Chapter 1. Overview

This chapter provides an overview of the latest set of quantitative medium-term projections for global and national agricultural markets. The projections cover consumption, production, stocks, trade and prices for 25 agricultural products for the period 2018 to 2027. The weakening of demand growth is expected to persist over the coming decade. Population will be the main driver of consumption growth for most commodities, even though the rate of population growth is forecast to decline. Per capita consumption of many commodities is expected to be flat at a global level. Consequently, the slower growing demand for agricultural commodities is projected to be matched by efficiency gains in production which will keep real agricultural prices relatively flat. Beyond the traditional risks that affect agricultural markets, there are increasing uncertainties with respect to agricultural trade policies and concerns about the possibility of rising protectionism globally

Introduction

The *Agricultural Outlook* presents a baseline scenario for the evolution of agricultural and fish commodity markets at national, regional and global levels over the coming decade (2018-2027). The projections rely on input from country and commodity experts and from the OECD-FAO Aglink-Cosimo model of global agricultural markets. This economic model is also used to ensure the consistency of baseline projections.

The projections are influenced both by current market conditions and by assumptions on the macro-economic, demographic and policy environment. These assumptions are detailed at the end of this chapter (Box 1.6) and in the commodity chapters. The sensitivity of the *Outlook* to these assumptions is discussed later in the chapter.

For the coming decade, economic growth of 1.8% per annum is expected for OECD countries, broadly the same pace as over the last decade (1.7% p.a.). Growth is projected to slow for the People's Republic of China (hereafter "China") but accelerate in India compared with the past decade. Following the strong increase in 2017, nominal oil prices are expected to increase at an average rate of 1.8% per year over the outlook period, from an average price of USD 43.7 per barrel in 2016 to USD 76.1 per barrel by 2027.

The *Outlook* assumes current policy settings continue into the future. In particular, the decision of the United Kingdom to leave the European Union is not included in the projections as the terms of departure have not yet been determined. Projections for the United Kingdom are therefore retained within the European Union aggregate.

Current market conditions for the different commodities included in the *Outlook* are summarised in Figure 1.1, which shows the evolution of production and prices during the base period (2015-17) compared to average levels over the past decade. For most cereals, meat types, dairy products and fish, 2017 production levels exceeded even the high levels recorded last year.

Despite a global economic recovery and higher oil prices, prices for most agricultural commodities did not change much in 2017 compared to the previous year, except for dairy and sugar. Dairy markets were in flux, with low prices in 2016 followed by a recovery in 2017 and a 65% spike in butter prices in the first half of the year which eventually came back down by the end of the year. The recovery of sugar production after two years of shortage contributed to a decline in prices.

These current market conditions form the backdrop for the ten-year projections of consumption, production, trade and prices presented in the next sections.

Figure 1.1. Market conditions for key commodities

Current market conditions

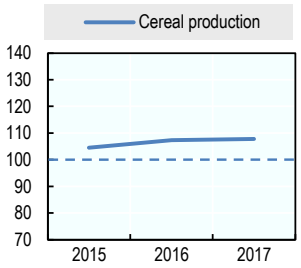
Cereals: World production reached a new record in 2017, as maize and rice output levels surpassed historical levels. Global supplies have exceeded demand for several years, resulting in a significant build-up of inventories and low prices.

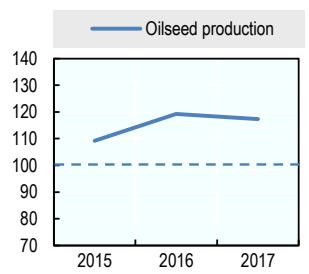
Oilseeds: Soybean production declined slightly in the 2017 marketing year, although aggregate production of other oilseeds remained stable. Demand growth for protein meals was lower than in 2016. Overall, there were no major disruptions.

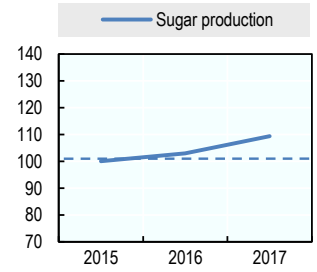
Sugar: After two years of supply shortage, production in 2017 rose and was close to the 2012 record. Sugar prices fell after having increased strongly in 2016. The growth in demand increased in countries with low per capita consumption. Global import demand continued to decline, in part as demand from China waned.

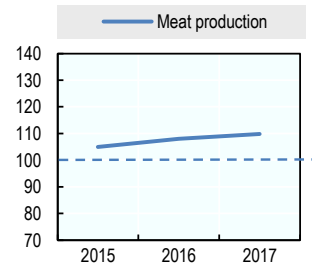
Meat: World meat production increased by 1.2% in 2017. Much of the increase in production originated in the United States, but other main contributors to growth include Argentina, China, India, Mexico, the Russian Federation and Turkey. After declining in 2016, international meat prices increased by 9% in 2017 (as measured by the FAO Meat Price Index), as import demand grew. The highest price increase was noted for sheep meat.

Production Index
Average 2008-2017 = 100

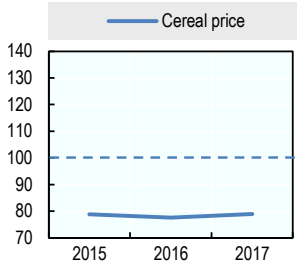


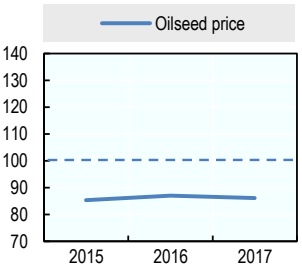


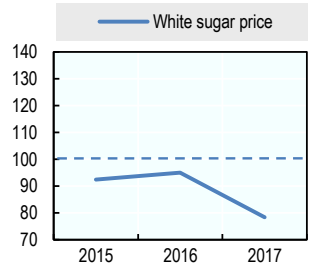


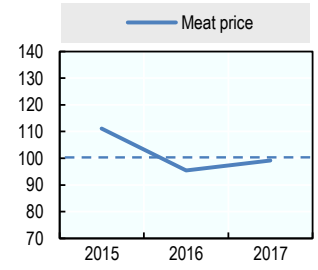


Nominal Price Index
Average 2008-2017 = 100

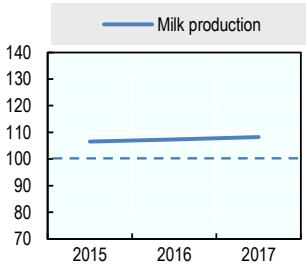


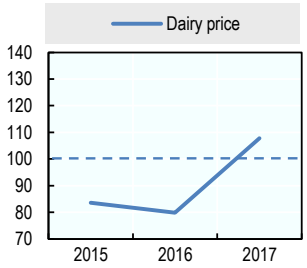




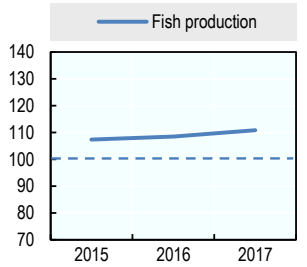


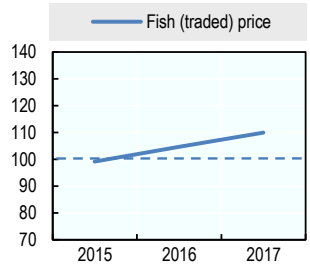
Dairy: Global dairy markets experienced strong price increases in 2017. After an initial increase of 65% in the first half of the year, butter prices came back down by the end of 2017. The price of whole milk powder increased by 46%; the price of skim milk powder, by contrast, only increased by 3%. World production experienced a modest growth of 0.5%, below the average growth rate of the last decade.



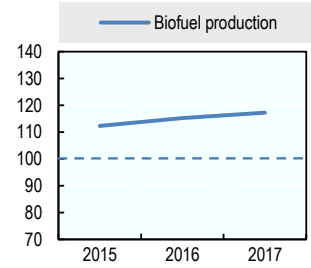


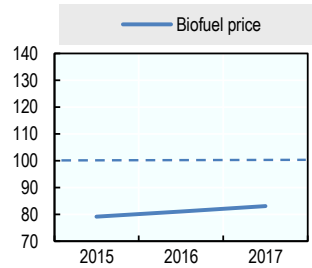
Fish: Production grew faster than in 2016, as catches of anchoveta in South America recovered while aquaculture continued to grow at 4% per year. As in recent years, aquaculture was responsible for most of the growth in production. Despite these higher production levels, fish prices increased globally as improving economic conditions stimulated demand.



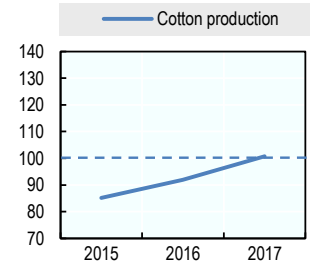


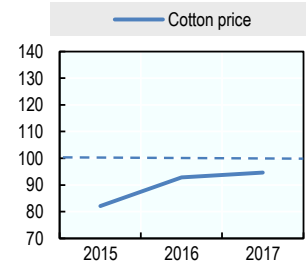
Biofuels: Demand for biofuels was sustained by obligatory blending and by higher demand for fuel due to relatively low energy prices, despite increasing crude oil prices in 2017. Several countries announced policy decisions to stimulate demand for biofuels in 2017. Prices for ethanol and biodiesel diverged: ethanol prices fell by 2.3% while biodiesel prices increased by 8%.





Cotton: Production continued to recover from the strong drop in 2015, growing by around 9%. Production increased in almost all major cotton producing countries except for China. Despite an increase in world demand, global stocks grew and remained at a high level of almost nine months of world utilisation.





Note: All graphs expressed as an index where the 2008-2017 average is set to 100. Production refers to global production volumes; price indices are weighted by the average global production value in the preceding decade as measured at international prices. More information on market conditions and evolutions by commodity can be found in the commodity snapshot tables in the Annex and the online commodity chapters.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933741903

Consumption

Agricultural commodities are consumed mainly as food, feed, and in industrial applications including fuel. Food demand is influenced by population and income growth, and increasingly also by trends in dietary patterns and consumer preferences. Demand for animal feed is closely linked to the human consumption of livestock products, such as meat, eggs and milk, but also by the evolution of livestock production technology. Industrial uses of agricultural commodities (mostly as biofuel and as input in the chemical industry) are shaped by general economic conditions, as well as regulatory policies and technological advances. Moreover, the relative importance of each use varies by commodity, by region, and by level of economic development.

Over the last ten years, agricultural markets experienced a strong increase in demand across a wide range of commodities. Much of that growth was attributable to non-food uses of agricultural commodities, mostly feedstock for biofuel and animal feed. While food demand stagnated in the developed world, biofuel mandates led to increased demand for maize, sugarcane and vegetable oils as feedstock. In parallel, rising incomes in China and other emerging economies raised demand for meat. This in turn drove an intensification of livestock production which boosted demand for animal feed on global markets. Together, these sources of demand growth contributed to real agricultural prices remaining above the levels seen in the early 2000s, fuelling production growth worldwide.

Biofuels and Chinese demand growth will continue to play a role in global agricultural markets. However, their relevance is diminishing and they are not fully being replaced by new sources of demand growth, whether for food, feed, or fuel uses.

In terms of food demand, per capita consumption of many commodities is expected to be flat at a global level. This is not only expected for staple foods such as cereals and roots and tubers, where consumption levels are close to saturation levels in many countries, but also for meat. Some low-income regions which currently have low per capita consumption levels of meat, such as Sub-Saharan Africa, are not expected to increase these levels significantly due to a lack of sufficient income growth. Some emerging economies, in particular China, have already transitioned to relatively high levels of per capita meat consumption. In India, where income growth is stronger, dietary preferences translate rising incomes into an increased per capita demand for dairy as preferred animal protein, rather than meat.

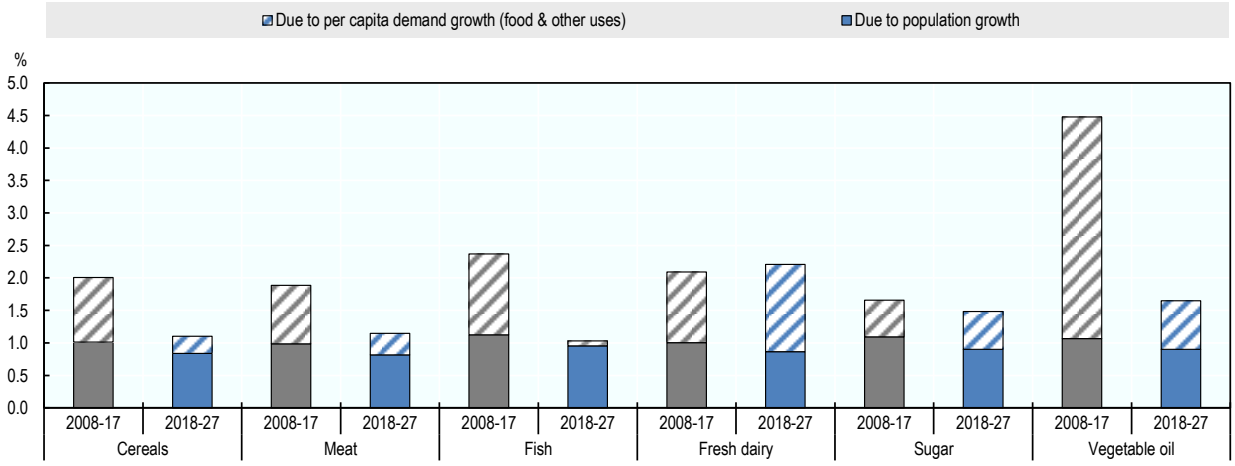
One implication of relatively flat per capita food consumption is that population growth will be the principal determinant of food demand growth, even though global population is projected to grow at a lower rate in the coming decade. The bulk of additional food consumption in the coming decade will originate in regions with high population growth such as Sub-Saharan Africa, India, and the Middle East and North Africa (the focus of Chapter 2). Demand patterns in these regions will increasingly influence international agricultural markets.

The demand for feed, meanwhile, will continue to outpace food demand as livestock production intensifies. A large share of additional feed demand will come from China, as in the previous decade. Yet, compared with the previous decade, demand growth for feed slows down.

Finally, recent developments in biofuel policies combined with the assumption of a relatively moderate increase in the crude oil price suggest a more modest growth in the use of agricultural commodities in the production of biofuels.

As a result of these developments in food, feed, and fuel uses of agricultural commodities, a slower growth in global demand for agricultural commodities is expected in the coming decade (Figure 1.2).

Figure 1.2. Annual growth in demand for key commodity groups, 2008-17 and 2018-27



Note: The population growth component is calculated assuming per capita demand remains constant at the level of the year preceding the decade. Growth rates refer to total demand (for food, feed and other uses).
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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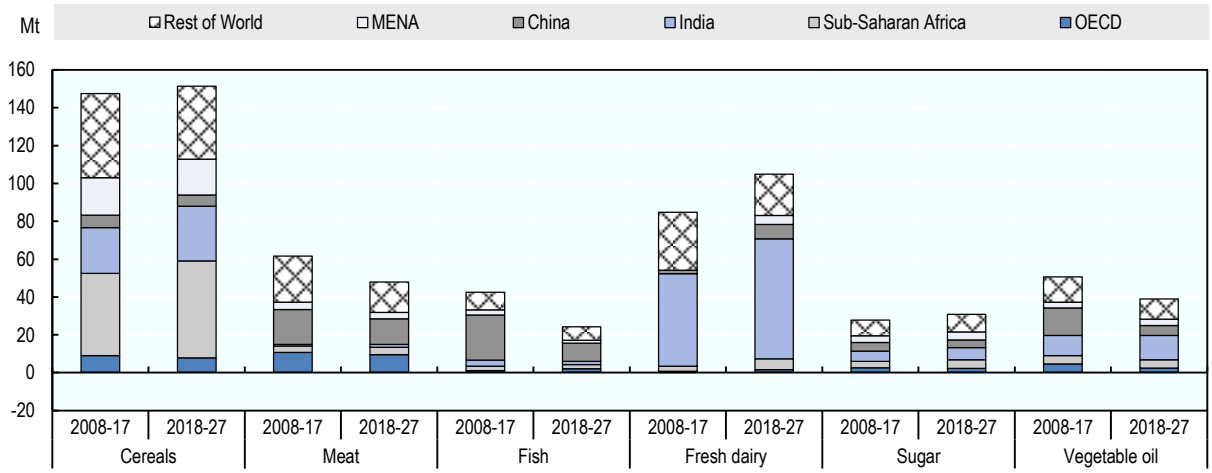
For cereals, meat, fish, and vegetable oil, growth rates are around half their rates in the previous decade. The slowdown is particularly pronounced for vegetable oil, which was the fastest-growing commodity over the past decade, as biofuel policies, industrial uses (for paints, lubricants, detergents, etc.) and a strong growth in food use supported demand. Despite the slowdown, vegetable oil remains one of the fastest growing commodities in the *Outlook*, together with fresh dairy products and sugar.

Food: Population and income growth spurs demand in the developing world

Food consumption will continue to expand due to population growth and higher per capita income for most commodities with the developing world as the source of most demand growth over the coming ten years (Figure 1.3). Sub-Saharan Africa and India will account for a large share of the additional food demand for cereals in the coming decade. Consumption of dairy products and vegetable oil in India will underpin growth in these commodities over the next ten years, while China continues to account for a large share of demand growth for meat and fish.

Figure 1.3. Regional contributions to food demand growth, 2008-17 and 2018-27



Note: Each column shows the increase in global demand over a ten-year period, split by region, for food uses only. MENA stands for Middle East and North Africa, and is defined as in Chapter 2.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

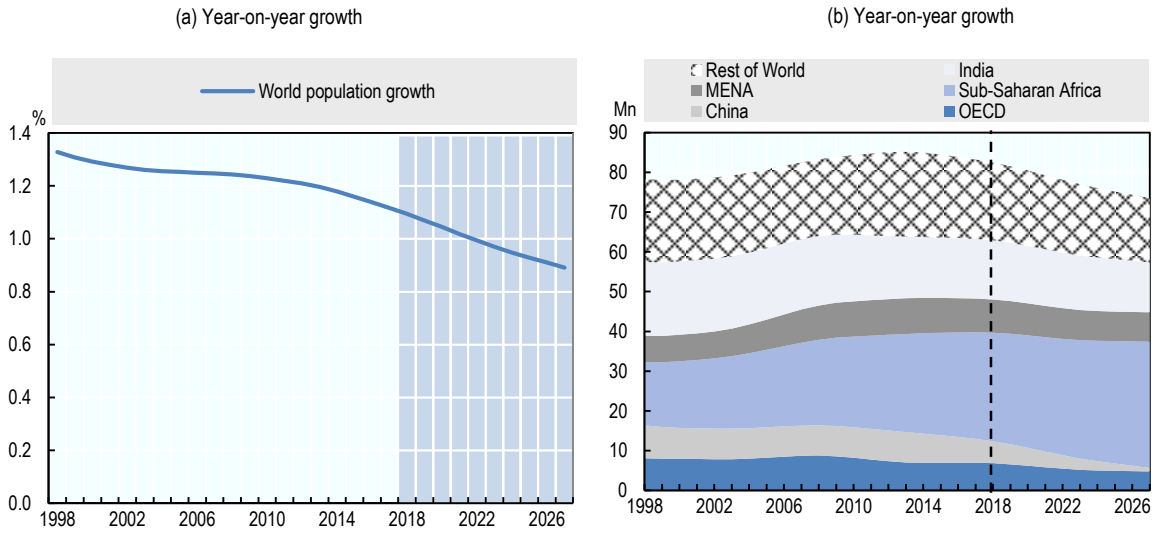
StatLink http://dx.doi.org/ 10.1787/888933741941

The important contribution from Sub-Saharan Africa and India reflects in large measure continued strong population growth in these regions (Figure 1.4). The global population growth rate is expected to fall from 1.1% at present to 0.9% per year in 2027. Since around 2013, growth has also been falling in absolute terms, although world population will still grow by around 74 million people per year by 2027. Most of this growth occurs in Sub-Saharan Africa and India, as well as the Middle East and North Africa. Population growth in Sub-Saharan Africa is accelerating in absolute terms: while the region's population increased by 27 million in 2017, this rate will increase to 32 million extra people per year in 2027.

In addition to population growth, food demand is influenced by the growth of per capita incomes. The macro-economic assumptions underlying this *Outlook* suggest strong growth in per capita GDP in India (6.3% p.a.) and China (5.9% p.a.). For Sub-Saharan Africa, 2.9% p.a. per capita growth is expected over the coming decade, but with variations across the continent. Moreover, high growth in average incomes does not necessarily translate to income growth for poorer households. Per capita food demand in Sub-Saharan Africa is therefore expected to remain at relatively low levels.

Finally, differences in dietary preferences shape demand patterns. While income growth in China in the last decade led to increased demand for meat and fish, rising incomes in India are mostly expected to lead to higher consumption of dairy products as the preferred source of animal proteins. The interplay of such regional differences in population growth, income growth and dietary preferences thus result in different developments for individual commodities.

Figure 1.4. World population growth, 1998-2027



Note: MENA Middle East and North Africa.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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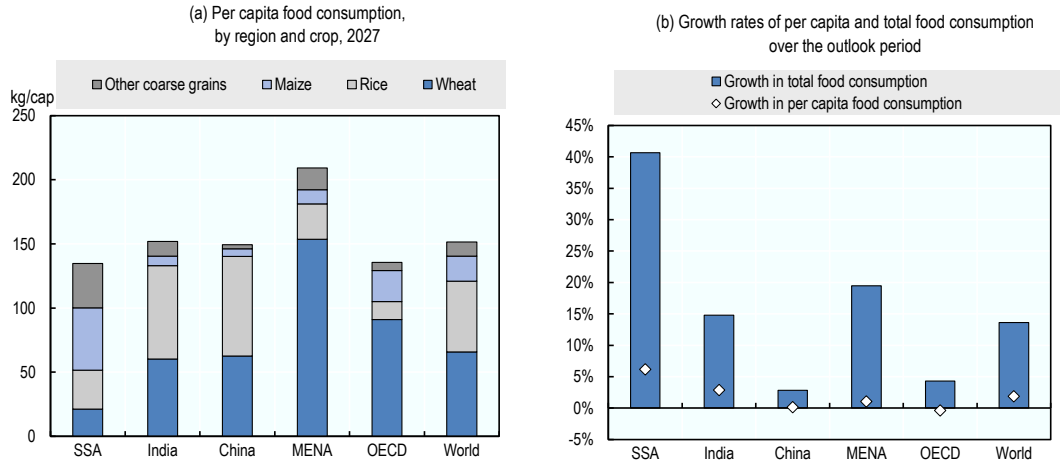
Cereals: Growth in food consumption determined mainly by population growth

Figure 1.5 shows the level and composition of per capita consumption of cereals in main regions, illustrating the high per capita consumption of cereals around the world, especially in the Middle East and North Africa. It also shows the continued dominance of wheat and rice across regions, except in Sub-Saharan Africa. In this region, white maize plays a major role in cereals consumption, and in calorie intake, as discussed in Box 1.1.

Globally, per capita cereals consumption increases by less than 2% over the coming decade. This slow growth is explained in large part due to the near-saturation level of cereals consumption in many regions across the world. Per capita food consumption of cereals is expected to grow only in low-income regions such as Sub-Saharan Africa, where per capita consumption increases by 6% over the next decade. In such low-income regions, cereals account for about two-thirds of dietary energy, compared to about one-third in developed regions.

Given relatively flat per capita consumption, population growth is the main determinant of growth in the coming decade, and the regions with the greatest population expansion (Sub-Saharan Africa, India, the Middle East and North Africa) will also account for the bulk of the additional food consumption of cereals.

Figure 1.5. Cereals: Availability for food consumption



Note: SSA is Sub-Saharan Africa; MENA is Middle East and North Africa. The *Agricultural Outlook* measures consumption in terms of food availability and hence does not account for waste.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/10.1787/888933741979

Box 1.1. White maize and food security in Sub-Saharan Africa

Maize is a primary source of calories in Sub-Saharan Africa[1], contributing about 19% of calorie availability on average (Table 1.1). Consumers prefer non-GMO white maize, typically produced locally or imported from within the region. Production is mostly low-input, rain-fed and smallholder-based, resulting in significant local yield variability. Local deficits are offset mostly through intra-country and regional trade; where such flows are impeded, production volatility threatens local food security.

Regional trade within Sub-Saharan Africa accounts for about 5% of food consumption, but this figure varies considerably by country. South Africa, Zambia, Uganda and Ethiopia are consistent surplus producers; Malawi, Mozambique and Tanzania are either exporters or importers depending on weather conditions. Yet other countries, such as Kenya and Zimbabwe, have steadily increased imports in recent years and depended on imports for as much as 27% of domestic consumption in 2015-17.

Most trade occurs within the region. Trade policies tend to prioritise a stable supply for domestic markets, e.g. by imposing export controls during perceived production shortages. Such restrictions often limit access to local and regional supplies, amplify price swings, and add to import costs as countries have to source supplies internationally.

In the coming decade, white maize will continue to play a pivotal role for the region's food security (Table 1.1). The *Outlook* foresees further increases in food demand as growing per capita consumption of maize combines with strong population growth. This is expected to result in 18.4 Mt of additional maize food use over the coming decade, about half of the global growth in food consumption for maize.

Productivity growth among regional suppliers is key to ensuring progress towards the Zero Hunger target. Additionally, open and reliable trade relationships are crucial to sustain food security. Sub-Saharan Africa will be increasingly dependent on imports from other regions, as not all of the rising demand can be satisfied through local production.

Table 1.1. Per capita calorie availability for maize versus other food products

	2015-17		2027	
	Calories per capita	Share of total	Calories per capita	Share of total
Maize	491	19%	515	19%
Other cereals	784	30%	827	31%
Other crops	530	20%	536	20%
Animal products	188	7%	194	7%
Sugar	130	5%	137	5%
Vegetable oil	217	8%	235	9%
Other	255	9%	268	10%
Total	2 596	100%	2 711	100%

Note: Data refers to the average value for Sub-Saharan Africa.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.
1. This box summarises a more extensive analysis of the white maize market in Sub-Saharan Africa, available at www.agri-outlook.org.

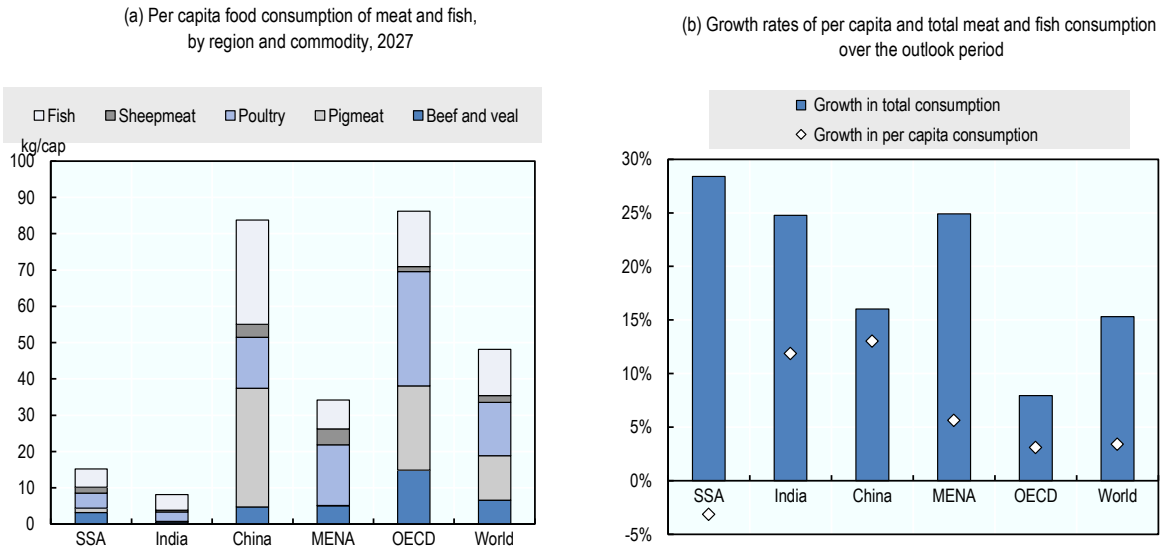
Meat and fish: Global convergence in consumption patterns remains limited

Compared with cereals, which are an important food source across the world, consumption of meat and fish differs significantly across regions according to dietary patterns and income levels (Figure 1.6). The availability of meat and fish is particularly low in Sub-Saharan Africa, where low incomes limit consumption, and in India, where dairy constitutes an important part of protein intake. Availability is high in advanced economies and in Latin America (not shown on the chart), but also in China, where fish and pig meat account for more than half of the total.

At a global level, total consumption of meat and fish is expected to increase by 15% over the outlook period, while per capita consumption of meat and fish rises by only 3%, with stark variations across regions (Figure 1.6). The strongest growth in total consumption is expected in Sub-Saharan Africa (+28%), although this reflects exclusively the impact of population growth; per capita consumption is expected to decline by 3%. By contrast, per capita consumption growth is higher in India (+12%, albeit from a low base) and China (+13%).

For meat, per capita consumption will grow most strongly in absolute terms in the developed world (+2.9 kg/capita over the outlook period), facilitated by lower prices. A growing gap thus exists with developing countries, which expand availability by 1.4 kg/capita. This smaller expansion is partly a reflection of income constraints, supply chain issues in some areas (e.g. lack of a cold chain infrastructure) and, in some regions, dietary preferences where protein is obtained more from non-meat sources. Within the developing world, least developed countries will add only 0.3 kg/capita, due to slow growth in disposable income. Asian countries in this group are projected to show some growth while Sub-Saharan Africa is expected to experience declining per capita consumption of both meat and fish.

Figure 1.6. Meat and fish: Per capita availability for food consumption



Note: SSA is Sub-Saharan Africa; MENA is Middle East and North Africa. Consumption is defined here in terms of food availability, and hence does not account for waste. Per capita consumption data refers to edible weight, estimated using conversion factors of 0.7 for beef and veal; 0.78 for pigmeat; 0.88 for poultry and sheep; and 0.6 for fish.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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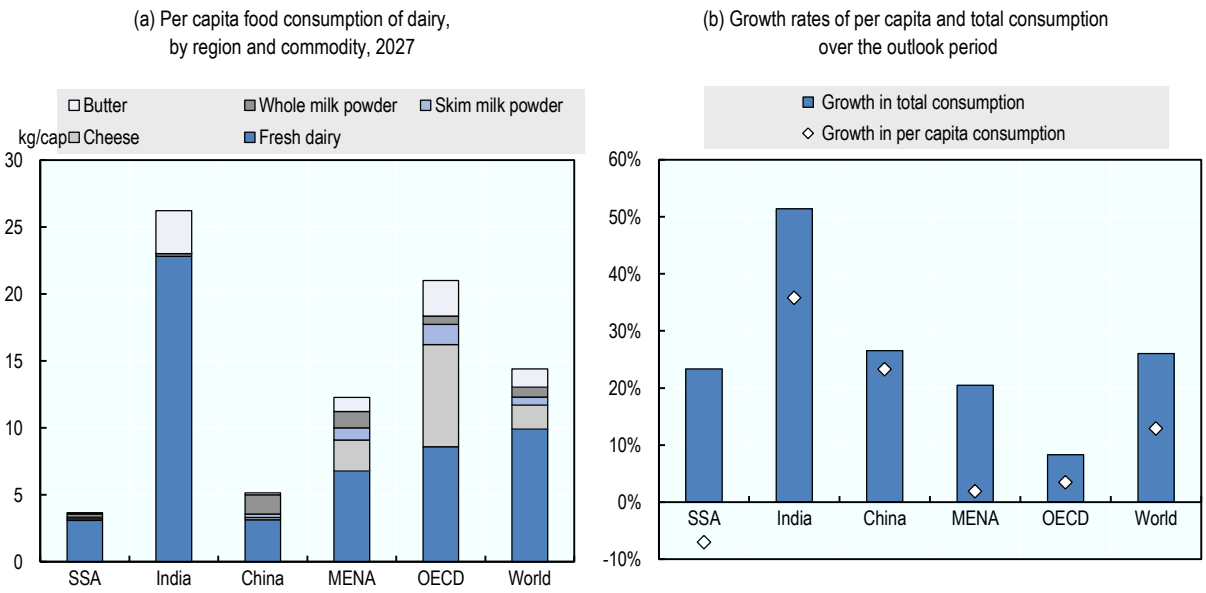
The past decade saw strong growth in the global per capita consumption of poultry (+16%), while the per capita consumption of beef and veal decreased by almost 5% between 2008 and 2017. For the coming decade, per capita consumption of poultry (typically the least expensive meat) is expected to increase by 5.5%, while beef and veal is projected to recover, with growth of 3.5% over the next decade, notably in China. Per capita pigmeat consumption will be flat at the global level, but growth is expected to be strong in regions and countries where pork is popular, such as Latin America and the Philippines, Thailand and Viet Nam. The role of China in global pork consumption growth is anticipated to diminish due to an already-high level of per capita consumption. Whereas China accounted for 65% of the increase in the previous decade, it will only contribute 45% of the expansion in the next ten years. Sheepmeat will remain a niche market in most countries, despite per capita consumption growth of 8% over the next ten years, concentrated mostly in China and other Asian countries as diets in the region diversify.

Dairy: Consumption of fresh dairy products expands in emerging economies

Dairy products can be consumed as fresh dairy products, butter, cheese, or as milk powders (e.g. for use in food processing). Fresh dairy products dominate consumption in developing regions and at a global level, while processed products such as butter and cheese dominate dairy consumption in the developed world (panel (a) (Figure 1.7).

Figure 1.7. Global consumption of dairy (in milk solids)



Note: Food consumption of dairy products in milk solid (fat and non-fat solid) equivalents. SSA is Sub-Saharan Africa; MENA is Middle East and North Africa. The Agricultural Outlook measures consumption in terms of food availability and hence does not account for waste.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742017

The dominance of fresh dairy products will increase in the coming decade, with 2.2% p.a. growth in consumption, the highest growth rate among the commodities covered in the *Agricultural Outlook*. This increase can be attributed largely to India, where dairy is an integral component of the diet. In Ukraine and Kazakhstan, per capita consumption is also expected to grow strongly from already-high levels.

While developing countries are increasingly consuming fresh dairy products, adding 8.4 kg/capita by 2027, fresh dairy consumption in developed countries will fall by 1.7 kg/capita as consumers continue shifting towards processed dairy products, such as milk powders, cheese and butter.

A growing preference for butter in higher-income countries has been attributed in part to changing perceptions of the health implications of consuming dairy fat. Despite strong price movements in the past year, global demand for butter is expected to grow at nearly 2.2% per year. This growth will be supported by high and expanding consumption in India.

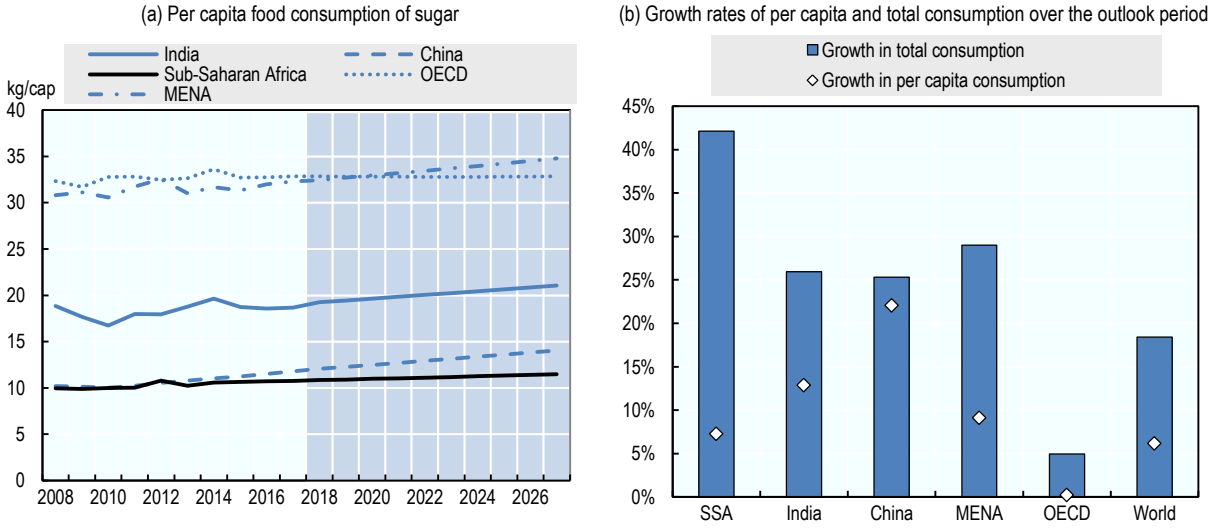
Sugar and vegetable oil: Consumption rising despite mounting health concerns

In addition to fresh dairy products, relatively high growth rates are also expected for sugar and vegetable oil, as urbanisation in developing countries leads to greater demand for convenience foods, typically characterised by a higher sugar and oil content.

Most of the additional demand for sugar will originate from the developing world (94%), in particular Asia (60%) and Africa (25%), two sugar-importing regions. Per capita consumption is projected to grow by 2.4 kg/capita in India, 2.5 kg/capita in China and 2.9

kg/capita in the Middle East and North Africa, compared with flat consumption in developed countries (Figure 1.8). In Sub-Saharan Africa, per capita consumption is projected to increase by 7% or 0.8 kg/capita over the next decade. Combined with strong population growth, total consumption in the region is expected to grow by 42%. While the increase in per capita consumption in Sub-Saharan Africa is relatively small, it contrasts with the projected decline in per capita consumption of meat, fish and dairy.

Figure 1.8. Food consumption of sugar



Note: Charts show food consumption of sugar from sugarcane and sugar beet (i.e. excluding other sweeteners such as high-fructose corn syrup). SSA is Sub-Saharan Africa; MENA is Middle East and North Africa. The Agricultural Outlook measures consumption here in terms of food availability and hence does not account for waste.

Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742036

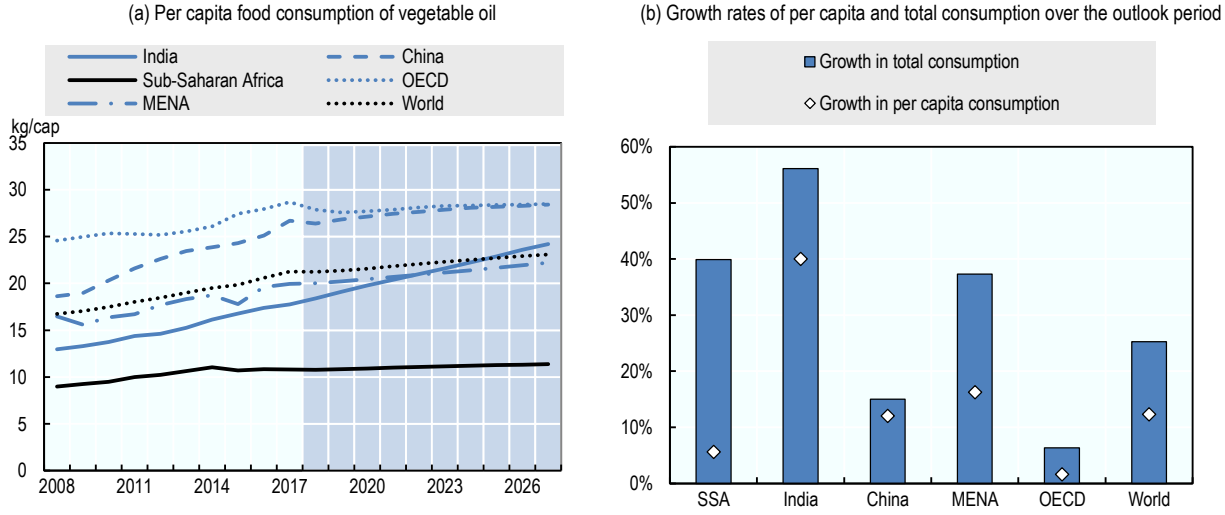
As for other commodities, patterns of sugar consumption are influenced by local factors as well as by incomes and preferences. For instance, per capita consumption is high in Brazil (the world's largest sugar producer) and other Latin American countries, and projected to continue increasing. Per capita consumption levels are also high in OECD countries, but projected to remain flat. This stagnation may partly be due to the identification of high levels of sugar consumption as a contributory factor to rising rates of obesity and non-communicable diseases. By contrast, even though per capita consumption levels in the Middle East and North Africa are similar to those in OECD countries, those factors are not expected to limit sugar consumption over the next ten years, which will continue to rise.

Compared with other commodities, expected growth in food demand is strong for vegetable oil, at 2.0% per year, although this represents a considerable slowdown compared with last decade's 3.9% annual growth rate.

For the world as a whole, per capita food use of vegetable oil is projected to increase from 21 to 23 kg per capita (Figure 1.9). In several developing countries, per capita consumption is approaching levels seen in the developed world. This is especially true for China, but also for India and the Middle East and North Africa. By contrast, per capita

consumption in Sub-Saharan Africa will remain at levels much below those in the rest of the world, although it is projected to increase by 6% over the outlook period, or 0.6 kg/capita.

Figure 1.9. Food consumption of vegetable oil



Note: Charts show food consumption of vegetable oil (i.e. excluding use as feedstock for biodiesel and other uses). SSA is Sub-Saharan Africa; MENA is Middle East and North Africa. The *Agricultural Outlook* measures consumption here in terms of food availability and hence does not account for waste.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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As the preceding discussion shows, the strong demand growth in the developing world does not always correspond to increasing per capita availability of food. In Sub-Saharan Africa, high growth rates for fish and meat are the result of strong population growth, while per capita availability is expected to fall; while in the Middle East and North Africa, per capita availability of meat and fish is not expected to increase much. By contrast, in these regions per capita availability of sugar and vegetable oil are expected to increase. More generally, Least Developed Countries (LDCs) are expected to increase their calorie availability at a slower rate in the coming decade, and this increase is due mostly to increased sugar and oil consumption while per capita intake of animal proteins is expected to remain low. As a result, malnutrition will remain an important problem in LDCs, as detailed in Box 1.2.

Box 1.2. Prospects for food consumption and nutrition in Least Developed Countries

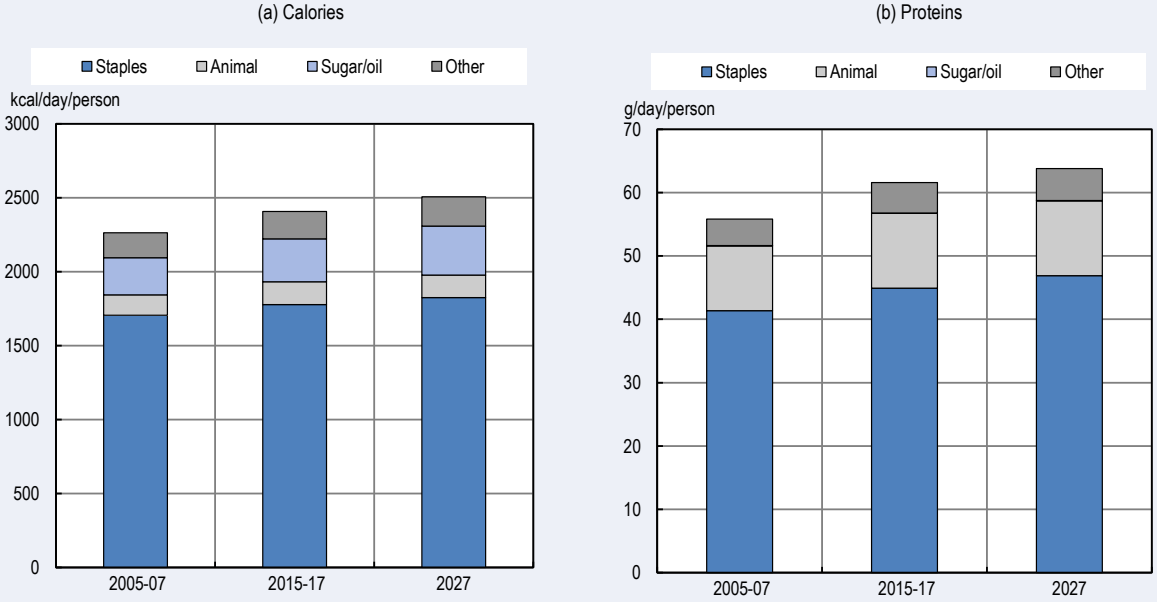
The United Nations recognise Least Developed Countries (LDCs) as particularly disadvantaged and deserving of special international support. Currently, countries with an annual per capita income below USD 1 025, a low level of human capital, and a structural vulnerability to economic and environmental shocks are classified as LDC. Of these, 33 are located in Africa, 13 in Asia and the Pacific, and one in Latin America. They are home to 12% of the global population, but account for less than 2% of global GDP and only about 1% of global merchandise trade.

Economic conditions in several LDCs have improved over the last decade, as average per capita income growth in LDCs exceeded 3% per year. Subsequently, the Prevalence of

Undernourishment (PoU) in LDCs as a group fell from 32.8% in 2000-2002 to 23.8% in 2010-2012. However, estimates for 2014-2016 suggest a rebound to 24.4%, equivalent to 232 million undernourished people.

Conflict and weather-related production shocks have been identified as the main factors driving the recent rise in undernourishment, particularly in the Middle East and North Africa. Wars and civil strife have been disrupting domestic economic activities and foreign exchange earnings as well as damaging local food production. Food import dependency, particularly for cereals, remains high in several of the most food insecure LDCs. Countries that are simultaneously affected by conflict and climate-related shocks have seen a particularly large toll on their food security. In 2016, these factors severely compromised the food security of 45 million people in eight LDCs (Afghanistan, Burundi, Central African Republic, Democratic Republic of the Congo, Somalia, South Sudan, Sudan, and Yemen).

Figure 1.10. Sources of calories and proteins in Least Developed Countries



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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The macroeconomic outlook for LDCs projects a 3% annual growth of per capita income over the next decade. This rate is expected to support a further increase in the calorie availability of LDCs, but at a slower rate. In the last decade, daily calorie availability grew 115 kcal to 2 415 kcal/day. In the coming decade, daily calorie availability in LDCs is projected to rise by 85 kcal, reaching 2 505 kcal/day by 2027. This is 30% lower than the projected level in developed countries, which should reach 3 482 kcal/day by 2027.

Not only has progress been limited in expanding calorie availability, it was also unevenly distributed across countries and regions – and will continue to be so. In Asian LDCs, calorie availability is estimated to reach almost 2 700 kcal/day, while African LDCs are expected to reach only 2 450 kcal/day by 2027 despite a higher growth rate. Food availability in LDCs in the Middle East and North Africa fell in recent years, but it is expected to recover from an current average of 2 270 kcal/day to 2 420 kcal/day by 2027.

Staples (cereals, pulses, roots and tubers) are expected to remain the main source of calories in LDCs, even if their share is expected to gradually decline to 73% in 2027, down from 75% in 2005-2007. The additional dietary energy is expected to come from more sugar and fats, which are

predicted to increase their share from 12% in 2015-2017 to 13% in 2027.

Even less progress is expected in improving the protein intake. Average protein availability will remain about 64 grams per day in 2027, mostly from cereals, with the availability of high-quality animal proteins reaching only about 12 grams per day. Consumers in LDCs will continue to have access to only a limited variety of foods and therefore their diets will still lack macronutrient diversity and essential micronutrients, adding to the burden of persistent calorie deficits.

The slow growth in dietary energy and continued poor nutrition prospects also suggest that many LDCs will not be able to meet the UN's Sustainable Development Goal of eliminating all forms of malnutrition by 2030. Achieving this goal would require substantial progress in reducing conflicts while helping smallholders to improve local production and bring about resilience to climate change and weather-related shocks.

Non-food uses affect demand for several agricultural commodities

For most agricultural commodities reviewed in the *Agricultural Outlook*, the demand for food uses dominates overall demand. However, non-food uses, particularly feed and fuel, are important for several agricultural commodities, and often show faster growth rates than food demand. In the case of feed, this will remain true in the coming decade. Biofuels by contrast were a major factor stimulating demand for agricultural commodities in the past decade, but growth is slowing down in the coming decade.

Feed: Rising share of global crop output directed towards feed use

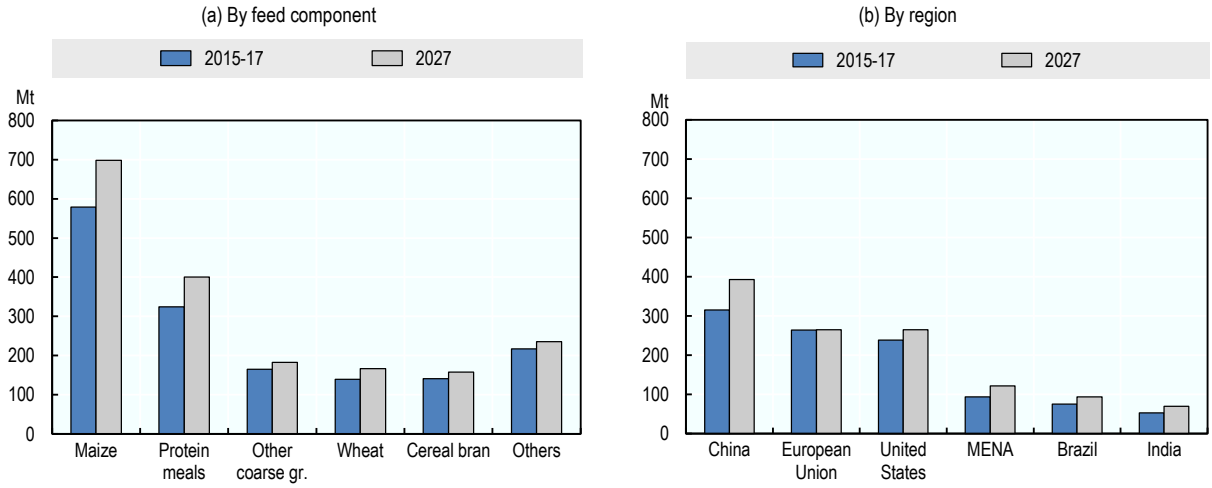
The global demand for feed reached 1.6 bln t in 2015-17, and is expected to increase further to 1.9 bln t by 2027, at an annual growth rate of around 1.7%. Demand for feed is thus expected to grow faster than the demand for several commodities shown in Figure 1.11 and markedly faster than food demand for cereals, for which 1.1% p.a. growth is expected. This growth results in about 260 Mt of additional feed demand by 2027; slightly less than the expansion of the previous decade in which demand grew by more than 300 Mt. Demand for feed also outpaces the growth in demand for meat, indicating an intensification of meat production.

The main set of agricultural commodities used for feed includes maize, protein meal, other coarse grains (especially barley and sorghum), wheat, and by-products of cereal processing such as cereal bran. As shown in Figure 1.11, maize and protein meal will remain the most important commodities used as feed, accounting for 60% of all feed by 2027 (up from 58% in the base period). Feed demand for maize is expected to grow by 21% over the outlook period, and demand for protein meal is expected to expand by 23%, considerably faster than the other commodities used as feed.

Projections for protein meal, which is derived from crushing oilseeds, will be influenced by developments in feed systems and in agricultural policies. For instance, Least Developed Countries' total demand is expected to grow around 45% between 2015-17 and 2027, reflecting the intensification of livestock production as these countries move towards compound feed-based livestock production. Yet, global demand growth for protein meal is expected to fall below the average annual rate of the past decade (1.7% compared to 4.2%). That high growth rate was in large part due to China, where the intensification of meat production coincided with a high support price for grains. This discouraged the use of maize as feed. The reduction of maize support prices in China since 2016 means that maize will play a more important role in the Chinese feed mix in the next decade.

Overall growth patterns in the demand for feed will vary across geographic regions. Around 30% of the additional demand for feed will originate in China, where feed demand is expected to grow 25% over the outlook period. Strong growth in feed demand is also expected in the Middle East and North Africa (+29%, with the region expected to account for around 10% of additional global demand), as well as Brazil (+25%) and India (+31%). Growth rates in the European Union and the United States are considerably lower at 0.4% and 11% over the outlook period respectively. For the European Union, this rate reflects the expected decline in domestic meat consumption over the outlook period.

Figure 1.11. Demand for feed



Note: MENA stands for the Middle East and North Africa.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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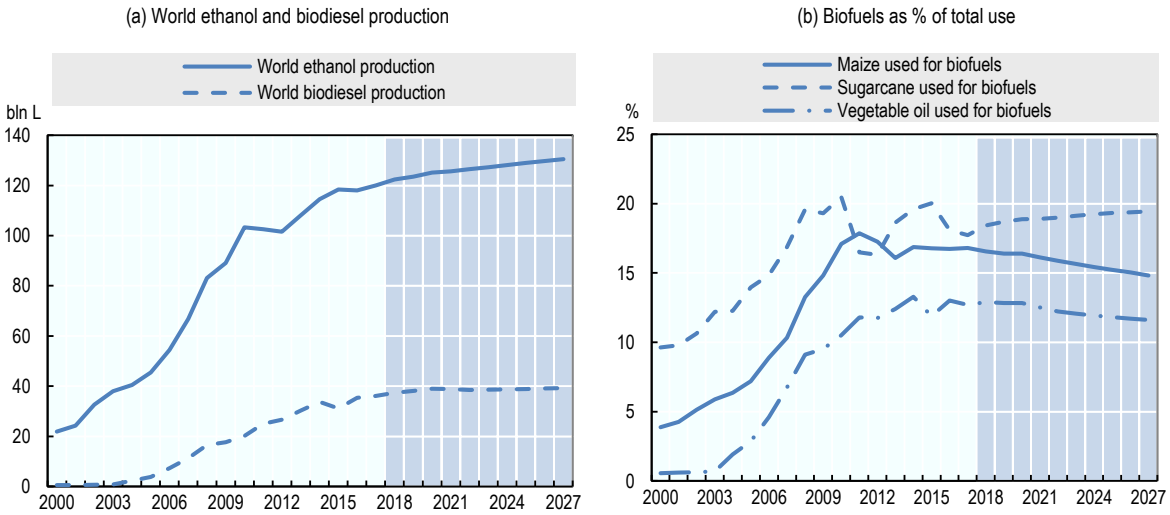
Fuel: Growth in Brazil and emerging producers

Agricultural commodities are not only used as food and feed, but also as fuel in the form of biofuels. These include ethanol, based mostly on maize and sugarcane, and biodiesel, produced mostly from vegetable oil. The evolution of biofuels is highly sensitive to potential changes in policy, as well as to overall demand for transport fuel, which in turn depends on the crude oil price. In many countries, mandatory blending rules impose a minimum share of ethanol and biodiesel to be used in transport fuel. The link between oil prices and biofuel prices is therefore complex, as explained in more detail in Box 1.3 The baseline projections in the *Outlook* are based on the policies currently in place in the key regions. Projections are clearly sensitive to changes in that policy environment.

In the second half of the 2000s, various policies started to stimulate biofuel production, leading to a strong increase in world ethanol and biodiesel output. As a result, a growing share of global sugarcane and maize production was used for ethanol production, while a growing share of vegetable oil was used for biodiesel production (Figure 1.12). This policy-induced expansion of biofuels was a major driver of increased demand for maize, sugarcane and vegetable oil over the past decade.

Over the next ten years, the demand for these commodities as inputs to biofuel production is expected to stabilise, as mandatory blending requirements are not expected to rise at the same pace as over the past ten years. As such, the production of biofuels is expected to grow more slowly over the coming decade. In the past ten years, global production of ethanol grew by 64 billion litres (bln L), equivalent to 3.9% p.a. growth; over the next ten years, only an addition of 12 bln L (0.7% p.a.) is projected. For biodiesel, the past decade saw an increase of 29 bln L (9.5% p.a.), whereas only 5 bln L (0.4% p.a.) is expected to be added over the outlook period.

Figure 1.12. Biofuels and the demand for feedstock, 2000-2027



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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The composition of the demand for biofuels is also changing, with a shift towards developing countries which are increasingly putting in place policies favouring the domestic biofuel market. For ethanol, the main markets are the United States, Brazil, China, and the European Union. Declining demand for transport fuel is expected to decrease the demand for ethanol in the United States and the European Union, while strong growth is expected in Brazil, China, and Thailand, spurred by favourable policies. The demand in China could increase further with the implementation of the country's proposed new ethanol mandate (discussed in the Biofuels chapter). Overall, 84% of the additional demand for ethanol in the coming decade will come from developing countries.

For biodiesel, the main markets are the European Union, the United States, Brazil, Argentina and Indonesia. As with ethanol, demand is expected to decline in the European Union and the United States, which will drive down demand for vegetable oil as feedstock. Instead, an expansion is expected in Brazil, Argentina, Indonesia, and other developing countries, again mainly through favourable policy measures.

Food, feed and fuel: Competing sources of cereal demand

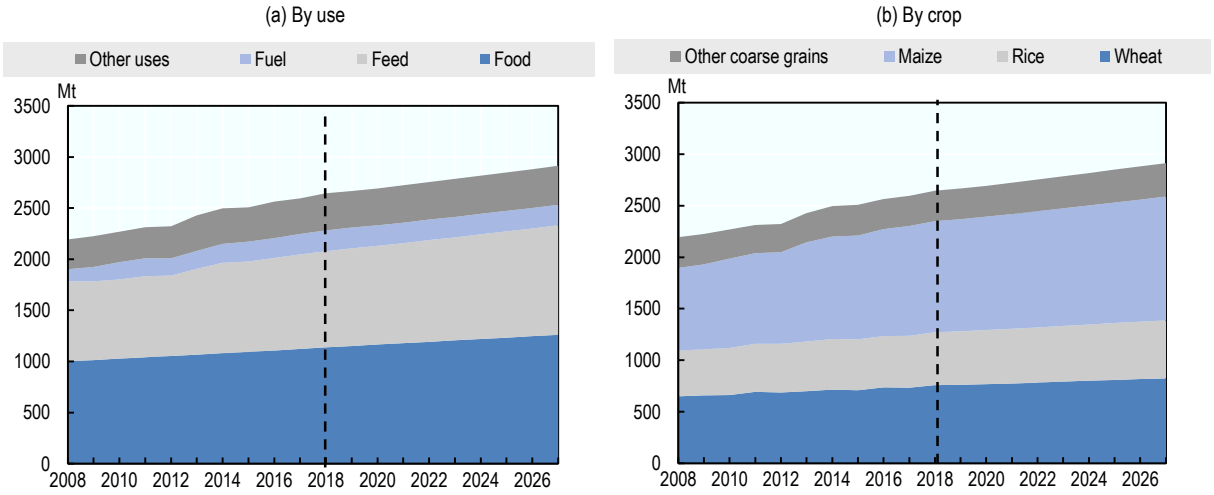
In addition to being an important and relatively low-cost source of calories, cereals are widely used for feed and fuel, in large part because of the ease with which cereals can be processed into other forms. This versatility also implies that food use of cereals may

come into competition with non-food uses, especially when non-food uses expand rapidly.

As shown in Figure 1.13, between 2005-7 and 2017 the global demand for cereals increased by around 520 Mt to around 2.6 bln t. Over the coming decade, demand will grow by around 360 Mt, but the composition of this demand growth is changing. While fuel was a major component of demand growth in the past decade (contributing more than 120 Mt to demand), this is no longer expected to be the case over the outlook period. Instead, food and feed uses are driving growth, together accounting for almost all additional demand over the coming decade.

Panel (b) shows cereal demand by crop. In the past decade, maize accounted for almost 330 Mt of the 520 Mt of additional cereals demand, or more than 60%. Over the outlook period, demand for maize will grow by 164 Mt, accounting for 46% of demand growth only. This slowdown in growth is consistent with the evolution of biofuel markets over the coming decade. For both rice and wheat, demand growth is expected to be more robust, with 97 Mt of additional wheat demand and 66 Mt of additional rice demand, most of it for food uses. Following flat demand over the last decade, renewed interest is expected in other coarse grains, which are projected to grow by more than 32 Mt over the coming decade. The projected trends in cereals are thus a reflection of the demand trends in food, feed and fuel.

Figure 1.13. Global demand for cereals, 2008-2027



Note: The *Agricultural Outlook* measures demand in terms of availability, and hence does not account for waste.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Production

While the last decade was characterized by robust demand and high agricultural prices, leading to strong production growth across commodities, the coming decade will see global agricultural production grow more slowly. Under the current set of assumptions, agricultural and fish production is expected to grow by 1.5% p.a. over the coming decade, or a total growth of 16% over the outlook period. Most of this growth will be due to

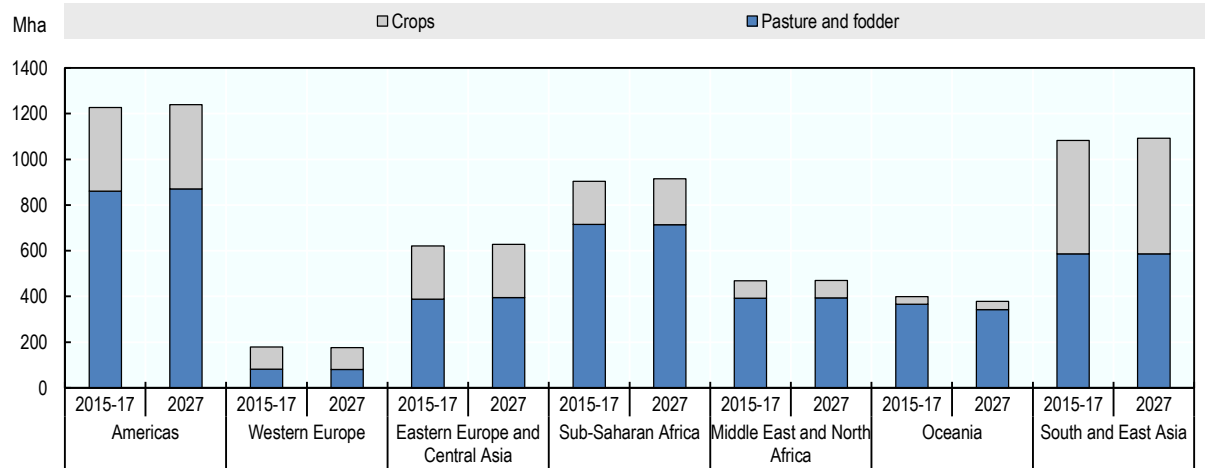
increasing productivity, with no major increase in agricultural land use at the global level, although this varies by commodity and by region. Trends across main producing regions are discussed in more detail below.

Agricultural output will grow with little change in global land use

Land is an important input into agricultural production, both for arable crops and for grazing. Production growth in agriculture can come from taking more land into production, or from increasing the output per unit of land. Since land use is largely defined according to agro-ecological characteristics, the availability of agricultural land and the relative share of cropland versus pasture differ strongly across regions (Figure 1.14). Since 1960, global agricultural land is estimated to have increased by around 10%, with most of this increase occurring before 1990 and relative stability since. At a global level, this relative stability is expected to continue over the coming decade.

Pasture land, used for grazing ruminants such as cattle, sheep, or goats, is mainly concentrated in three regions: the Americas, which hold over one-fourth of the world's pasture land; Sub-Saharan Africa, which accounts for 21% of global pasture; and South and East Asia, home to 17% of global pasture. While the Americas and South and East Asia also lead in global ruminant meat output, jointly producing more than 60% of global supplies in 2015-17, Sub-Saharan Africa only contributes about 8%. This low share is indicative of the small-scale and in large part traditional nature of the sector. Western Europe, by contrast, reports the lowest share of global pasture at 2%, yet accounts for 11% of global ruminant meat in 2015-17, an indication of the industrial nature of meat production in the advanced economies of that region.

Figure 1.14. Land use in global agriculture, 2015-17 and 2027



Note: Western Europe includes the European Union, Norway, and Switzerland; Eastern Europe and Central Asia includes the Russian Federation, Ukraine, Kazakhstan, Turkey, Israel, some smaller non-EU countries in Eastern Europe, and some smaller Central Asian countries); Middle East and North Africa is as defined in Chapter 2; Oceania includes Australia, New Zealand and some smaller countries in the region; South and East Asia includes all other countries.

Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

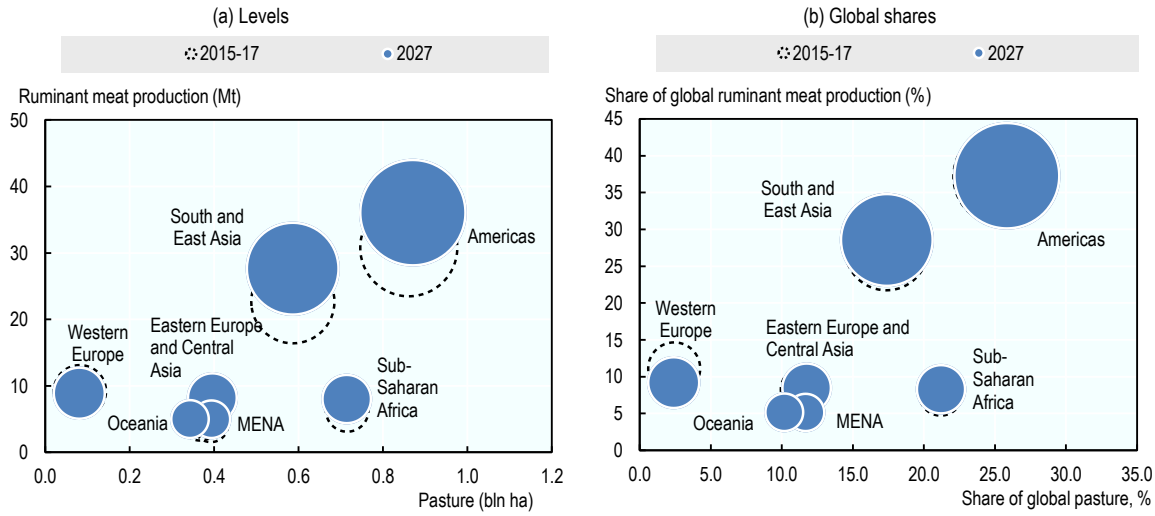
StatLink http://dx.doi.org/10.1787/888933742150

Changes in ruminant meat production will not be accompanied by corresponding shifts in global pasture area over the outlook period. While global production is projected to increase 16% for beef and veal and 21% for sheepmeat, largely due to increases in output in the Americas, South and East Asia and Sub-Saharan Africa, the land allocation to pasture remains largely unchanged. Moreover, the non-ruminant meat sector, which does not require pasture, is also set to expand over the coming decade, with global poultry and pigmeat production growing 18% and 11% respectively.

About half of global crop land is dedicated to cereals and oilseeds. Given arable land constraints, the overall area of crop land is not expected to change substantially over the coming decade, and productivity growth will be essential for sustaining crop production growth. Nevertheless, changes in area allocation and yields will vary across crops and regions. For maize and other cereals, most of the production increase will come from higher yields, not from greater land use (except for maize in Latin America). For other crops, soybeans in particular, land use will play a greater role, as area expansion and greater cropping intensity is expected in Latin America (Brazil, Argentina) (Figure 1.15).

Yields are set to rise fastest for Sub-Saharan Africa, albeit from a low base, with high growth rates across practically all crops. This trend is indicative of the production potential of the region, but also of the relatively low yields experienced today for most major commodities. In comparison, Western Europe and the Americas will record more moderate yield growth rates, as productivity is already high for most crops. Figure 1.16 indicates that maize yields will reach 8.0 t/ha in Western Europe by 2027, and in the Americas 8.6 t/ha, compared to only 2.5 t/ha in Sub-Saharan Africa.

Figure 1.15. Pasture and ruminant meat production by region



Note: MENA stands for Middle East and North Africa. The size of e ach bubble is proportional to the region's ruminant meat production level.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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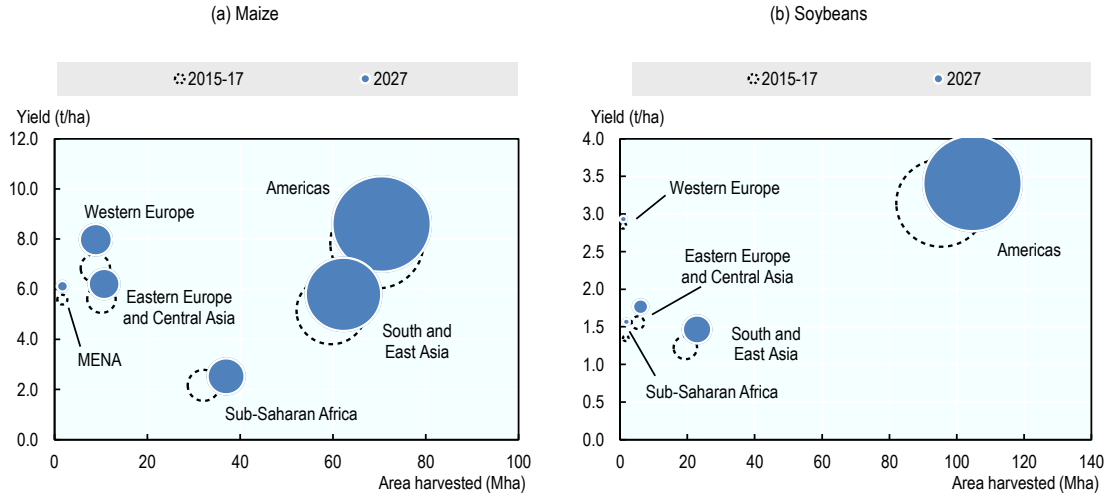
Figure 1.16. Crop land and yield trends for maize and soybeans



Note: MENA stands for Middle East and North Africa. The size of each bubble is proportional to the region's crop production.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

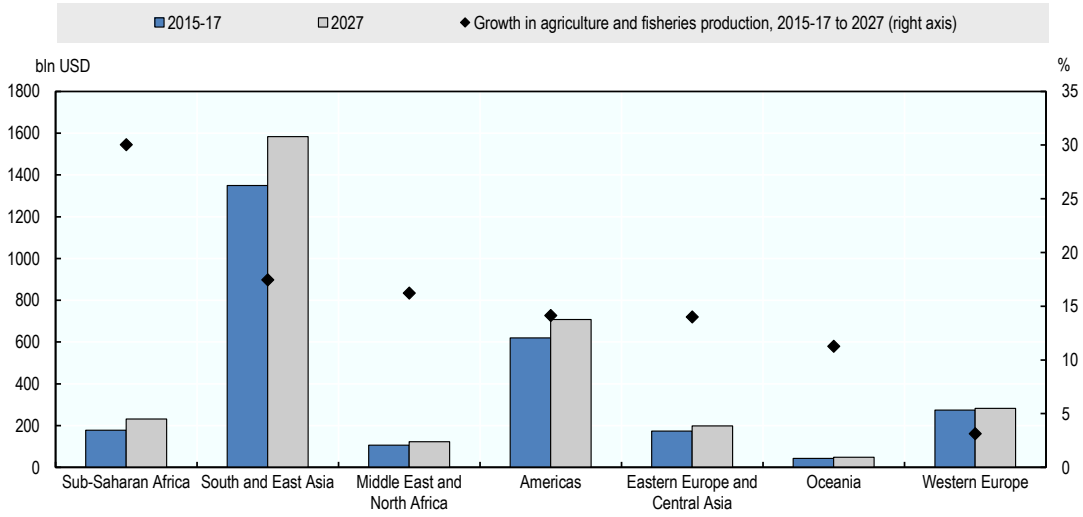
StatLink http://dx.doi.org/10.1787/888933742188

Developing regions expand and intensify agricultural production

Over the coming decade, the expansion of agricultural production will be disproportionately concentrated in the developing world (Figure 1.17). The fastest growth is expected in Sub-Saharan Africa and South and East Asia, with the latter also expected to show the greatest growth in absolute terms. Overall, output will expand less in developed economies, notably in Western Europe, where agricultural and fish production is only projected to grow by around 3% over the outlook period.

The improved availability of high-quality seeds, fertilisers and other technologies will favour production, while sustainability concerns may impose constraints. Agricultural policies worldwide will also shape global production decisions. India's agricultural policies are focused on stimulating agricultural growth in order to meet domestic food security objectives, while other countries such as China and Argentina are aligning more closely with global markets. Since such trends do not affect all regions and commodities in the same way, the factors underlying these regional trends are discussed in more detail below.

Figure 1.17. Regional trends in production



Note: Figure shows the estimated net value of agricultural and fish production, in billions of USD, measured at constant 2004-6 prices. Regions as defined in Figure 1.14.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742207

Sub-Saharan Africa: Productivity gains in basic foods

Despite accounting for over 13% of the world population and close to 20% of global agricultural land, Sub-Saharan Africa's share of global agricultural output is relatively low. Agricultural production is constrained by challenging agro-ecological conditions, limited access to and utilisation of technology, and the fact that economic growth in many cases remains only marginally ahead of population increases. Its most important commodity, among those analysed by the *Outlook*, is 'other coarse grains' (including millet, sorghum and teff) for which Sub-Saharan Africa today accounts for 14% of global production.

However, robust growth in agricultural production is expected for the coming decade. Crop production will expand by 30%, while meat, dairy and fish will respectively grow by 25%, 25% and 12%. This output growth will be accompanied by area expansions for maize, soybeans, and sugarcane and improved productivity across the board. Fertiliser, pesticides, improved seeds, and other technologies such as mechanisation and irrigation have the potential to introduce substantial productivity gains, as adoption is typically low among the small-scale production units that characterise the region.

Even with the projected strong growth, the region's food security will continue to depend on global markets as domestic production capacity will remain insufficient to meet the region's growing consumption needs. At the same time, there are some commodities for which African countries have become regional providers. Maize is one example, where Zambia consistently produces an exportable surplus. Vegetable oil is another example, as West African countries seek to promote their palm oil sectors, and production is expanding rapidly, notably in Nigeria. Yield improvements are expected to contribute to a 22% growth in output of palm oil in Sub-Saharan Africa over the outlook period. Similarly, yield improvements in teff production in Ethiopia will allow the country to account for nearly one-fifth of the world's production growth in other coarse grains.

Robust production growth is also expected for cotton (+33% over the outlook period), sugarcane (+18%) and sugar (+34%). Yield improvements will account for the cotton production expansion, notably in the case of Burkina Faso. Although the growth in sugar and sugarcane production marks the region among the fastest growing for these two commodities, by 2027 Sub-Saharan Africa will still account for less than 5% of global output.

Emerging challenges to agricultural production could threaten any of these projections for the region. The recent emergence of the Fall Armyworm, which has affected 28 countries across the region, could have serious implications for the region's expansion of maize, rice, sorghum, sugarcane and soybean production and, by extension, its food security (Box 1.4).

South and East Asia: Production growth remains strong amid sustainability challenges

South and East Asia (which includes China, India, Japan, Korea, and the countries of Southeast Asia) is the world's main producer for an array of agricultural products. Despite facing serious constraints in terms of land, water, and workforce shortages, the region produces almost 40% of the world's output of cereals (including nearly 90% of global rice output); close to 40% of global meat production; more than half of vegetable oil supplies; and nearly 70% of combined global capture and aquaculture fish production.

The coming decade is likely to add new challenges, in particular the need to reconcile high output levels with increasingly stringent standards for sustainable production. Nonetheless, the region is expected to expand agricultural and fish production by 17% over the outlook period.

Yield improvements will underlie a large part of the expansion of crop production, with yield growth over the outlook period of 10% for wheat, 12% for maize and rice, 15% for cotton and 20% for soybeans. While these figures are in line with global trends, oilseed yields are set to rise strongly in India, led by investment in production and information technologies, such as eNAM, an online trading platform for agricultural commodities. Oilseed production and crush are anticipated to expand as India seeks to meet growing domestic demand for vegetable oil.

Indonesia and Malaysia will continue to supply most of the world's palm-oil sourced vegetable oil. Intensification of production on existing palm oil plantations is foreseen as area expansion possibilities are limited, especially in light of global pressure to improve the sustainability of palm oil production.

South and East Asia will remain a major global supplier of meat and dairy commodities, accounting respectively for 39% and 44% of global output by 2027. Dairy production is set to expand by 41% over the outlook period with butter rising 44% and milk expanding 40%. Meat production will grow by 18%. China, India and Thailand will lead output growth of poultry and sheep meat, while slower growth in pork for the region is explained by a slowdown in China's production.

Fish production from capture and aquaculture will expand by 15% in South and East Asia, despite China's plans to scale back fisheries production over the coming decade and introduce sustainable practices to the sector. If China's 13th five-year-plan is fully implemented, capture fisheries from China will contract by about 29% by 2027, and aquaculture will expand by 20%, instead of 31% in the absence of the plan. With limited global capacity to fill China's production gap under the five-year-plan, upward pressure

will be placed on global fish prices (as discussed in more detail in the Fish and seafood chapter).

Biofuels production expansion in the region is also led by China, which is expected to become the world's third largest ethanol producer, with output of 11 bln L by 2027. About half of that output will be directed to biofuel production; the remainder is allocated to industrial uses. This projection does not take into account the possible impact of a recently proposed new nationwide E10 ethanol mandate. If implemented, this could raise Chinese ethanol output to 29 bln L by 2027, similar to the expected output for Brazil. (The possible impacts of this mandate are explored in more detail in the Biofuels chapter). Thailand is also projected to play a prominent role in regional and global ethanol markets producing 3.2 bln L in 2027. In terms of biodiesel, Indonesia will continue to be the region's main producer (4.3 bln L in 2027).

In India, policy makers focus on promoting agricultural growth to meet domestic food security objectives, and policies will likely seek to stimulate investment in the domestic agricultural sector both through protection against import competition through import tariffs and through producer support. While India's policies may impact domestic production more than global markets, China's policies, in particular regarding cereals, are likely to affect global markets through price movements, stock releases and import regulations. The reduction in maize support prices since 2016 will have implications in the coming decade for domestic and global production of maize, soybean, and other coarse grains.

Middle East and North Africa: Improved economic growth set to stimulate agricultural output

The agricultural sector in the Middle East and North Africa has historically been constrained by unfavourable agro-ecological conditions for crop production as well as political instability. However, over the coming decade, the region is projected to enter a period of improved economic growth, which should underpin 16% growth in agricultural and fish output over the coming decade. Greater agricultural production will depend on innovation to enhance productivity growth in the face of scarcity of water and arable land across the region.

Livestock activities serve as the main source of agricultural value added in the region, with regional production of meat and dairy largely taking place in Iran and Egypt. Poultry is the main type of meat produced by these countries, each of which will pursue both extensive growth and productivity improvements over the coming decade. Production of milk, maize and oilseeds will expand at faster rates than over the previous decade. Nonetheless, the region will remain a net importer of these and most major commodities, given its various production constraints.

More details on the region's production trends can be found in Chapter 2, which offers an in-depth discussion of the agricultural sector with disaggregated projections for most countries in the region.

Americas: Export-oriented agricultural sectors respond to global demand

Alongside South and East Asia, the Americas are major producers of most commodities analysed by the *Outlook*. The region accounts for nearly 90% of global soybean production, and also holds large shares of global production in cereals (28%), specifically maize (52%). The region is a large producer of commodities with a high value added,

such as protein meal, sugar, and biodiesel, where it accounts for 41%, 39%, and 42% of global output, respectively. With area harvested expanding and crop intensities rising over the next ten years, crop production in the region is anticipated to grow by 14%.

Area expansion will lead sugar production from Brazil, the world's leading producer, to grow 1.9% p.a., contributing to a 1.8% p.a. growth for the region as a whole. This growth occurs despite replanting setbacks and the competition between sugar and sugarcane-based ethanol production, as Brazil is also a global leader in biofuel production. Ethanol production in Brazil is set to expand by 1.5% p.a. over the outlook period. However, its global share will decline from 90% to 88%, given a rapid expansion of production in Asia.

Global soybean production will remain dominated by the United States and Brazil. In Brazil, higher cropping intensity will sustain its position, as it obtains soybean as a second crop on land cultivated with maize. These expansions will provide an input to regional dairy production and the global supply of protein meals and vegetable oils. In this context, Colombia is expected to become a net exporter of vegetable oil over the outlook period, expanding its area for oil palm cultivation, while Paraguay will follow trends in Brazil, expanding the area dedicated to soybean production and increasing oilseed crush.

The development of protein meal production will be essential for feeding the region's growing livestock sector. The United States and Brazil will continue to produce most of the world's meat supplies, with herd expansions in both regions. Production is expected to grow by 17% for beef and pork, 16% for poultry and 9% for sheep. Animal products such as milk and eggs will grow at similarly robust levels. Fish production is expected to expand by 9% over the outlook period, with a major expansion in aquaculture (+35%), in particular in Brazil and Chile.

Eastern Europe and Central Asia: Growing prominence in global cereals market

Agricultural production in Eastern Europe and Central Asia (a region which includes the Russian Federation, Ukraine, Kazakhstan and Turkey as main agricultural producers) expanded rapidly over the previous decade, due to an overall economic recovery and considerable investments into the modernisation of agriculture. In the coming decade, agricultural and fish production will expand by 14%.

In terms of arable crops, the region will maintain its position as second-largest wheat producer, increasing its share of global production to almost 22% by 2027. Maize output will also expand by 17% over the outlook period, although the region's global share will remain relatively low, at less than 6% by 2027. The region's share in global production of sunflowers and rapeseed will increase from 22% in 2015-17 to 25% by 2027, underpinned by an expansion in area harvested, which will be offset by a reduction in the area for roots and tubers.

These shifts in crop production are largely attributable to the evolutions in the Russian Federation, with area expansion underpinning growth in production of soybeans, other oilseeds, cereals and sugar beet. For the rest of the region, yield improvements will contribute disproportionately to output growth.

Livestock production will grow both in terms of meat and dairy products, accompanied by an increase in pasture area of 2% over the outlook period. The meat sector will expand 16% for the region, despite much slower output growth for the Russian Federation. Dairy production in the Russian Federation will be flat over the next ten years (following a

contraction of 0.7% p.a. in the last decade). For the region as a whole, milk production will grow 1.1% p.a., and dairy processing is expected to focus on cheese production, leading to a growth of 1.7% p.a.

In contrast to the trends in the Russian Federation, Turkey should experience a production expansion for meat. Herd size expansion and yield improvements will characterise beef, sheep and poultry production for Turkey, in part driven by a self-sufficiency policy for red meat over the outlook period. In parallel, Turkey's cotton sector, one of the highest-yielding globally, will also see production growth. Its output is based on non-GM seeds, and yield improvements will come from mechanisation, irrigation, and the use of improved seeds.

Oceania: Environmental regulations constrain growth of livestock sector

Oceania is an important agricultural producer and net exporter of meat, dairy and cereals. As is the case in most other regions, Oceania will expand production of its main commodities at a slower rate than in the last decade.

Despite productivity improvements foreseen over the coming decade, the global share of sheep meat from Australia and New Zealand will decline as developing countries expand output. This relative decline will occur in parallel to a slowdown in milk production from the region, emerging from land constraints and environmental restrictions. Consequently, milk output in New Zealand will expand at 1.5% p.a., down from 3.3% p.a. over the last decade. The region is also an important producer of skim milk powder (SMP) and whole milk powder (WMP); by 2027, it will account for 17% of SMP and 27% of WMP global supplies.

Coconut oil production will become the focus of niche production by countries in the region over the coming decade, yielding per annum growth in vegetable oil production of 2.2%. For cotton, an increase of 16% in area harvested over the outlook period will underpin output growth in the region. In Australia, cotton production is expected to expand by 23%, due in part to the adoption of GM varieties.

Total fish production will increase by 19%, and will continue to play a major role in the food security of many Small Island Developing States in the region.

Western Europe: High productivity maintained within tight regulatory and resource base

The countries of Western Europe (which includes the European Union, Switzerland, and Norway) hold significant shares in the global production of other coarse grains (barley, oats, rye; 31% of global production); other oilseeds (rapeseed, sunflower; 20%); wheat (20%); milk (21%); and meat (15%). The coming decade will see declines in these global shares as other countries and regions report faster growth.

The decline will be especially pronounced for biodiesel, where the region's share of global production will fall from 40% to 34%, as output falls by around 4% over the outlook period, in line with lower demand for diesel. Despite this diminishing share in global production, Western Europe will remain the world's second largest producer of biodiesel. A major uncertainty in the region is the potential reduction in obligatory blending which, if implemented, would drastically reduce production.

Total agricultural and fish production for the region will grow by about 3% by 2027, making it the region with the slowest expansion of production for the projection period. Despite this slow growth, and the region's limited potential for area expansion, its strength as a region of high productivity and continued high yields allows it to remain a major global provider of numerous agricultural commodities.

As the area harvested for various crops such as other oilseeds, sugar beet, and roots and tubers is expected to contract over the outlook period, crop production growth will come predominantly through yield improvements, which is notable for a region that already reports some of the highest yields in the world across commodities. Fish production will also show limited growth, mainly due to strict management and environmental policies.

The EU system of sugar quota was abolished in 2017. In the past, the quota system kept EU sugar prices above the world market price while limiting producers' ability to respond to these higher prices. The anticipated end of the quota system led to a 14% increase in sugar beet area in 2017 compared to the previous year, but in the coming decade, as EU prices fall in line with global markets, the area dedicated to sugar beet is expected to contract again to pre-2017 levels. At the same time, sugar beet yields will continue to grow. The net result is that sugar beet output in the European Union will expand by 2.5% between the base period (2015-17) and 2027.

Strict management and environmental policies will constrain growth in fish, livestock and dairy production. Policies such as the EU nitrate directive, which imposes constraints on nitrates from agricultural production to protect water quality, is expected to constrain growth in milk output, and in turn beef production, over the outlook period. Despite the slowdown in fresh milk production, which will grow by 8% over the next decade (compared to 10% for the past ten years), SMP and WMP output for the region will expand by 10% and 18% by 2027. For WMP, this growth is substantially above that of the previous decade.

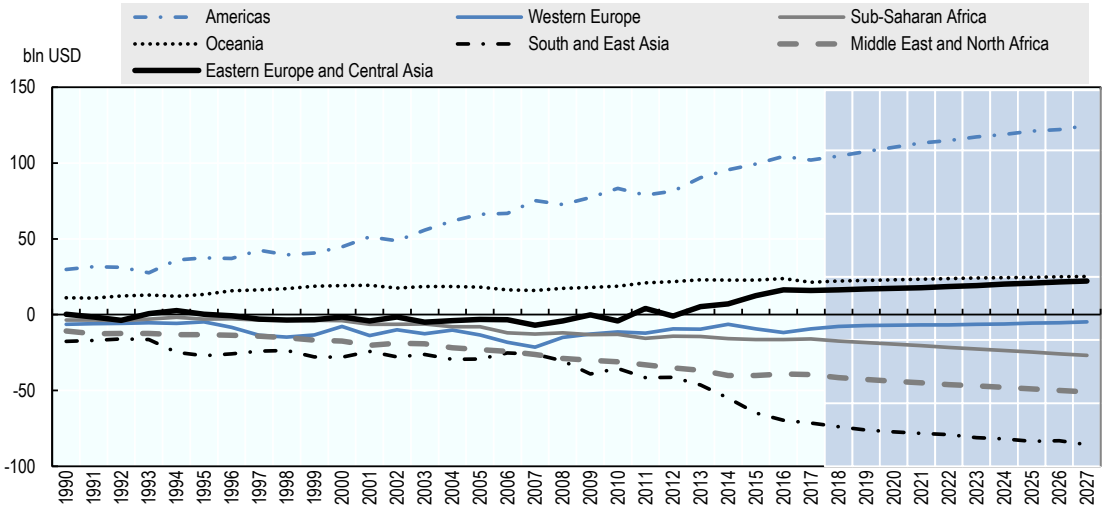
Trade

Specialisation between regions is increasing

Differences in climate and geography, including the availability of good agricultural land, determine the pattern of comparative advantage in producing different agricultural commodities. Together with differences in population density and population growth, as well as policy factors, this determines trade flows between regions. Countries with slow population growth, low population density and favourable natural endowments tend to become exporters of agricultural commodities, while countries with rapid population growth, greater population density, and less favourable natural endowments tend to become importers.

Figure 1.18 shows the historic and projected evolution of agricultural trade balances by region. These balances broadly reflect the forces described above and are projected to become more accentuated over time in most regions.

Figure 1.18. Agricultural trade balances by region, in constant value, 1990-2027



Note: Net trade (exports minus imports) of commodities covered in the *Agricultural Outlook*, measured at constant 2004-06 USD. Regions are as defined in the Production section.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742226

Net exporters: Traditional suppliers expand market shares for most commodities

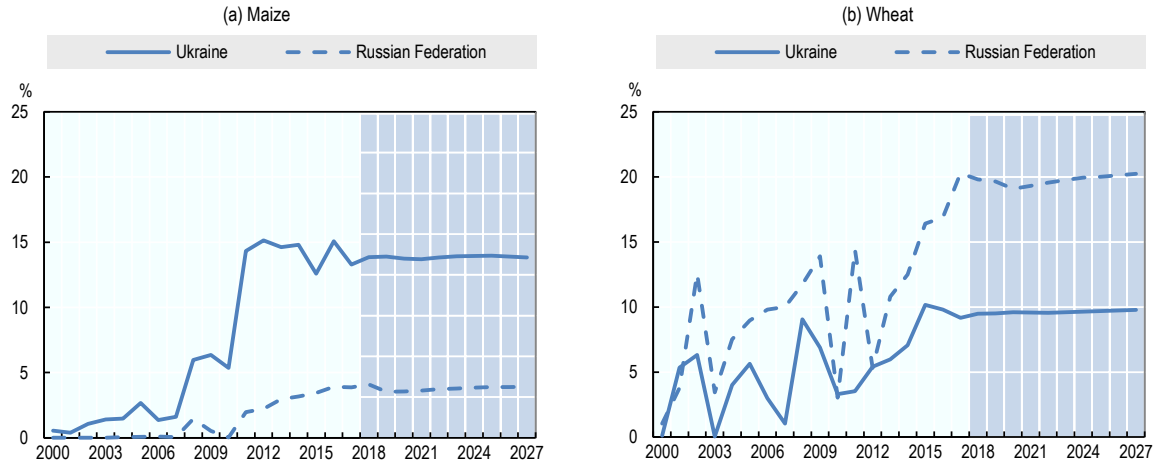
The Americas and Oceania are traditionally net exporters of agricultural commodities. The overall surplus for the Americas is split roughly equally between North America (United States and Canada) and Latin America and the Caribbean (most notably Brazil and Argentina). In Oceania, Australia accounts for roughly 60% of the overall surplus, with New Zealand accounting for the remainder.

While Oceania's agricultural trade surplus has remained stable over time, there has been a strong growth in the agricultural trade surplus of the Americas. Net exports have increased over time as producers responded to higher international demand for maize, soybean, and meat, among other commodities. The positive trade balance of the Americas is expected to expand further over the projection period.

In recent years, Eastern Europe and Central Asia has emerged as an important agricultural exporter. This change can be traced to improved export performance of the Russian Federation and Ukraine. The Russian Federation has switched from being a net importer to net exporter since around 2013. Agricultural trade in Ukraine was roughly balanced until 2007, when a strong growth in net exports began. The strong growth in Russian and Ukrainian exports is reflected in these countries' shares of global maize and wheat exports (Figure 1.19). Before 2008, Ukraine accounted for less than 5% of global maize exports. By 2011, this share had grown to 15%. The Russian Federation's share of global maize exports remains more modest, but nonetheless has grown from practically 0% in 2010 to 4% of the global total. In wheat, the relative positions are reversed. Both Ukraine and the Russian Federation have a history of exporting wheat surpluses globally, although export shares tended to be highly variable before 2012. Since then, the export shares have grown while becoming less volatile. Ukraine now accounts for 9% of global wheat

exports, while the Russian Federation is now the largest exporter, providing 19-20% of global exports.

Figure 1.19. Ukraine and the Russian Federation: Share of global exports for maize and wheat



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Net importers: Rising trade deficits among countries with rapid population growth

South and East Asia is a major net importer, although aggregate figures for the region hide considerable heterogeneity across countries. While Indonesia and Malaysia are established as net exporters (in large part due to palm oil), Japan is historically a net importer, although its agricultural trade deficit has been broadly constant over time. Conversely, since 2000 the Chinese agricultural trade deficit has grown strongly, accounting in 2017 for USD 40 billion of the region's USD 70 billion trade deficit (in constant 2004-06 dollars). Net imports in China (and hence in South and East Asia as a whole) are expected to grow in the coming decade, but at a slower rate.

Two regions which have similarly experienced increasing agricultural trade deficits are the Middle East and North Africa, and Sub-Saharan Africa. However, the role of imports in satisfying the consumption needs of these two regions varies considerably. While imports represent nearly 20% of consumption of major food commodities in Sub-Saharan Africa, approximately 57% of consumption is met through imports in the Middle East and North Africa region. The evolution of import dependence in the Middle East and North Africa is discussed in more detail in Chapter 2.

Western Europe's agricultural trade deficit (mostly attributable to the European Union) peaked in 2007. Since then, the deficit has fallen by around half to some USD 10 billion (at 2004-06 prices), and is expected to further decrease by around half over the outlook period.

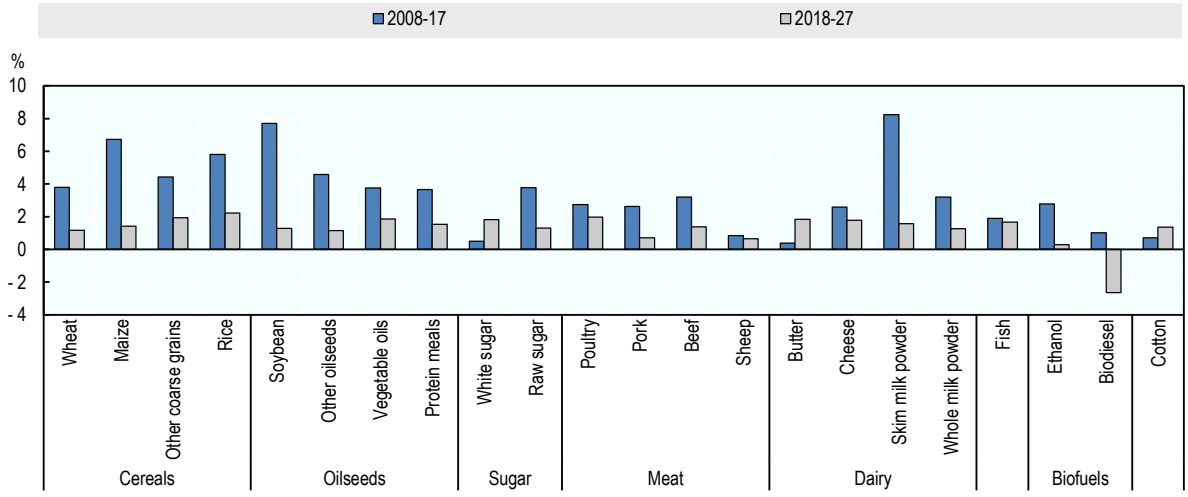
Trade in fish and seafood

Regional trends in the overall agricultural trade balance may mask differences in the pattern of net importers and net exporters of specific commodities, such as fish and seafood, one of the most intensively traded products covered in the *Outlook*. Whereas the United States is a large net exporter of agricultural commodities and China a large net importer, the situation is reversed for fish and seafood. Over time, such regional differences have become more pronounced; since the early 1990s, net imports have increased in the European Union, the United States and Sub-Saharan Africa (among others), while net exports have increased in Norway, Viet Nam and China. For net exports, Viet Nam and Norway are expected to continue increasing their exports but a decline is projected for China due to a reduction in its fish production coupled with growing domestic demand.

Agricultural trade growth is slowing

Across the commodities covered in the *Agricultural Outlook*, the growth of trade volumes is expected to slow down significantly, as shown in Figure 1.20. For some commodities such as skim milk powder, soybeans, and cereals, trade volumes grew strongly in the past decade with growth rates of 4% to 8% per year. In the coming decade, consistent with the slower growth of demand, trade volumes will grow at a much slower pace. The highest expected growth rate (for rice) is only 2.2% per year, while some commodities (e.g. biofuels) will barely register any trade growth at all.

Figure 1.20. Growth in trade volumes, by commodity



Note: Annual growth rate of trade volumes.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

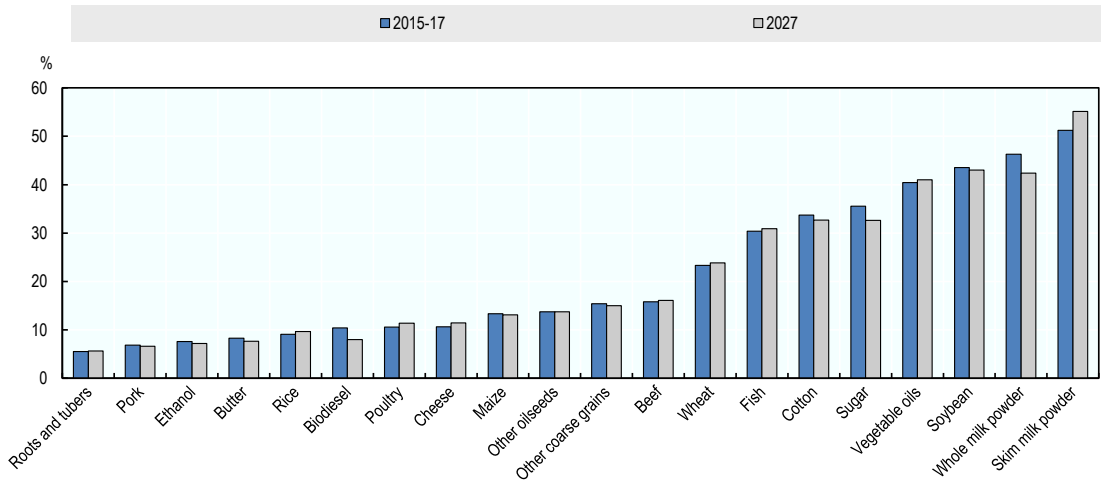
StatLink http://dx.doi.org/10.1787/888933742264

The importance of trade differs by commodity, as shown in Figure 1.21. For many agricultural commodities the share of production traded is low. Less than 7% of global pork production is traded internationally, and only around 8% of global butter production; the share is 9% for rice and 10% for biodiesel. Only for some commodities does trade represent at least one-third of global production. This is the case for cotton, sugar and soybeans, and also for vegetable oils and milk powders, which have a higher degree of processing.

Milk powders in particular are used as a low-cost way of shipping dairy, which explains their high trade share. As shown earlier, most dairy is consumed in the form of fresh dairy products (Figure 1.7), which are typically consumed domestically.

A low trade share at the global level does not mean that trade is not important. For many developing countries, imports of agricultural commodities are essential to guarantee food security. Import dependence is particularly high in the Middle East and North Africa, as discussed in Chapter 2.

Figure 1.21. Share of production traded



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Agricultural exports to remain concentrated among a few key suppliers

A small number of countries with a comparative advantage in production often account for most of the global exports of agricultural commodities, a situation which is expected to continue during the next decade (Figure 1.22). Even for commodities with relatively less concentrated exports such as beef or wheat, the five leading exporters account for more than two-thirds of the global total. For soybean and pork, this share even exceeds 90%.

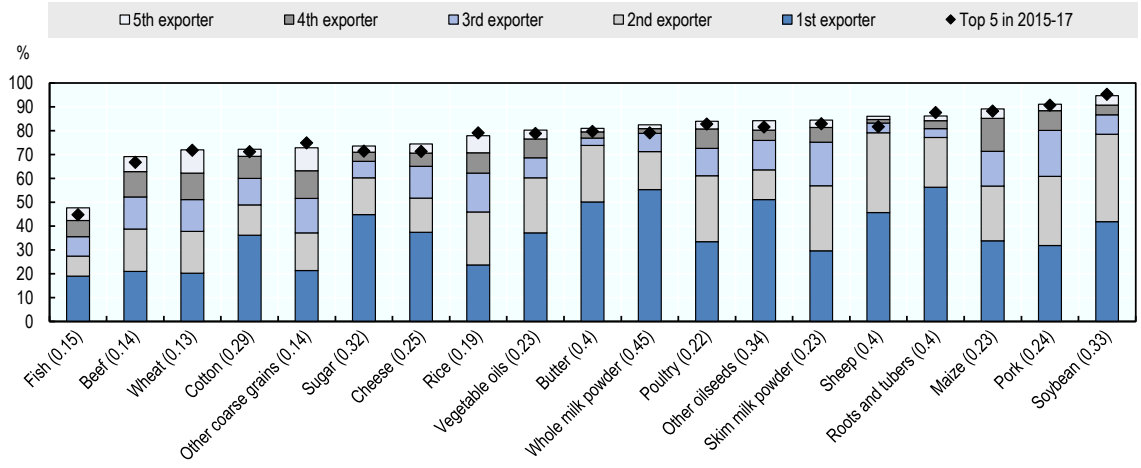
Moreover, even for some commodities where the share of the five main exporters is more modest, a single country often dominates. This is the case for sugar (where Brazil by itself accounts for 45% of global exports), other oilseeds (where Canada accounts for 54% of global exports), roots and tubers (where Thailand accounts for 56% of global exports), and several dairy products. For cheese, the European Union exports almost a third of the global total, a share which is expected to increase further. For butter and whole milk powder, New Zealand accounts for more than half of global exports.

Conversely, exports for skim milk powder are more equally distributed among key exporters. In 2015-17, the European Union, the United States and New Zealand had export shares of 30%, 25% and 19% respectively; in the coming decade, the United States is expected to increase its share of global exports but without changing this overall ranking. Exports are also less concentrated for fish for human consumption, where the

top 5 exporters are expected to account for less than half of global export volumes by 2027.

Figure 1.22 also denotes for each commodity the value of the Hirschman-Herfindahl Index, a commonly used indicator of market concentration. Higher values of the Hirschman-Herfindahl index indicate greater concentration of exporters, whereas lower values are indicative of greater "evenness" with market shares more evenly distributed among participants. This measure conveys the relative dominance of exporters, complementing the information conveyed by the sum of market shares of the top 5 exporters. The Hirschman-Herfindahl Index will report relatively greater concentration when a single large exporter dominates the market, as is the case for sugar, other oilseeds, and whole milk powder.

Figure 1.22. Export shares of the top 5 exporters in 2027, by commodity



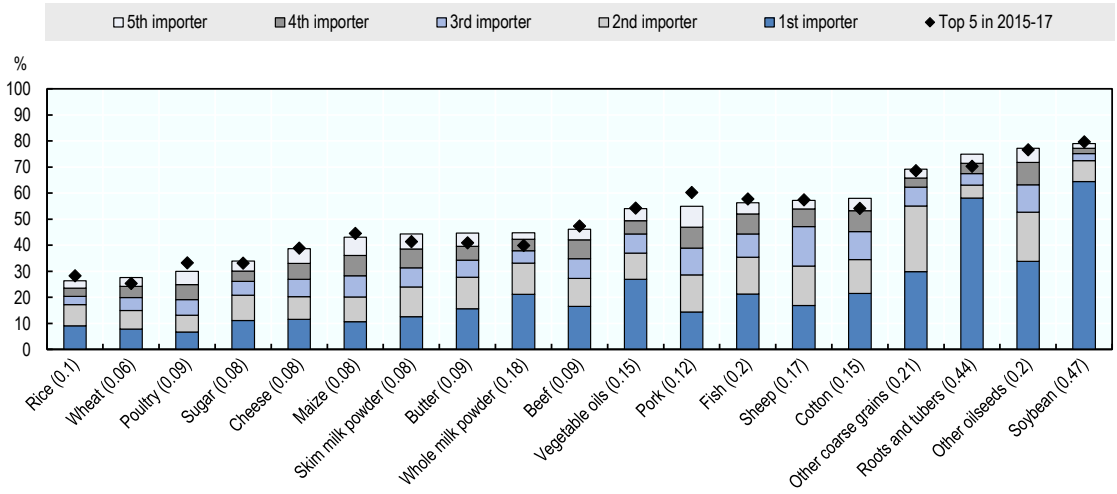
Note: The number in the brackets denotes the value of the Hirschman-Herfindahl Index of concentration of exports across countries for 2027. The Hirschman-Herfindahl Index equals the sum of squared market shares, here rescaled between 0 and 1, where a value closer to 0 corresponds to the absence of concentration and a value of 1 would correspond to a single country being the sole exporter.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742302

Overall levels of concentration tend to be stable, and little change is expected over the coming decade. The high concentration of agricultural exports creates a risk of significant impacts on global markets if exports are interrupted, for instance because of adverse production shocks (e.g. poor harvests) or policy changes in the major exporting countries. Such interruptions could affect prices and local availability, with implications for food security.

Compared with exports, agricultural imports are typically more dispersed – that is, agricultural trade typically flows from a small number of exporters to a large number of importers (Figure 1.23). For rice and wheat, for instance, the five largest importers jointly account for less than 30% of global imports; for most commodities in the *Agricultural Outlook*, the share of the five largest importers is less than 60%. Similarly, the Hirschman-Herfindahl Index is generally lower for imports than for exports.

Figure 1.23. Import shares of top 5 importers in 2027, by commodity



Note: The number in the brackets denotes the value of the Hirschman-Herfindahl Index of concentration of imports across countries for 2027. The Hirschman-Herfindahl Index equals the sum of squared market shares, here rescaled between 0 and 1, where a value closer to 0 corresponds to the absence of concentration and a value of 1 would correspond to a single country being the sole importer.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742321

Notable exceptions are oilseeds (soybeans and other oilseeds), roots and tubers, and other coarse grains, where Chinese demand dominates. China currently is responsible for 63% of all global soybean imports, a share which is expected to increase somewhat in the coming decade. For roots and tubers, China is projected to increase its share of global imports from 53% to 58%. Soybeans and roots and tubers also have a high level of exporter concentration. Global soybean trade is hence dominated by US and Brazilian exports to China, while global trade in roots and tubers (cassava) is dominated by Thai and Vietnamese exports to China.

As with exports, the degree of import concentration by product will change over the next decade but without a clear trend towards higher or lower concentration. Greater import concentration is projected for skim milk powder, cotton and roots and tubers, among other commodities; while greater import dispersion is projected for poultry, beef and especially pork. For pork, while global trade is expected to continue growing, the volumes imported by the two main importers (China and Japan) are expected to decline over the outlook period. China is projected to fall below Japan as largest pork importer; together, these countries are expected to account for 29% of global imports in 2027 as opposed to 34% in the baseline period.

Prices

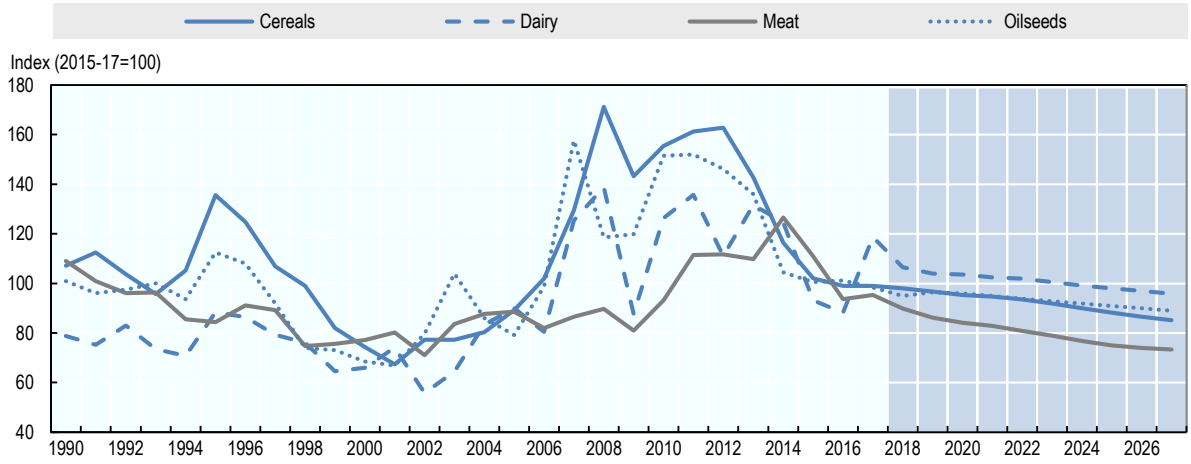
Real prices for most commodities are expected to fall

The *Outlook* uses recorded prices at main markets (e.g. US gulf ports, Bangkok) of each commodity as international reference prices and provides projections for these prices. Near-term price projections are still influenced by the effects of recent market events

(e.g. droughts, policy changes), whereas in the outer years of the projection period, they are driven by fundamental supply and demand conditions.

Prices of different commodity groups such as cereals, oilseeds, dairy, and meat are highly correlated. In the coming decade, prices for these key commodity groups are projected to fall in real terms (Figure 1.24). This implies real prices are expected to be below the peaks seen in 2006-8 for cereals and oilseeds and in 2013-14 for meat and dairy, yet above the levels of the early 2000s.

Figure 1.24. Medium-term evolution of commodity prices, in real terms



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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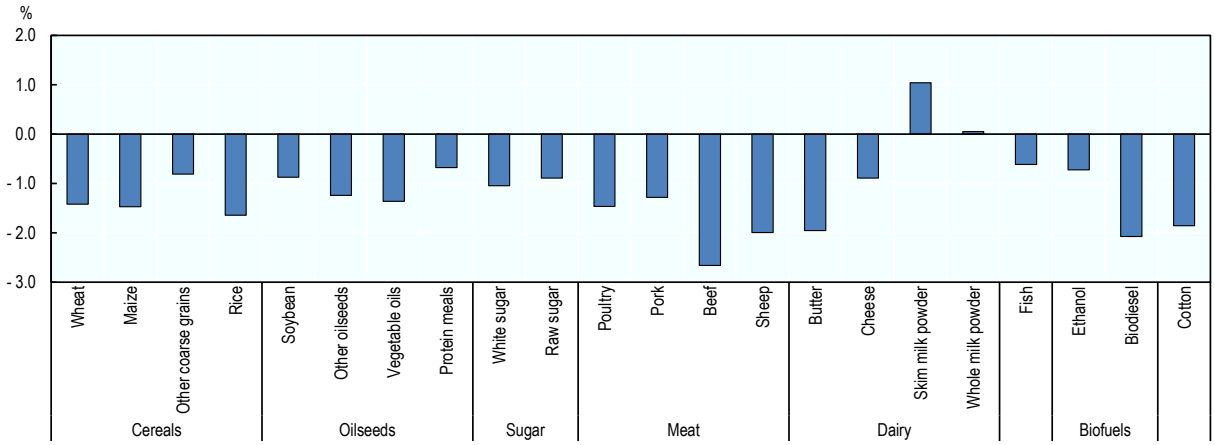
A more detailed view per commodity is provided in Figure 1.25 which shows the projected average annual real price change over the outlook period. Among generally declining real prices, projected trends for dairy stand out. Following the "butter bubble" in 2017, real prices for butter are expected to exhibit an average annual decline of 2% per year as prices come down further at the beginning of the projection period, but prices of skim milk powder are expected to increase by 1% per year. Along with whole milk powder, it is one of the only commodities covered in the *Agricultural Outlook* where prices are not projected to fall in real terms.

Trends in real prices for agricultural commodities reflect a balance of factors which would lead to higher prices (such as higher demand induced by population growth and higher incomes) and factors which would tend to reduce prices (such as productivity improvements, which allow greater output without using additional inputs). The pattern of real price decreases shown in Figure 1.25 indicates that under the assumptions made in the *Agricultural Outlook*, price-reducing factors, principally productivity growth, are expected to dominate in the coming decade.

Figure 1.25. Average annual real price change for agricultural commodities, 2018-27



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742359

Despite a downward trend, risk of price peaks remains

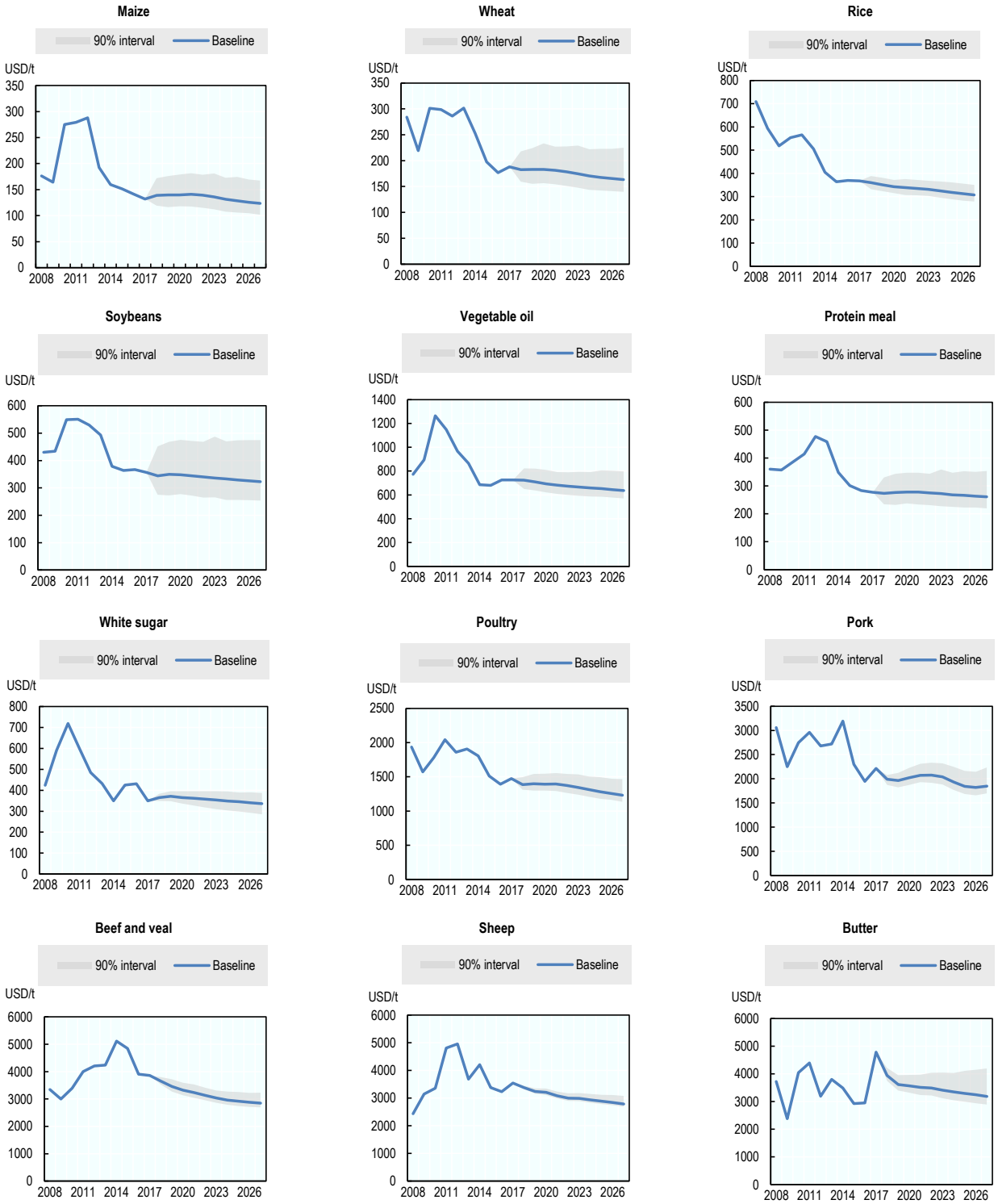
Agricultural commodity prices tend to be volatile, as both demand and supply are relatively insensitive to short-term price movements. This implies that temporary shocks or uncertainty in the projections will have a relatively greater impact on prices than on consumption or production levels. The price trends presented here summarise the interplay of fundamental supply and demand factors, but short-term volatility may lead to considerable deviations from the trend.

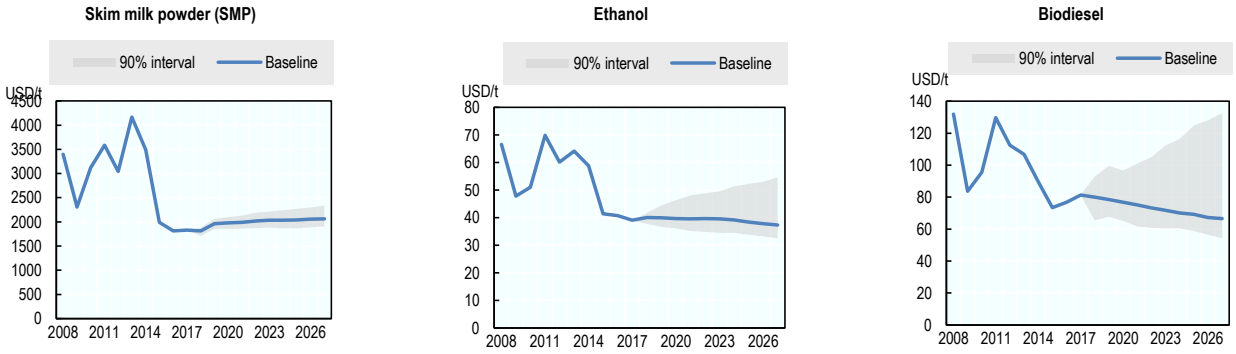
To assess the uncertainty around prices, a partial stochastic analysis was performed on the projections of the *Agricultural Outlook*. The stochastic analysis simulates the potential variability of agricultural markets using 1 000 different scenarios for macroeconomic and other variables, such as oil prices, economic growth, exchange rates and yield shocks. In each scenario, the Aglink-Cosimo model underlying the *Outlook* projects different outcomes for prices. These can be used to provide an indication of the sensitivity of the estimates in the *Outlook*.

The degree of variation included in the stochastic analysis is based on the historical variability, which means more extreme shocks than those observed in the past are not incorporated in the stochastic analysis. Moreover, the analysis is only partial in that it does not capture all the sources of variability that can affect agricultural markets. For example, uncertainty related to animal diseases is not captured, as this factor is hard to quantify. The major sources of uncertainty in agricultural markets included in the stochastic analysis are (Araujo-Enciso et al, 2017):

- *Global macroeconomic drivers:* Values of 32 variables including the real Gross Domestic Product (GDP), the Consumer Price Index (CPI) and the GDP Deflator in the United States, the European Union, China, Japan, Brazil, India, the Russian Federation and Canada; national currency-US dollar exchange rates for these regions; and the world crude oil price.

Figure 1.26. Evolution of real prices for selected commodities





Note: Charts show the evolution of real prices over the outlook period in the baseline projection (solid blue line) as well as the 90% interval from a partial stochastic analysis (see text for details). Cotton and fish are not included in the stochastic analysis and are hence not shown here. Real prices are defined as nominal world prices deflated by the US GDP deflator (2010=1).
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742378

- *Agricultural yields*: Uncertainty affecting the yields of 17 crops in 20 major producing countries is also analysed, giving a total of 78 product-country-specific uncertain yields.

Figure 1.26 shows the expected evolution of real prices for selected commodities under the baseline scenario of the *Agricultural Outlook* as a solid line in each chart. The sensitivity of the price projections is shown as a 90% confidence interval around the projection; 90% of simulated prices in the stochastic analysis fall in this grey range. Under the assumptions of the stochastic analysis, the likelihood that prices will remain within the range is 90% in any given year. The likelihood that prices remain in this range throughout the decade is therefore much lower, at $(0.90)^{10}$ or around 35%. The likelihood that prices will fall outside the range (either above or below) at some point in the next decade is therefore 65%.

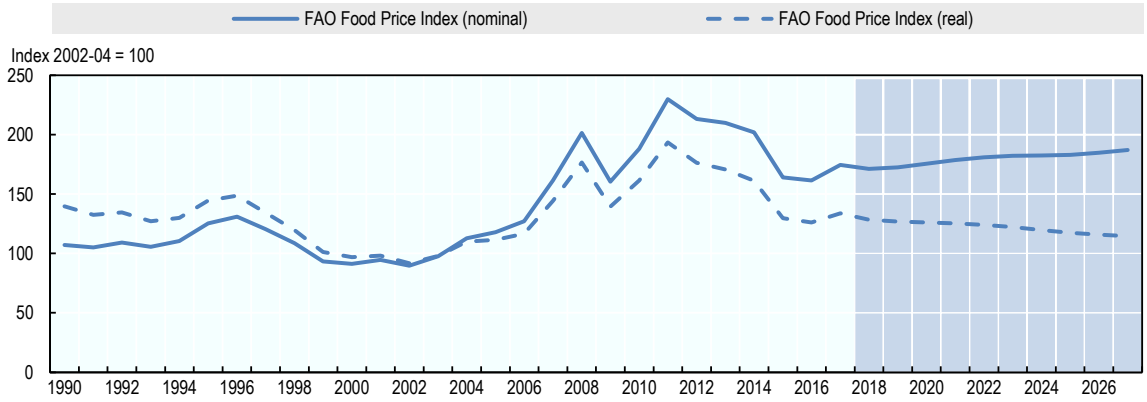
Importantly, this grey range does not capture all uncertainty around the projected prices, only the uncertainty coming from the variables included in the stochastic analysis. As a result, the range tends to be larger around crops than livestock, given the susceptibility of yields to weather conditions. Among crops, the price of rice varies least across the different simulations of the stochastic analysis, in part because paddy rice yields are less sensitive to weather conditions once planting decisions have been made. (Weather shocks instead affect area planted, since flooding paddy fields is a precondition for planting, but such area variations are not currently included in the stochastic analysis). By contrast, the variation is highest for biofuels (ethanol and biodiesel), which combine uncertainties affecting physical production with greater uncertainty on the demand side. In general, the degree of uncertainty tends to be asymmetric, as there is more upside potential for price spikes than for price declines.

Projected evolution of the FAO Food Price Index

Another way of assessing the evolution of prices is through the expected future path of the FAO Food Price Index. This index, introduced in 1996, captures the development of nominal prices for a range of agricultural commodities in five commodity groups, weighted with the average export shares of these groups in 2002-2004. As this commodity price index is similar in commodity coverage to the *Agricultural Outlook*, it is

possible to project the future evolution of the FPI as a summary measure of the evolution of nominal agricultural commodity prices (Figure 1.27).

Figure 1.27. Projected evolution of the FAO Food Price Index



Note: Historical data is based on the FAO Food Price Index, which collects information on nominal agricultural commodity prices; these are projected forward using the Agricultural Outlook baseline. Real values are obtained by dividing the FAO Food Price Index by the US GDP deflator (2002-04 = 1).
Source: FAO World Food Situation (http://www.fao.org/worldfoodsituation/foodpricesindex/en/) and OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742397

Based on the supply and demand conditions projected in the *Outlook*, nominal agricultural commodity prices as summarised by the FAO Food Price Index are expected to grow by only 0.7% per year over the coming decade. In real terms, the FAO Food Price Index is expected to decline over the coming decade. Both nominal and real prices are expected to remain below the peaks reached between 2008 and 2014, but above the levels seen in the early 2000s.

Risks and uncertainties

The *Agricultural Outlook* combines projections using the Aglink-Cosimo model with expert judgment on the likely evolution of drivers of agricultural markets. The projections in the *Outlook* are therefore sensitive to the underlying assumptions, such as the assumptions on macro-economic conditions and relevant policies discussed in Box 1.6. While based on the best available information at the time of preparation, these assumptions are inherently uncertain. Moreover, a number of factors not explicitly taken into account could affect global agricultural markets in the coming decade. Uncertainty on such issues tends to accumulate over time. Over the ten-year horizon of the *Outlook*, temporary deviations from the trend may hide the actual trend, even if the projections of the *Outlook* are sound.

Some of the uncertainties can be quantified. For instance, the impact of a different oil price scenario is explored in Box 1.3. Moreover, the partial stochastic analysis introduced in the previous section can provide useful information on the sensitivity of the projections in the *Outlook* to changes in global macroeconomic conditions and agricultural yields. Finally, several other factors are harder to quantify; their potential impact is discussed below.

Box 1.3. The impact of an alternative oil price scenario

The assumption on crude oil prices during the projection period is based on the average crude oil price projected by the World Bank Commodities Price forecasts, as released in October 2017. These projections imply that nominal oil prices increase at an average annual rate of 1.8% over the outlook period, from USD 54.7 per barrel in 2017 to USD 76.1 per barrel by 2027.

To test the sensitivity of the *Outlook* projections to this assumption, a scenario analysis was conducted with an alternative oil price based on the "New Policies Scenario" developed by the International Energy Agency (IEA) in its *World Energy Outlook 2017*. Under this alternative scenario, nominal oil prices increase to USD 122.2 in 2027, or 61% higher than in the baseline scenario.

A large change in oil prices would also affect the GDP assumptions underlying the *Outlook*, especially for oil-exporting economies. To incorporate these effects, the scenario analysis included GDP responses to oil prices based on a recent study by the Joint Research Centre of the European Commission (Kitous et al., 2016).

Higher oil prices increase agricultural production costs through higher prices for fuel and fertiliser, as well as through general cost increases induced by higher inflation. Higher fuel prices can also affect demand for agricultural commodities through biofuels markets, through two opposing effects. On the one hand, higher prices depress the demand for transportation fuels, which in turn reduces the demand for biofuels that is due to mandatory blending. On the other hand, a higher crude oil price leads to a substitution in favour of biofuels. This effect would be more pronounced for biodiesel than for ethanol, for which the share in gasoline fuel is already close to its technical maximum in several main markets.

The scenario suggests that higher crude oil prices would have a negative but small impact on the production of most agricultural commodities. For instance, for maize, global production would be 0.7% lower than under the baseline projections. Stronger effects are found for biofuels. Higher oil prices would stimulate the global production of biodiesel by 2.5% compared to the baseline while global ethanol production would decrease by 1.5%.

Higher crude oil prices would also affect agricultural prices. Nominal prices of maize, wheat, soybeans and vegetable oil would all be 10-11% higher than under the baseline while nominal livestock and dairy prices would be 6-8% higher. A stronger price increase is expected for biodiesel, where higher demand, production costs and inflation lead to nominal prices that are 27% above those in the baseline.

Several factors affect the "pass-through" of oil prices to agricultural commodity prices. The scenario assumes that the higher oil price is caused by supply-side factors, so that higher oil prices reduce demand for transportation fuel, in turn reducing the demand for biofuels due to mandatory blending. If higher oil prices were caused by an increased demand for transportation fuel, it would be accompanied by a stronger growth in biofuels demand and hence a stronger increase in agricultural prices.

A second factor is the impact of higher oil prices on fertiliser prices. Traditionally, high oil prices led to high prices of natural gas, a main input for nitrogen-based fertilisers. The price of natural gas was in the past often indexed to crude oil prices, creating a direct link. In recent years, however, natural gas prices have shown signs of becoming "decoupled" from oil prices. This would weaken the link between oil and fertiliser prices. On the other hand, it seems likely that a large increase in crude oil prices sustained over a decade, as considered in the scenario, would be accompanied by higher natural gas prices – whether due to the way in which natural gas is priced, or due to substitution effects. The scenario therefore assumes that crude oil prices will indeed affect fertiliser prices.

Source: Kitous, A., et al. (2016) Impact of low oil prices on oil exporting countries, *JRC Science for Policy Report*, EUR 27909 EN (doi:10.2791/718384).

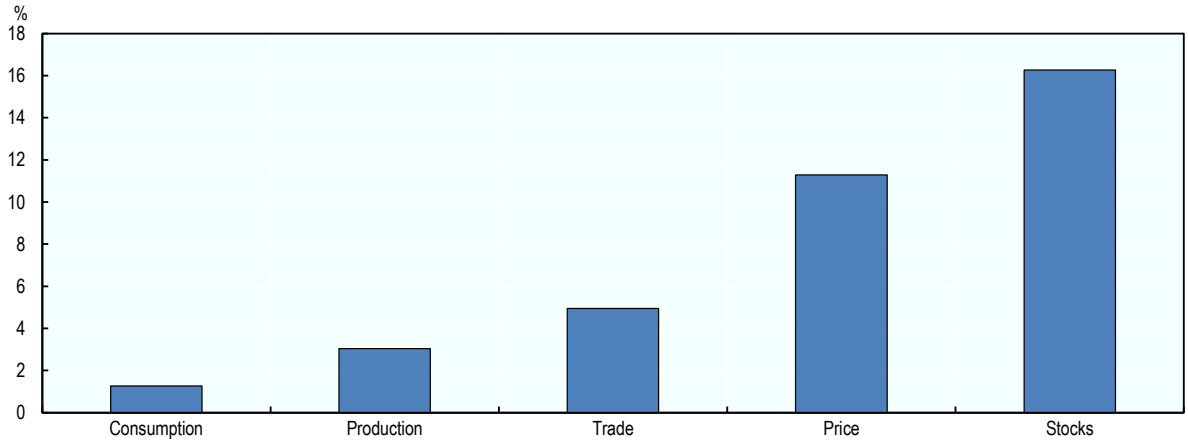
Partial stochastic analysis

In the previous section, a partial stochastic analysis was used to provide an indication of the range of uncertainty around projected real prices for various commodities. The stochastic analysis also offers insights on other aspects of the *Outlook*. One way of representing and comparing the impact of uncertainty on projected outcomes is the coefficient of variation in the last projection year, 2027. The coefficient of variation (CV) is defined as the standard deviation divided by the mean, and can therefore be interpreted as a percentage deviation from the "central" projection in the *Outlook*.

Figure 1.28 compares the coefficients of variation of global consumption, production, trade, (nominal) prices and stocks of maize. Whereas the coefficient of variation for global consumption is around 1%, variability of production is larger at almost 3%. For trade, the coefficient of variation is around 5%. Variability of prices is much larger at 11%, while the highest variability is for stocks, at 16%.

This result captures two essential characteristics of global agricultural markets. First, the demand and supply of many agricultural commodities are relatively less sensitive to prices. Shocks to demand or supply therefore lead to relatively large adjustments in prices. Second, trade and stocks serve as buffers and are therefore more variable. Stocks can be used to smooth consumption in the face of fluctuations in production. Likewise, trade allows countries to increase imports to keep consumption more stable in years where production is low.

Figure 1.28. Maize: Coefficient of variation in 2027



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Other uncertainties affecting the Outlook

While the partial stochastic analysis captures uncertainty around a range of factors affecting the evolution of agricultural markets, many other uncertainties are harder to quantify but no less important, in particular those associated with government policies.

Demand

On the demand side, an important source of uncertainty relates to biofuel policies in major markets, notably China. The Chinese government recently proposed a new nationwide ethanol mandate, which would expand an earlier mandate that had been in force in 11 trial provinces to the entire country by 2020. The potential implications are discussed in more detail in the Biofuels chapter, but preliminary estimates show that the policy would increase Chinese ethanol use by 18 bln L to 29 bln L. To put this increase in context, world ethanol production in 2027 is currently projected at 131 bln L. If inputs are sourced domestically, Chinese maize reserves could be used in large part; but if the additional demand is instead satisfied by imports, the effect on agricultural markets could be large.

Changing consumer preferences could also impact markets. Some evolutions in consumer demand can be projected from current trends, such as the decreasing role of cereals and the increasing demand for proteins as average incomes grow. Other changes, such as a rise in vegetarian or vegan lifestyles or an increasing preference for local or organic food, are harder to assess, but these tend to be relatively slow-moving trends and are often of limited importance to global markets. Food health scares, by contrast, have the potential of reducing consumer demand in the short run, sometimes with lasting consequences.

Obesity and overweight are increasingly recognised as public health problems in a large number of countries. Various policies have been introduced to stem the rise of obesity, varying from the provision of information and education to labelling and product formulation requirements, and subsidies and taxes (most notably on sugar and sweetened beverages). Further measures may be deployed over the projection period, with a view to affecting the levels of calorie consumption as well as the composition of diets.

Supply

The production of agricultural commodities is unique in its vulnerability to natural elements, including bad weather and diseases which can affect plant and animal production. Historically, such diseases have often presented important disruptions to agricultural markets; it is possible that similar disruptions will occur over the outlook period (see Box 1.4 for a discussion of the threat posed by the Fall Armyworm in particular). As noted above, agricultural exports tend to be concentrated among a small number of countries; all else equal, this raises the risk that a shock in a single country will affect world markets.

Regulatory changes can impact agricultural production, for instance through the introduction of measures that ban or raise the costs of certain production practices (e.g. the use of neonicotinoid pesticides). Similarly, policies to mitigate climate change could impact agriculture, in particular ruminant production, which contributes to methane emissions. On the other hand, developments of new technologies such as digital and precision agriculture or new plant breeding techniques could improve agricultural productivity beyond the rate currently projected in the *Outlook*.

Agricultural input industries are currently witnessing a trend of increasing consolidation and market concentration. Such trends have been seen in crop protection chemicals, seeds and biotech, and fertiliser markets, among others, raising concerns that less competition may reduce private spending on research and development (R&D).

For the fisheries and aquacultures sector, an important source of uncertainty relates to changes in policies being implemented by China, which can have an impact on global

supply, demand, and prices due to the key role played by China in the sector. The potential implications are discussed in more detail in the fish and seafood chapter.

Box 1.4. Combatting the expanding Fall Armyworm infestation in Sub-Saharan Africa

Fall Armyworm (*Spodoptera frugiperda*) is an insect native to the Americas that was first detected in Central and Western Africa in early 2016. Since then, it has spread to most countries in Sub-Saharan African and is likely to reach North Africa (FAO, 2017). In the medium term, experts fear that infestations could extend into Southern Europe and Asia and, during the summer season, even reach Northern Europe. In the Americas, farmers, researchers and governments have been combatting Fall Armyworm for decades, keeping losses to a minimum. However, in Sub-Saharan Africa the majority of maize farmers are smallholders and do not have access to the necessary knowledge or inputs to fight this new pest. While some studies based on farmer's perceptions claim that in the absence of any control method Fall Armyworm can cause maize production losses up to 53% (Day et al., 2017), the majority of the field trials show yield losses below 20%.

The Fall Armyworm outbreak in Sub-Saharan Africa does not appear to have impeded the recovery in maize production following two consecutive years of severe drought conditions in Southern Africa. In 2017, cereal production increased by about 16 Mt compared to 2016, putting the aggregate output at 80 Mt, an above-average level. The *OECD-FAO Agricultural Outlook* foresees a continuation of this positive trend, with maize production projected to reach about 93 Mt in 2027 for the region. The projections assume Fall Armyworm control methods become effective enough to allow continued yield gains.

Nonetheless, such methods are not easily implemented and Fall Armyworm could become a threat to food security in the region. It holds the potential to endanger the production of cereals and other crops because, unlike the Americas, small-scale producers represent the vast majority of cereal production in Sub-Saharan Africa. Their crops are typically more vulnerable to pests and diseases, and their ability to cope with infestations is limited.

The *OECD-FAO Agricultural Outlook* projections take the Fall Armyworm into account as an important uncertainty. At the same time, severe production losses are expected to be prevented by initiatives already underway, notably FAO's five-year programme of "Sustainable Management of the Fall Armyworm in Africa." The programme incorporates the participation of researchers, governments, and small producers in Latin America with vast experience on managing Fall Armyworm. The methods and tools developed in Latin America are expected to prove effective in containing Fall Armyworm in Sub-Saharan Africa.

There is a possibility that the Fall Armyworm gradually moves to North Africa and from there to Europe and Asia. Unlike Sub-Saharan Africa, which is more of a regional market, the spread of Fall Armyworm to North Africa, Europe and Asia could pose problems for the global maize market, as those regions comprise major importers and exporters of maize. While it is still too early to assess the implications of such an outcome, efforts are already underway to ensure an effective monitoring and early detection of the pest. These efforts should eventually enable farmers and governments to take adequate and timely actions to contain the spread and mitigate the effects of Fall Armyworm.

Sources

FAO (2017), "Sustainable Management of the Fall Armyworm in Africa", FAO Programme for Action, 6 October, http://www.fao.org/3/a-bt417e.pdf

Day, R. et al. (2017), "Fall Armyworm: Impacts and Implications for Africa", *Outlooks on Pest Management*, Vol. 28, No. 5, pp. 196-201.

Trade

The international trade environment is facing increasing uncertainty in recent years, which may impact agricultural trade flows.

A number of current trade issues involving agricultural commodities (such as the Russian import ban, the dispute around Argentine and Indonesian biodiesel exports to the US, and China's anti-dumping probe into imports of US sorghum) may have important bilateral effects for specific commodities, but are not likely to have large effects at a global level and across different commodities (Box 1.5). However, even if such disputes are eventually resolved, they may end up permanently changing trade flows between countries, as exporters find new markets and importers find new sources of supply.

Brexit – the announced exit of the United Kingdom from the European Union – is currently still being negotiated; little is known about the exact arrangements that will govern agricultural policy in the United Kingdom and its trade relations with the European Union and other countries. While Brexit is likely to have a big impact on certain bilateral agricultural trade flows (most notably for beef, dairy and lamb), the effect on global agricultural trade is likely to be small.

In March 2018, eleven countries (Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore and Viet Nam) signed the Comprehensive and Progressive Agreement for Trans-Pacific Partnership. Parties to the agreement are reducing tariffs on each other's agricultural imports, which is likely to intensify trading relations among participant countries. The agreement is also likely to have a negative effect on exports to countries that are party to the agreement by countries that are not. Again, these changes will impact individual countries and bilateral trade flows more than global agricultural markets.

The renegotiation of NAFTA, which is currently ongoing, could impact agriculture in North America. Agricultural trade has grown strongly because of NAFTA, leading to a highly integrated region. Currently, more than 25% of US maize exports go to Mexico, and one-third of US beef exports go to Canada and Mexico; disruptions to these trade flows could impact not only North American but global markets as well.

Box 1.5. Potential impacts of China imposing additional import tariffs on US agricultural products

China is the United States' largest trading partner. Total merchandise exports to the United States rose from USD 84 billion in 2000 to USD 506 billion in 2017. In terms of net trade, the United States has an annual deficit of about USD 375 billion in total merchandise trade, while it maintains a surplus of about USD 20 billion on agricultural products, with soybean exports accounting for USD 13 billion.

In March 2018, the United States imposed additional import duties on steel and aluminium products, and announced possible actions to respond to alleged unfair treatment of US companies seeking to do business in China on grounds of intellectual property infringement. Chinese authorities, in turn, suspended tariff concessions on multiple US products – including fruits, nuts and pigmeat – and announced eventual further duties on other agricultural products. Additional *ad valorem* duties of 25% have been put in place for pigmeat imports, and announced for soybeans and sorghum.

About 60% of US soybean exports are destined for China, which is highly dependent on imports for its domestic needs. In 2017, China imported an estimated 96 million tonnes, accounting for 64% of global soybean imports, while it produced around 13 million tonnes. Additional duties on

soybeans would lower imports from the United States, but are likely to be offset by larger purchases from other suppliers, notably Brazil and Argentina. This could lead to a wider reallocation of trade, with US exports redirected to other markets, notably in Europe and Latin America, when the price spread between United States and Brazilian soybeans substantially widened. Indications of this have already been observed.

China has taken further measures to curb sorghum imports from the United States. In 2017, 80% of US sorghum exports were shipped to China, accounting for around USD 957 million. In February 2018, China self-initiated an antidumping and countervailing duty investigation on imports of United States sorghum, and therefore in principle outside the scope of retaliatory measures announced by Beijing. As of early April, China requests a provisional deposit on sorghum imports from the United States, equivalent to an *ad valorem* duty of 178.6%. This measure, applied to all US companies, has led to a halt of US exports and a redirection of vessels already underway to China. Higher trade barriers on China's sorghum imports could trigger secondary effects, potentially leading to a reduction in China's high maize stocks or stimulating the import of other feed grains, notably barley, which would open up opportunities for alternative suppliers.

China is the world's largest producer and importer of pigmeat. In 2017, it produced more than 53 million tonnes, about 45% of the global production, and imported an estimated 1.6 million tonnes. The industry relies heavily on soybean meal to feed pigs. Over the medium term, higher tariffs and hence higher costs for soybeans and feed grains would raise the costs of production for China's pigmeat industry. This, combined with the higher tariffs and hence higher prices for imported pork, could lead to noticeable increases in domestic pork prices. China may elect to source its needs from alternative suppliers such as the European Union, Canada and Brazil.

Across these major product categories, additional import tariffs would imply some immediate losses to both US suppliers and Chinese consumers. Beyond immediate dislocations the overall market effects should be modest as these are highly tradable products and China has the potential to source from other countries, while the United States has the potential to supply other markets. Nevertheless, diverting trade comes at a cost, especially due to the size of the United States - China soybean relationship and lack of alternative partners. The impact would be greater if China were to seek to meet the demand shortfall from domestic production.

Highlights of the commodity projections

Cereals

Global cereal production is projected to expand by 13% by 2027, accounted for in large part by higher yields. For maize and wheat, the Russian Federation is emerging as a major player on international markets, having surpassed the European Union in 2016 to become the top wheat exporter. For maize, market shares will increase for Brazil, Argentina and the Russian Federation while declining for the United States. Thailand, India, and Viet Nam are expected to remain the major suppliers on international rice markets, while Cambodia and Myanmar are projected to capture a greater share of the global export market. Over the projection period, prices are expected to increase slightly in nominal terms but decline modestly in real terms.

Oilseeds

Global oilseeds production is expected to expand at around 1.5% p.a., well below the growth rates of the last decade. Brazil and the United States will be the largest soybean producers, with similar volumes. Protein meal use will grow more slowly due to slower growth in livestock production and as the protein meal share in Chinese feed rations has

reached a plateau. Demand for vegetable oil is expected to grow more slowly due to slower growth in per capita food use in developing countries and the projected stagnation in demand as feedstock for biodiesel. Vegetable oil exports will continue to be dominated by Indonesia and Malaysia, while soybean, other oilseeds and protein meal exports are dominated by the Americas. Prices are projected to increase slightly in nominal terms over the outlook period, with slight declines in real terms.

Sugar

Production of sugarcane and sugar beet are projected to expand at a slower pace than in the previous decade. Brazil is projected to remain the largest producer with strong growth prospects foreseen in India, China and Thailand. Demand for caloric sweeteners (sugar and high fructose corn syrup) is expected to grow faster than for most commodities. Per capita consumption is stagnant in developed countries and in some developing countries where consumption has reached levels that raise health concerns. In Asia and Africa, population growth and urbanisation are expected to sustain growth in sugar consumption. Brazil will continue to account for some 45% of global exports, making it the largest exporter. Sugar prices are projected to follow a moderate upward trend in nominal terms but a downward trend in real terms.

Meat

Global meat production is projected to be 15% higher in 2027 relative to the base period. Developing countries will account for 76% of the output growth, with poultry seeing the most rapid expansion. However, consumers in developing countries are expected to increase and diversify their meat consumption towards more expensive meat such as beef and sheepmeat. Import demand is expected to remain strong in Asia, with significant growth in the Philippines and Viet Nam; other main importers include China, Korea and Saudi Arabia. The combined export share of the two largest meat exporters, Brazil and the United States, is expected to increase to around 45%. Nominal meat prices are projected to gradually increase until 2027, while real prices are expected to trend downwards.

Dairy

Growth in world milk production is projected to increase by 22% over the projection period, with a large share of the increase coming from Pakistan and India. In 2027, these two countries are expected to jointly account for 32% of global milk production. Most of the additional production in these countries will be consumed domestically as fresh dairy products. Over the projection period, the European Union's share in global exports of dairy commodities is expected to increase from 27% to 29%. As the 2017 butter bubble continues to deflate, nominal and real prices for butter will decrease over the projection period. With the exception of milk powders, dairy prices are expected to decrease in real terms.

Fish

Global fish production will continue to grow, albeit at a much reduced pace compared with last decade. Additional output derives completely from continued but slowing growth in aquaculture, while capture fisheries production is expected to fall slightly. Policy changes in China imply a potentially large reduction in the growth of its aquaculture and capture fisheries output. Asian countries will account for 71% of the

increase in fish consumption as food, and per capita fish consumption will increase in all continents except Africa. Fish and fishery products will continue to be highly traded; Asian countries will continue to be the main exporters of fish for human consumption while OECD countries will remain the main importers. Fish prices will all increase in nominal terms but remain broadly flat in real terms.

Biofuels

Given current policy developments and trends in diesel and gasoline demand, global ethanol production is expected to expand from 120 bln L in 2017 to 131 bln L by 2027, while global biodiesel production is projected to increase from 36 bln L in 2017 to 39 bln L by 2027. Advanced biofuels based on residues are not expected to take off over the projection period due to lack of investment in research and development. Trade in biofuels is projected to remain limited. Global biodiesel and ethanol prices are expected to decrease respectively by 14% and 8% in real terms over the next decade; however, the evolution of ethanol and biodiesel markets will continue to be shaped by policies and demand for transport fuel, which implies considerable uncertainty on these projections.

Cotton

World cotton production is expected to grow at a slower pace than consumption during the first few years of the outlook period, reflecting lower prices and releases of global stocks accumulated between 2010 and 2014. India will remain the world's largest country for cotton production, while the global area devoted to cotton is projected to recover slightly despite a decrease of 3% in China. Processing of raw cotton in China is expected to continue its long-term downward trend, while India will become the world's largest country for cotton mill consumption. In 2027, the United States remains the world's main exporter, accounting for 36% of global exports. Cotton prices are expected to be lower than in the base period (2015-17) in both real and nominal terms, as the world cotton price is continuously under pressure due to high stock levels and competition from synthetic fibres.

Box 1.6. Macroeconomic and policy assumptions

The main assumptions underlying the baseline projection

The *Outlook* presents a scenario that is considered plausible given assumptions on the macro-economic, policy and demographic environment, which underpins the projections for the evolution of demand and supply for agricultural and fish products. The macro-economic assumptions used in the *Agricultural Outlook* are based on the *OECD Economic Outlook* (November 2017) and the IMF's *World Economic Outlook* (October 2017). These and other assumptions are detailed in this box.

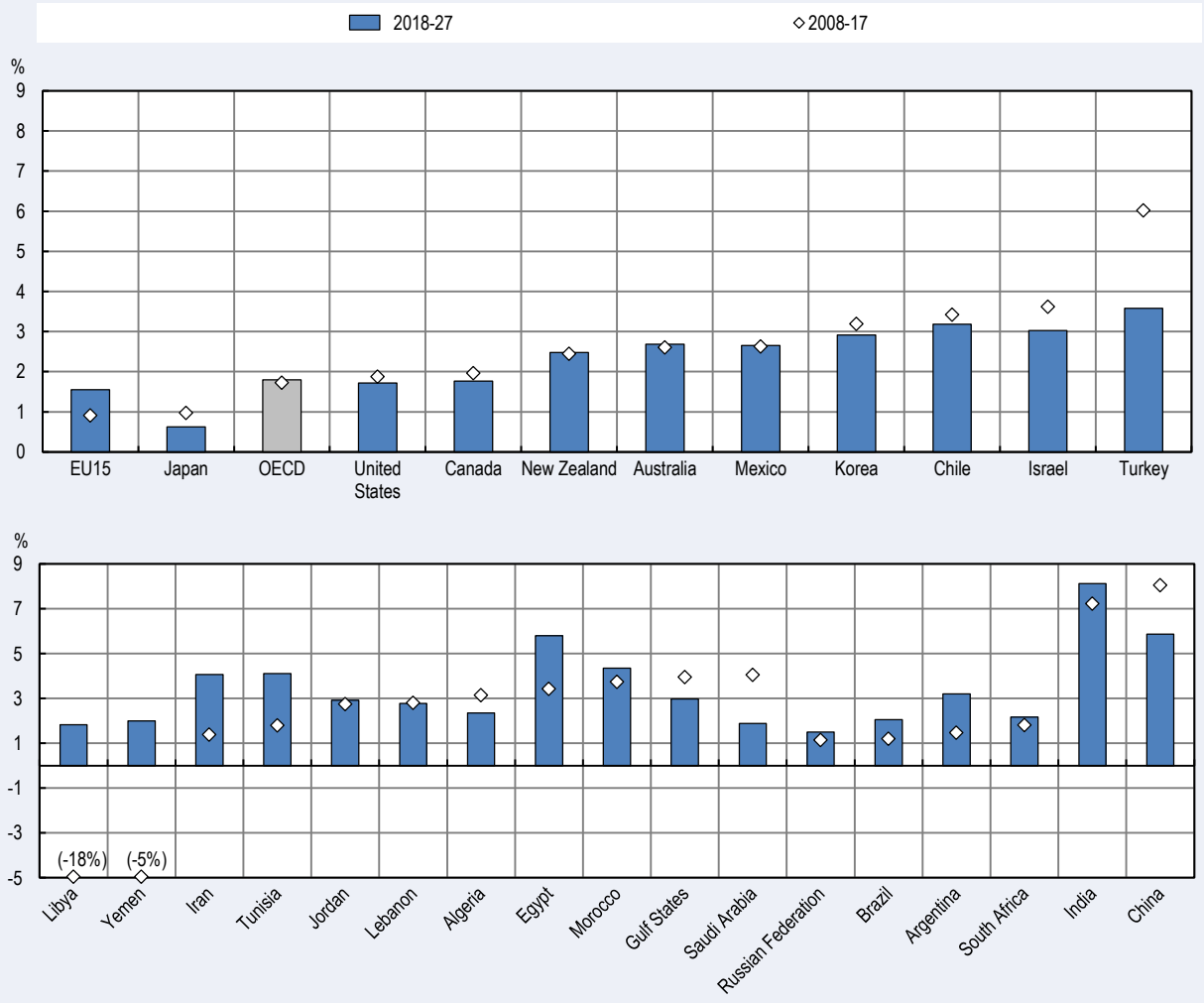
Global growth

After particularly weak growth in 2016, the upturn of the global recovery gathered strength in 2017, with growth of 3.6%. Similar rates of growth are expected in 2018 and 2019. In advanced economies, growth is accelerating in Europe, Canada, Japan and the United States, and inflation is still subdued, but growth at these rates may not be sustainable in the medium-term. World growth is mostly driven by emerging market and developing economies, but that growth remains uneven, in particular for some commodity exporters.

Growth in the United States is projected to increase to 2.2% in 2017 and 2.5% in 2018, boosted by fiscal stimulus, favourable financial conditions, and greater confidence among consumers and

investors. Over the next ten years, growth is expected to be moderate at an average annual rate of 1.7%.

Figure 1.29. GDP growth rates in OECD and selected developing countries



Note: Only selected developing countries shown in second panel. Assumptions for all countries are available in the online Statistical Appendix.
Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933742435

The recovery in the euro area is expected to gather strength this year, with growth at 2.1%, and be slightly down in 2019 at 1.9%, but is expected to remain moderate in the next decade due to weak productivity and low population growth. For EU15 members as a group, an annual average growth rate of 1.6% is expected during the projection period.

After a rebound of 1.5% in 2017, growth in Japan is projected to decrease again in 2018 and 2019, to 1.2% and 1.0%, respectively. Annual average GDP growth is expected to weaken further to 0.6% over the projection period due to a reduced labour force.

Among OECD countries, Turkey is expected to experience the highest growth rate over the next ten years, with an average annual rate of 3.6%, followed by Chile at 3.2%, Israel at 3.0%, Korea at

2.9%, and Australia and Mexico at 2.7%. Growth in Canada shows a strong recovery in 2017 at 3.0% but is projected to decrease in 2018 to 2.1% and not exceed 1.8% on average during the next decade.

Growth is projected to continue to slow down in China to an average of 5.8% over the next ten years compared to 8.0% during the last decade, while growth in India is anticipated to be strong at 8.1% p.a. on average.

After recessions in 2016, growth in Brazil, Argentina and the Russian Federation recovered in 2017 and is expected to average 2.0%, 3.2% and 1.5% p.a. respectively over the projection period. Growth in South Africa should average 2.2% over the ten-year period.

Economic growth in the Middle East and North Africa region is recovering following a recession induced by weak crude oil markets. Modestly stronger growth is projected through the medium term, with the region as a whole growing at an average of 3% p.a. over the outlook period, although growth is uneven among countries due largely to geopolitical factors. Egypt is anticipated to be the strongest growing country, with GDP increasing at 5.9% p.a. Other countries are projected to grow at between 2% and 5 % p.a., but some may not recover ground lost in the previous decade.

Emerging developing countries in Southeast Asia are projected to continue experiencing robust growth over the medium term, at least matching their performance of the previous decade. Growth in Viet Nam, Indonesia, and the Philippines is anticipated to be in the 5-7% p.a. range, while that in Thailand is at around 3.1% p.a.

In countries of the Latin America and Caribbean region, economic growth varies considerably by country. While Brazil and Argentina may grow relatively slowly in the next decade, other countries including Colombia and Chile are projected to average between 3% and 4% p.a.

Growth in developing and least developed African countries, while highly diverse, is projected to continue at higher rates in the next decade, and on a per capita basis may average over 3% p.a. Continued growth in most African countries will be contingent on firm commodity markets, and domestic policy reforms.

Population growth

World population growth is expected to slow to 1% p.a. over the next decade, compared to 1.3% in the last decade. Developing countries continue to drive this growth, particularly Africa which is expected to have the fastest growth rate at 2.4% p.a. The Asia and Pacific region will account for nearly half the world's population, and India, with an additional 138 million people by 2027, should overtake China as the most populous country.

Among OECD countries, the population of Japan is expected to decrease by more than 4 million over the next ten years and that of the Russian Federation by 2.1 million. The population of the European Union is expected to remain stable. Australia has the highest projected population growth among OECD countries at 1.1% p.a., followed by Mexico at 1.1% p.a.

Inflation

Inflation rates are projected to increase over the next few years in both advanced and emerging market and developing economies, reflecting the recovery in demand and the increase in commodity prices, including energy prices. Inflation increased in OECD countries in 2017, averaging around 2%, but remained weak in Australia and Canada at around 1% and was close to zero in Japan.

Inflation is projected to increase gradually in the United States, averaging 2.3% p. a. during the next ten years. For the EU15 members as a group, the annual average inflation rate is projected at 1.8% for the next ten years. Inflation is expected to increase slightly in Japan, averaging at 1.6% p.a. Among the major emerging economies, consumer price inflation is projected to remain stable

in China at around 2.6% p.a. on average over the projection period, and ease slowly in Brazil at 4.1% p.a., while inflation in the Russian Federation rates should decline to 4.0% p.a. on average.

Exchange rates

Nominal exchange rates for the period 2018-27 are assumed to be mostly driven by the inflation differential in relation to the United States (with minor or no changes in real terms).

The Euro appreciated slightly in nominal terms against the US dollar in 2017 and should appreciate more in 2018, before depreciating again over the next ten years. The currencies of China and Japan are expected to appreciate in nominal terms relative to the US dollar over the next ten years. Conversely, strong depreciation is projected in the currencies of Argentina, Brazil, India, South Africa, Turkey, Paraguay and Nigeria, with lesser depreciations in Korea, Australia, Mexico, the Russian Federation, and Canada.

Energy prices

Historical data for world oil prices to 2016 is based on Brent crude oil prices obtained from the short-term update of the *OECD Economic Outlook* N°102 (November 2017). For 2017, the annual average monthly spot price in 2017 was used, while the estimate for 2018 is based on the average of daily spot prices in December 2017. Oil prices during the projection period follow the path of the World Bank average crude oil price projected by the World Bank Commodities Price forecasts, released in October 2017.

In 2017, crude oil prices started to recover following the extension of the production agreement by the Organization of the Petroleum Exporting Countries (OPEC). Despite strong shale production in the United States, oil prices are projected to continue to increase moderately over the next few years. The baseline projections assume that nominal oil prices increase at an average annual rate of 1.8% over the outlook period, from USD 54.7 per barrel in 2017 to USD 76.1 per barrel by 2027. (Implications of an alternative oil price scenario are explored in Box 1.3).

Policy considerations

Policies play an important role in agricultural, biofuel and fisheries markets, with policy reforms often changing the structure of markets. This *Outlook* assumes that policies will remain as they are throughout the projection period. The decision by the United Kingdom to exit the European Union is not included in the projections, as the terms of that departure have not been determined. In the current *Outlook*, projections for the United Kingdom are retained within the European Union aggregate. In the case of bilateral trade agreements, only ratified or implemented agreements are incorporated. Thus, the North American Free Trade Agreement (NAFTA) remains unchanged throughout the *Outlook* projection period, while the partly implemented but not yet ratified Comprehensive Economic and Trade Agreement (CETA) is incorporated. The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), which was signed in March 2018 and replaced the Trans-Pacific Partnership (TPP) following the withdrawal of the United States, has not been ratified and is not included. The ban by the Russian Federation on imports originating from specific countries was announced as a temporary measure and this *Outlook* assumes that the ban will be revoked at the end of 2018. The specific assumptions on biofuel policies are elaborated in the biofuel chapter.

Reference

Araujo-Enciso, S.R., S. Pieralli, and I. Pérez Domínguez (2017), "Partial Stochastic Analysis with the Aglink-Cosimo Model: A Methodological Overview", *JRC Technical Report*, EUR 28863 EN, doi:10.2760/680976