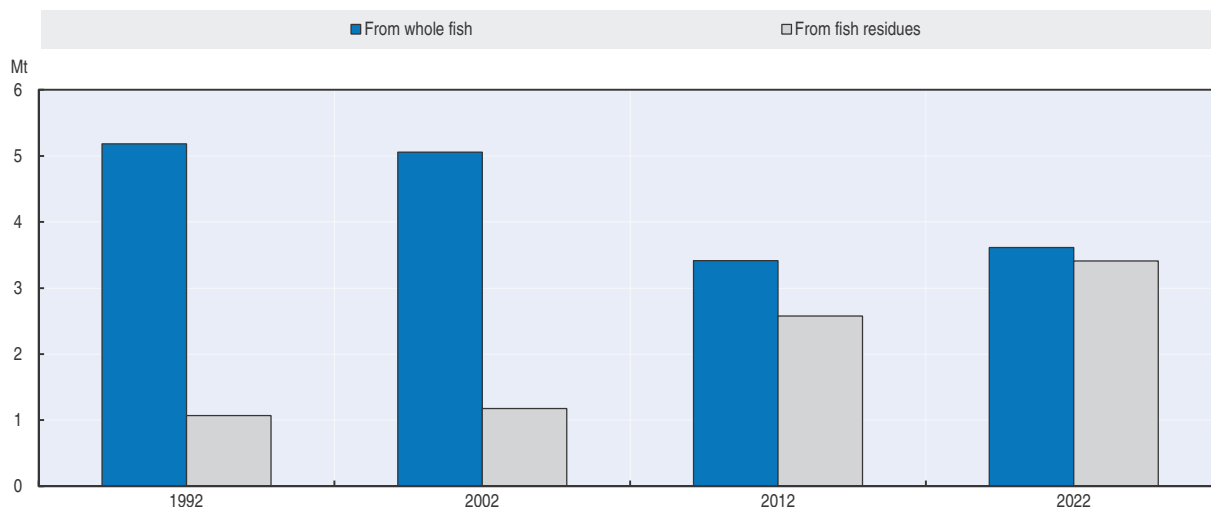
The rapid growth of aquaculture production in China over the last 20 years may slow down as the industry has reached the limit of available land suited for this activity, especially for freshwater species. Technological improvements have compensated for the lack of new land and this is expected to continue to some extent over the medium term. In this *Outlook*, Chinese aquaculture production is expected to grow at an annual rate of 2.4% p.a., lower than the 5.4% p.a. of 2003-12 and the 8.2% p.a. of 1993-2002.

An alternative scenario has been produced with the FAO fish model assuming a reduced growth path for most freshwater species. At present, freshwater species represent more than 60% of total aquaculture fisheries production in China. In the model, these species have been grouped into four main fresh and brackish (water in estuary with low-salt content) water species. Beyond "Carps, barbels and other cyprinids", representing by far the largest group, and "Tilapia and other cichlids", a particular case is represented by "Shrimps and prawns" because they are produced in fresh, brackish and salt water. Of all the freshwater species, shrimps have the highest per unit value by far. All other freshwater species are included in a residual category in the model called "other freshwater species". In this alternative slower growth scenario, it is expected that the economic rent (and the price) of the available land suited for aquaculture production will increase and that this higher rent should favour the production of the highest per unit value species such as shrimps. On that basis, it is assumed that shrimp production will maintain the same growth rate as that projected in the *Outlook*. The second highest value species ("other freshwater") will only grow at half the baseline rate. Tilapia will only increase at a one quarter of the rate of the *Outlook*, while carp production will not grow.


These slower growth paths will lead to an annual growth rate of 1.4% p.a. As a result, by 2022, total aquaculture production will be 10% lower than in the *Outlook*, a reduction of 5.3 Mt (lw). The impact on fish prices in China will be significant. Producer prices of aquaculture species will increase by 24%, while wholesale price of all species (farmed or wild) will increase by 18.5% and consumer prices by 7%. In response to these higher prices, fish consumption will decline by 3.1%, or 2 Mt (lw). The difference between the changes in production and consumption will be reflected in a reduction of the trade balance of 3.3 Mt. As a result, the world price of fish will increase by 13%. This growth in world price will affect, to some extent, producers and consumers in all the other countries. Their fish consumption will fall by almost 2.3 Mt, and their aquaculture production will grow by 0.85 Mt. With very tight production quota in most countries, world capture production will only rise by 0.15 Mt.

The impact on the fishmeal market is not straightforward due to two characteristics of the Chinese market. First, most Chinese fishmeal production is obtained from fish residues (89% in 2022). So when aquaculture production is diminished, fish residue and fishmeal production are automatically reduced. Secondly, in this scenario the species subject to the largest reduction in production growth do not consume very much fishmeal. The net reduction in demand is therefore not very large. The net effect of these two factors lead to a 10% increase in Chinese fishmeal imports in that scenario. This combined with the increase in demand for fishmeal caused by higher aquaculture production of other countries generate a 8% increase in the world fishmeal price in 2022. This last result would have been completely different if instead carp production had been maintained at the baseline level and shrimp production had been kept at the 2012 level.

Figure 8.5. **Increasing share of fishmeal obtained from fish by-products**  
Fishmeal production in product weight



Source: OECD and FAO Secretariats.

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### Consumption

Linked to the expansion of fish production and increasing demand, together with modern distribution channels, world fish food consumption is projected to continue to slowly expand over the next decade reaching around 161 Mt by 2022, a 22% increase compared to the 2010-12 base period. Per capita fish consumption will rise from 18.9 kg, on average, in the base period to 20.6 kg by 2022. However, the annual growth rate will be lower than the previous decade, declining from an average of 1.8% to about 0.6%. The decrease in growth rate will be more pronounced in the latter half of the projection period as fish becomes more expensive relative to red meats.

Per capita fish consumption should rise on all continents, except in Africa where population growth will outstrip supply. The highest growth rates are expected in Asia. Notwithstanding the increased availability of fish to most consumers, the rise in fish consumption will not be homogenous among countries and within countries in terms of quantity and variety consumed. This heterogeneity reflects the different levels of availability of fish and other foods in different regions, including the accessibility of fishery resources in adjacent waters as well as the interaction of several socio-economic and cultural factors affecting demand, including food traditions, tastes, income levels, seasons, prices, infrastructures and marketing facilities.

Being already mature markets with high initial levels, fish consumption is expected to show little to no growth (+4% by 2022 on average compared to the base period) in many developed countries. This limited increase reflects, among other things, slowing population growth and dietary shifts that are already underway. Developing countries will account for most of the additional fish consumption, being responsible for more than 91% of the total increase. This outcome will be due to the combination of several factors affecting demand for animal proteins, including rising living standards, population growth, rapid urbanisation, a growing recognition of fish as healthy and nutritious food, and technological development in food, processing, packaging and distribution. Improvements



in preservation and storage are particularly important as, being highly perishable, fish needs specific handling and preservation techniques. In spite of this additional growth, annual per capita fish consumption in developing countries will continue to be considerably lower than that of more developed regions (19.8 kg compared with 24.2 kg), even though this gap will narrow over the next decade. Per capita fish consumption in OECD countries will remain relatively flat while increasing for the BRICS, from 19.8 kg to 23.3 kg, mostly because of the significant expansion in domestic aquaculture production.

Consumption of fishmeal and fish oil will be constrained by the rather stable production with markets characterised by the traditional competition in the use of fishmeal between aquaculture and livestock and between aquaculture and dietary supplements for direct human consumption for fish oil.

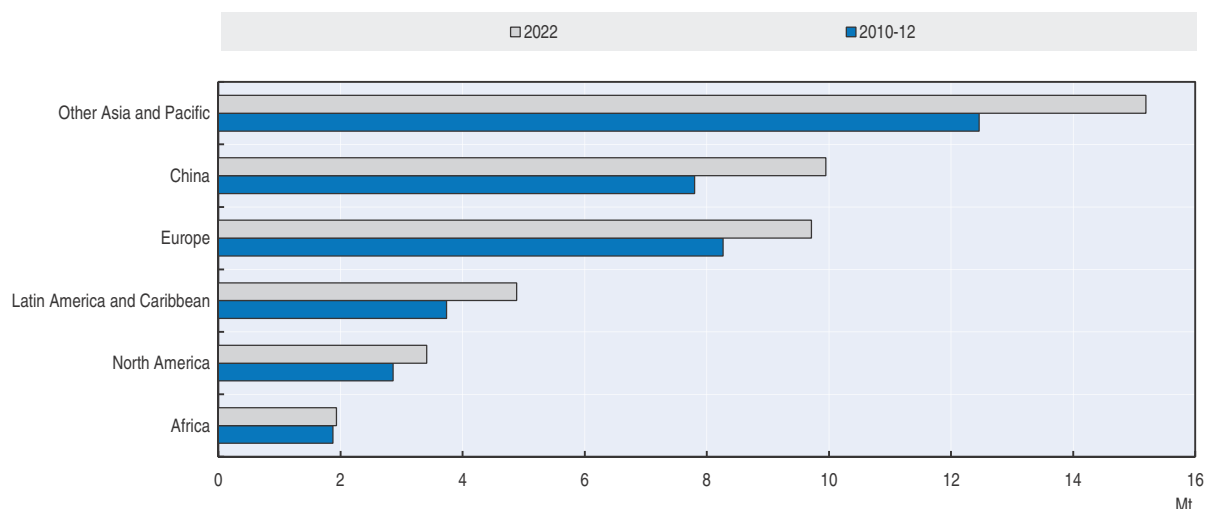
### **Trade**

Fish and fishery products are and will continue to be among the most traded food commodities worldwide. Sustained demand, trade liberalisation policies, globalisation of food systems, improved logistics and technological innovations will further expand international fish trade, even if at a slower rate than in the previous decade. About 36% of total fishery production including intra-EU trade (31% excluding intra-EU trade) is expected to be exported by 2022 in the form of various food and feed items, reflecting the sector's growing degree of openness to, and integration in, international trade. The fishery supply chain is expected to remain complex as fish products often cross national boundaries several times before final consumption due to the increasing outsourcing of processing to countries such like China, India, Indonesia, Thailand and Viet Nam, where comparatively low wages and production costs provide a competitive advantage.


Trade of fish for human consumption is projected to reach 45.1 Mt in live weight equivalent, representing an increase of 22% over the Outlook period. However, the annual growth rate of exports is expected to decline from 3.1% for the last decade to 1.8% p.a. over the next ten years. This is partly due to increasing prices which reduce consumption growth, higher transportation costs and slower expansion of aquaculture production. Trade in fish and fishery products is characterised by a wide range of product types and participants. The role of fishery trade varies among countries and is important for many economies, in particular for developing nations, which are the key suppliers to world markets, contributing 68% of global fishery exports for human consumption by 2022. Additional growth in fish exports is projected to come predominantly from Asian countries, which will account for about 61% of the additional output. By 2022, Asian countries are expected to increase their share in world exports for human consumption from 52% to 54% as a result of growing investment in the aquaculture sector. China will consolidate its position as the leading global exporter of fish products (Figure 8.6) and will account for over 22% of world trade of fish for human consumption, in quantity terms, by the end of the projection period.

Developed economies will continue to be increasingly dependent on imports of edible fish to meet their consumption and, by 2022, the ratio of fish imports over total fish consumption will grow to 69% from 64% in the base period. However, the share of developed countries in world fish imports for human consumption will slightly decline from 54% to 52% during the next decade. In the same period, developing countries will increase their imports of edible fish by 28%, which will consist of fish for domestic

Figure 8.6. **Major role of China and other Asian countries in fishery exports**  
Exports of fish for human consumption in live weight equivalent



Source: OECD and FAO Secretariats.

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consumption, particularly in emerging economies, as well as unprocessed fish to be used as raw material for their processing industries which are then subsequently exported.

Trade of fishmeal is expected to remain rather stable throughout the projection period, with a limited growth of 6%. Peru and Chile will remain the leading exporters of fishmeal, but their combined share in total exports will decline from 55% to 49% over the projection period. Asian countries will remain the main importers of fishmeal (66% of the total by 2022) due to their sizeable aquaculture production. China alone will account for 32% of global fishmeal imports, although slightly declining from 34% of 2010-12. Fish oil exports are projected to decrease by 1% over the period under review. European countries will remain the leading importers of fish oil with a 51% share of world fish oil imports, with Norway accounting for 19% of the imports by 2022 to be mainly used in its salmon industry.

### Main issues and uncertainties

The medium-term fish projections analysed in this chapter are a conditional scenario of likely developments based on a number of specific economic and policy assumptions. These include the macroeconomic environment, international trade rules and tariffs, frequency and effects of *El Niño* phenomenon, absence of abnormal fish-related disease outbreaks having an impact on aquaculture production, fishery quotas, longer term productivity trends and the absence of unforeseen market shocks.

A number of uncertainties remain. A major unknown factor for the projections is the impact of the ongoing financial turmoil and economic recession in selected markets with likely more significant repercussions on consumption and commercialisation of higher valued fish species. Variations in oil, energy and feed prices, exchange rates, inflation, access to credit and subsequent investments can have significant impacts on the competitive status and performance of national fishery industries. Other uncertainties include future changes in fishery policies and in trade and fishing agreements which could unleash a period of greater price volatility. Future prices might also be influenced by the

introduction of more rigorous regulations related to environment, food safety, traceability and animal welfare.

Vulnerability to climate change and extreme weather events could also have a major impact on the fisheries and aquaculture sector, with significant shortfall of production due to natural disasters. In a context of global socio-economic pressures on natural resources and ecosystems, new climate adaptation strategies will likely be part of improved fisheries governance. It will be important to conserve aquatic ecosystems and to safeguard fish stocks, and to promote productivity through technological innovation, investment in R&D and incentives from the fisheries management system. Considerable efforts are underway to rebuild fisheries, a task which is high on the international policy agenda.

Aquaculture production is particularly vulnerable to adverse impacts of disease, pollution and degraded local environments. In recent years, disease outbreaks have stricken fish farming (among affected species: salmon, shrimp and bivalves) in several countries in Asia (including China, India, Thailand, Viet Nam), South America (Ecuador, Chile), Europe (France, Spain) and Africa (Mozambique, Madagascar), resulting in partial or sometimes total loss of production. Moreover, such disease outbreaks impacts consumers' image of the sector and the quality of the fish.

Restructuring of fish food chains may impact the location of production and processing as well as trade flows. Improved management and efficiencies throughout the food value chain are essential for the sustainability and future growth of the fisheries industry. The fishery sector will be increasingly globalised with supermarket chains and large retailers emerging as important players in setting requirements for the products they buy and in controlling international distribution channels. Processing is adding more value and is becoming more intensive, geographically concentrated, vertically integrated and linked with global supply chains. Processors are becoming more integrated with producers to enhance the product mix, obtain better yields and respond to evolving quality and safety requirements in importing countries. The outsourcing of processing activities at regional and world levels is significant, its extent depending on species, product form, costs of labour and transportation. This trend might be affected by increasing oil prices and a subsequent rise of transportation costs as well as by the wage growth being experienced in selected countries, in particular in Asia, which might lead to changes in distribution and processing facilities and increases in fish prices.

The future role played by fisheries and aquaculture in world food security is constrained by an array of specific problems including weak governance, ineffective fisheries management practices, conflicts over the use of natural resources, the difficulties in incorporating the priorities and rights of small-scale fishing communities, and injustices relating to gender discrimination and child labour. The further growth of the aquaculture industry will rely on many factors including the accessibility to areas and water resources as well as to technology and finance; the sustainability, availability and cost of fish seeds (e.g. eggs, spawn, offspring, fry, larvae, etc.) and feeds in the requisite quality and quantities; antibiotic use; assessment of environmental impacts including pollution, fish diseases and escapees; food safety and traceability issues; and policy decisions and legislation. For example, aquaculture has had and will most probably continue to have difficulties establishing itself as a growth sector in many developed countries due to regulatory restrictions with respect to sites and environmental impacts (e.g. pollution, fish diseases and escapees).

Future growth of aquaculture will also depend on how the sector will invest to enhance productivity in a sustainable manner through technological development and better management practices. Improvements in genetics, breeding and nutrition are particularly important, and will have a major effect on the composition of feeds used by the aquaculture industry. Today about 45 Mt of feed are used for farming fed aquaculture species. According to some estimates,<sup>6</sup> feed for aquaculture currently makes up 5% of global feed production and it could represent a share of about 8% to 10% in the near future. With rising fishmeal and fish oil prices, the search for greater efficiency and substitutes is ongoing and further improvements are expected. In recent years, the percentage of fishmeal and fish oil in compound feeds has been a clear downward trend while their international prices were increasing. In the near future, fishmeal and fish oil will be more frequently used as strategic ingredients to enhance growth at specific stages of production, e.g. in fry. In response to growing prices of fishmeal and fish oil, as feed tonnages increase, feed companies will continue to stretch available quantities of fishmeal and fish oil further by substituting with other ingredients. However, depending on the alternatives used, their substitutions with other ingredients may affect the health properties and taste of farmed fish.

It is also important to note that, based on a recent revision of the feed ban rules, from 1st June 2013, Processed Animal Protein (PAP) from pigs and poultry is to be re-authorized by the EU for use as feed or feed ingredient in aquaculture. The prohibition on intra-species recycling remains valid and strict rules on the control of intra-species recycling must be adhered to. This ban indicates that the fish species cannot be used as feed in aquaculture for that same species of fish. The reintroduction of non-ruminant PAP in feeds for fish farming may permit the EU to diminish its dependence on other sources of proteins such as fishmeal for fish feed. Given the high price of fishmeal, PAP from these sources could be a much cheaper feed ingredient. The extent of this practice will depend on biological considerations and on the level of acceptance of producers and consumers. In order to assess the possible impact of this new policy, a scenario analysis was performed with the fish model since the possible effects of this change in regulation are not included in the Outlook baseline.

The amount of PAP available from those two sources surpasses by many times the total consumption of fishmeal in the European Union. However, for the reasons indicated this scenario assumes a gradual and incomplete replacement of fishmeal by PAP. It was assumed that the minimum use of fishmeal would not go below 25% of the baseline consumption of fishmeal, which is the case in the last three years of the scenario. The results indicate that the world price of fishmeal would drop by 9.7% in the last three years of the simulation. Since fish oil is a joint product of fishmeal, its price would increase by 1%. The lower price of fishmeal would be sufficient to increase world aquaculture production by 0.4% by 2022 and this would generate a reduction of 0.9% in the world price of fish product traded.

## Notes

1. The terms “fish and seafood” or simply “fish” indicate fish, crustaceans, molluscs and other aquatic invertebrates, but excludes aquatic mammals and aquatic plants.
2. For the third time, this *Outlook* publication includes a chapter illustrating the main results of the dynamic policy specific partial equilibrium model on fish. At present, it is a standalone model using the same macroeconomic assumptions, the same feed and food prices employed or generated by the agricultural market model Aglink-Cosimo. The baseline is deterministic and assumes normal weather and production conditions, with the exception of the impact of the El Niño phenomenon set for selected Latin American countries in 2015 and 2020.
3. In the fish model, production of capture fisheries is kept exogenous for most countries as being tightly managed, while it is endogenous responding to prices for other countries not subject to quotas and it is endogenous with no price elasticity for the South American countries affected by El Niño. This is a naturally occurring climatic event resulting in warmer sea surface temperatures in the Pacific Ocean and off the coast of South America that generally reduces fish catches, in particular of anchoveta (*Engraulis ringens*), a species mainly used for fishmeal and fish oil processing.
4. Tacon, A.G.J.; Hasan, M.R.; Metian, M. Demand and supply of feed ingredients for farmed fish and crustaceans: trends and prospects. *FAO Fisheries and Aquaculture Technical Paper*, No. 564. FAO, 2011. pp. 87.
5. Fish destined to human consumption/food indicates total fish production excluding non-food uses, such as fish destined to reduction into fishmeal and fish oil, fish destined to direct feeding to aquaculture and livestock, fish used as bait and others.
6. Alltech: [www.alltech.com/home](http://www.alltech.com/home).



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