1 Agricultural and food markets: Trends and prospects

Following a description of the macroeconomic and policy assumptions underlying the projections, this chapter presents the main findings of the *Agricultural Outlook*. It highlights key projections for consumption, production, trade, and prices for 25 agricultural products for the period 2021 to 2030. Agricultural demand growth is expected to slow down over the coming decade and to be mainly driven by population growth. Varying income levels and income growth projections, as well as cultural preferences around diets and nutrition, will underlie continuing differences in consumption patterns between countries. The slower demand growth for agricultural commodities is projected to be matched by efficiency gains in crop and livestock production, which will keep real agricultural prices relatively flat. International trade will remain essential for food security in food-importing countries, and for rural livelihoods in food-exporting countries. Over the coming decade, weather variability, animal and plant diseases, changing input prices, macro-economic developments and other uncertainties will result in variations around the projections

1.1. Introduction

The *OECD-FAO Agricultural Outlook 2021-2030* is a collaborative effort of the Organisation for Economic Co-operation and Development (OECD) and the Food and Agriculture Organization of the United Nations (FAO). The *Outlook* presents a consistent baseline scenario for the evolution of agricultural commodity and fish markets at national, regional and global levels for the period 2021 to 2030. This baseline scenario incorporates the commodity, policy and country expertise of both organisations, collaborating Members and international commodity bodies.

The baseline projections are developed based on the OECD-FAO Aglink-Cosimo model, which links sectors and countries covered in the *Outlook* to ensure consistency and a global equilibrium across all markets. The *Outlook*'s projections are influenced by current market conditions (summarised in Figure 1.1), as well as assumptions about macroeconomic, demographic, and policy developments, which are detailed in Section 1.2.

The baseline of the *OECD-FAO Agricultural Outlook* serves as a reference for forward-looking policy planning, and the use of the underlying Aglink-Cosimo model allows simulation analysis, including the assessment of market uncertainties. A detailed discussion of the methodology underlying the projections as well as documentation of the Aglink-Cosimo model are available online at www.agri-outlook.org.

The *OECD-FAO Agricultural Outlook* publication contains four main parts.

- Part 1: **Agricultural and food markets: Trends and prospects**. Following the description of the macroeconomic and policy assumptions underlying the projections (Section 1.2), this chapter presents the main findings of the *Agricultural Outlook*. It highlights key projections and provides insights into the main achievements and challenges facing agri-food systems over the coming decade. The chapter presents trends and prospects for consumption (Section 1.3), production (Section 1.4), trade (Section 1.5), and prices (Section 1.6). A stochastic analysis is provided in Section 1.6 to assess uncertainties around the projected price paths.
- Part 2: **Regional briefs**. This chapter describes key trends and emerging issues facing the agricultural sector in the six FAO regions, i.e. Asia and Pacific (Section 2.2), Sub-Saharan Africa (Section 2.3), Near East and North Africa (Section 2.4), Europe and Central Asia (Section 2.5), North America (Section 2.6), and Latin America and the Caribbean (Section 2.7). It highlights the regional aspects of production, consumption and trade projections and provides background information on key regional issues.
- Part 3: **Commodity chapters**. These chapters describe recent market developments and highlight medium term projections for prices, production, consumption and trade for the commodities covered in the *Outlook*. Each chapter concludes with a discussion of the main issues and uncertainties that might affect markets over the next ten years. This part consists of nine chapters: cereals (Chapter 3), oilseeds and oilseed products (Chapter 4), sugar (Chapter 5), meat (Chapter 6), dairy and dairy products (Chapter 7), fish (Chapter 8), biofuels (Chapter 9), cotton (Chapter 10), and other products (Chapter 11).
- Part 4: **Statistical Annex**. The statistical annex presents projections for production, consumption, trade and prices for the different agricultural commodities, fish and biofuels, as well as macroeconomic and policy assumptions. The evolution of markets over the outlook period is described using annual growth rates and data for the final year (i.e. 2030) relative to a three-year base period (i.e. 2018-20). The statistical annex is not part of the printed version of the *OECD-FAO Agricultural Outlook* but can be accessed online.

Figure 1.1. Market conditions for key commodities

Current market conditions

Cereal: Globally, the impact of the COVID-19 pandemic on cereal markets in terms of supply and demand could be considered as relatively modest. Some logistical bottlenecks and temporary export restrictions coincided with a substantial rise in import demand, resulting in international grain prices to increase rapidly. The surge in prices contributed to higher food inflation in many countries, especially those adversely affected by the pandemic-driven economic hardship, further reducing access to food.

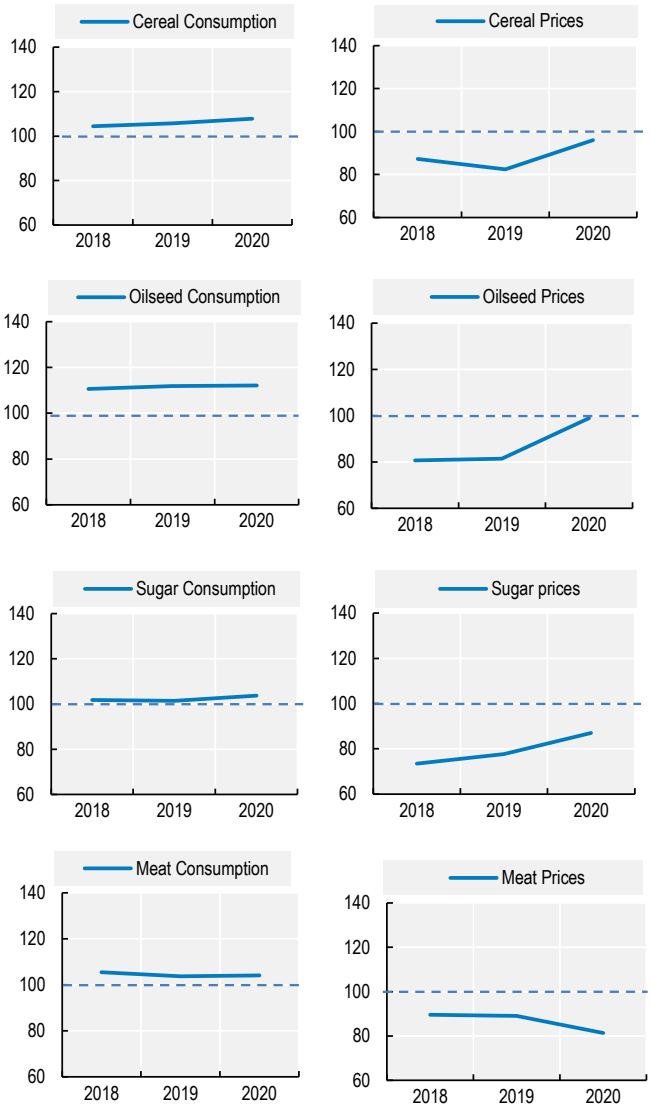
Oilseed: While the COVID-19 pandemic resulted in some market disruptions in early-2020, so far its overall impact on global oilcrop markets appears to have been limited. The steep rise in oilseed, oil and meal prices observed since mid-2020 was chiefly driven by the combined effect of a rebound in demand, notably for imported soybeans by China to feed the rebuilding pig herd, and limited growth in global supplies, especially of the key vegetable oils. The surge in prices contributed to food price inflation in numerous countries, aggravating food access problems stemming from pandemic-driven income losses.

Sugar: In almost all countries, a recovery in demand follows the drop in global consumption that took place in the midst of the Covid-19 pandemic which resulted in national lockdowns and/or closure of restaurants for several months. Unfavorable weather conditions in some key producing countries for a third consecutive season contribute to a rebound in prices in the current 2020/21 season.

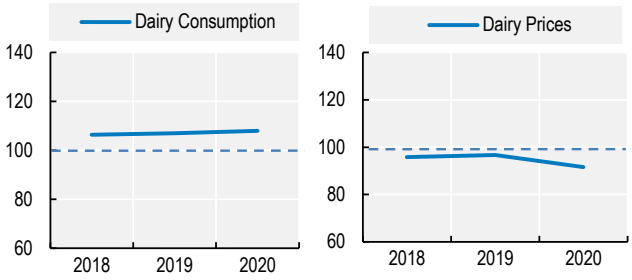
Meat: International meat prices declined in 2020 due to the impact of COVID-19, which temporarily curtailed meat demand by some leading consuming and importing countries given logistical hurdles, reduced food service and reduced household spending due to lower incomes. COVID-19-related market disturbances reduced incomes in net meat-importing, low-income countries, significantly eroding household purchasing power and compelling consumers to substitute the intake of meat and meat products with cheaper alternatives. The fall in international meat prices would have been larger if it were not for the sharp rise in meat imports by China, where ASF continues to limit local production.

Consumption index
Average 2011-2020 = 100

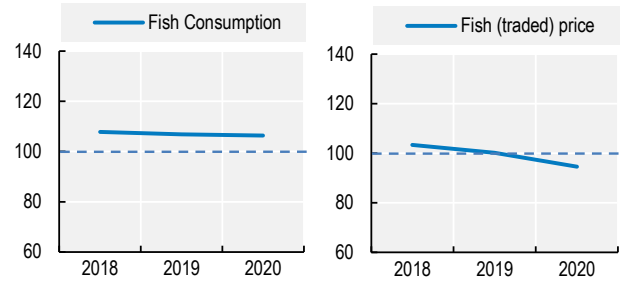
Real Price Index
Average 2011-2020 = 100



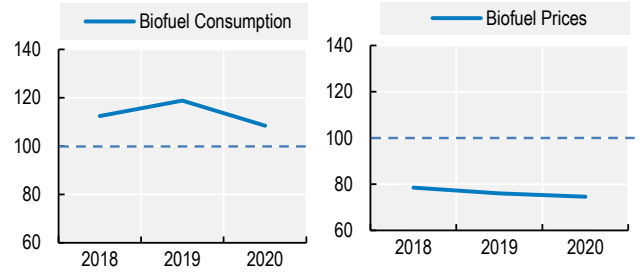
Dairy: The initial effects of the COVID-19 pandemic on the dairy sector varied regionally, with negative effects ranging from shipping container shortages to disposing of surplus products. Overall, the sector adapted quickly, and mitigated many of the initially drastic effects seen in the earlier months of the pandemic. Butter prices fell the most sharply in 2020, compared to WMP price which decreased by a smaller margin, and SMP and cheese prices which increased.



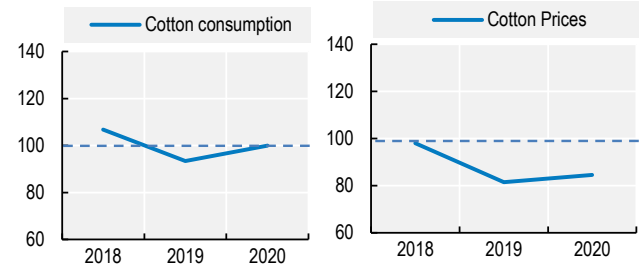
Fish: Fish production, trade, and consumption all contracted in 2020.The impact of COVID-19 during 2020 on the HORECA sector was particularly important, as fish are often consumed outside the home. Lower demand from out-of-home food services contributed to lower prices, particularly for high-value species. According to the FAO Fish Price Index, international fish prices were 7% lower on average in 2020 compared to 2019.



Biofuels: World biofuel consumption decreased in 2020 due to the impact of COVID-19 which curtailed the global transportation oil use. World consumption of biodiesel was less impacted than that of ethanol. Biofuel production decreased in all regions. Biofuel prices decreased, due to the lower ethanol demand in the United States and Brazil.



Cotton: Cotton consumption and trade recovered in 2020 from the 2019 low when the onset of the pandemic drove consumers from stores. However production fell to levels not seen since 2016 as production in the Americas was below expectations. As a consequence cotton prices increased and gained on the price of polyester.



Note: All graphs expressed as an index where the average of the past decade (2011-2020) is set to 100. Consumption refers to global consumption volumes. Price indices are weighted by the average global production value of the past decade as measured at real international prices. More information on market conditions and evolutions by commodity can be found in the commodity snapshot in the Annex and the online commodity chapters.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook OECD Agriculture statistics (database)", http://dx.doi.org/10.1787/agr-outl-data-en.

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1.2. Macroeconomic and policy assumptions

1.2.1. The main assumptions underlying the baseline projections

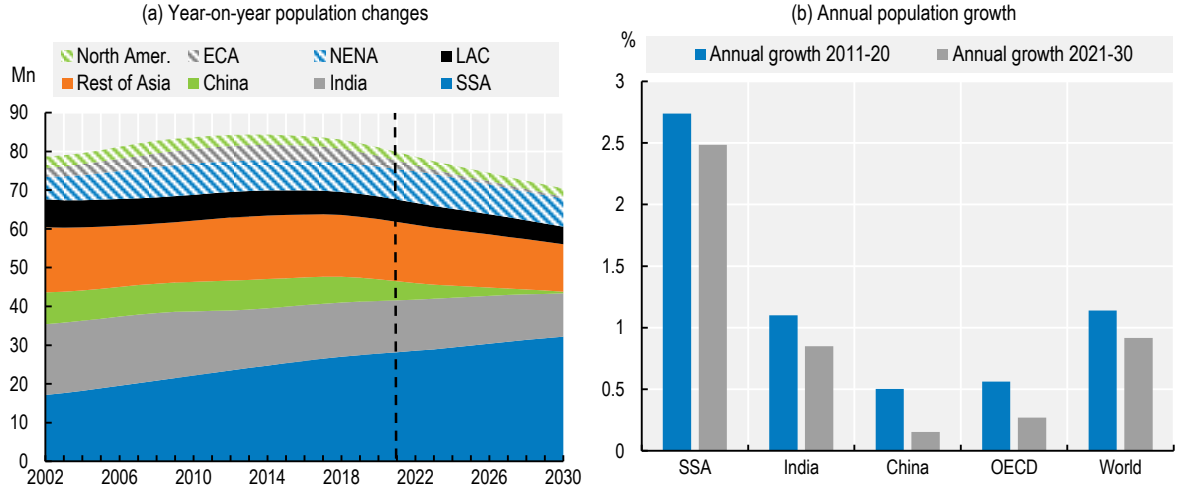
This *Outlook* presents a consistent baseline scenario for the medium-term evolution of agricultural and fish commodity markets, which is produced based on a set of macro-economic, policy and demographic assumptions. The main assumptions underlying the projections are highlighted in this section. Detailed data are available in the Statistical Annex.

1.2.2. Population growth

The *Agricultural Outlook* uses the UN Medium Variant set of estimates from the 2019 Revision of the United Nations Population Prospects database.

Over the projection period, world population is expected to grow from an average of 7.7 billion people in 2018-20 to 8.5 billion people in 2030. This corresponds to an annual growth rate of 0.9%, a slowdown compared to the 1.1% p.a. growth rate experienced over the last decade. Population growth is concentrated in developing regions, particularly Sub-Saharan Africa, which is expected to have the fastest growth rate at 2.5% p.a. (Figure 1.2). With an additional 137 million people by 2030, India is expected to overtake the People's Republic of China (hereafter "China") as the most populous country of the world.

Figure 1.2. World population growth



Note: SSA is Sub-Saharan Africa; LAC is Latin America and Caribbean; ECA is Europe and Central Asia; NENA stands for Near East and North Africa, and is defined as in Chapter 2; Rest of Asia is Asia Pacific excluding China and India.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database).

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1.2.3. GDP growth and per capita income growth

Estimates of GDP growth and per capita income growth are based on the *OECD Economic Outlook* No. 108 (December 2020) and the *IMF World Economic Outlook* (October 2020).[1] Per capita incomes are expressed in constant 2010 US dollars.

The COVID-19 pandemic has added an additional element of uncertainty to the macroeconomic assumptions underlying the projections of the *OECD-FAO Agricultural Outlook*. Although our assumptions suggest a widespread economic recovery beginning in 2021, the actual pace of recovery will largely

depend on the success of national pandemic control measures (e.g. vaccination campaigns) and on policies that support the recovery of businesses and consumer demand.

After dropping by 4.7% in 2020, global GDP is expected to rebound in 2021-2022 and grow at an average rate of 2.9% over the next ten years. The world economy should recover to its pre COVID-19 level by 2022. However, the path of recovery is projected to be uneven among countries and regions. Recovery is expected to be the fastest in Asia. China is one of the rare countries that recorded positive GDP growth in 2020. In South East Asia and India, recovery is projected to be achieved by 2021 and 2022, respectively. In the OECD and in Sub-Saharan Africa, GDP is expected to recover to its 2019 level (i.e. its pre-COVID level) by 2022. In Near East and North Africa and Latin America and the Caribbean, recovery is projected to be slower and to be achieved by 2023.

National average per-capita income levels and growth rates are approximated in this *Outlook* using per capita GDP. This indicator is used to represent household disposable income, which is one of the main determinants of demand for agricultural commodities. As shown in the World Bank's Poverty and Shared Prosperity 2018 report, however, national economic growth is unevenly distributed. In particular, in several Sub-Saharan African countries the incomes of the poorest 40% of the population have lagged average income growth. For this reason, national average agricultural demand projections in this *Outlook* can deviate from what might be expected based on average income growth. In addition, the COVID-19 pandemic especially impacted the income of the poorest households.

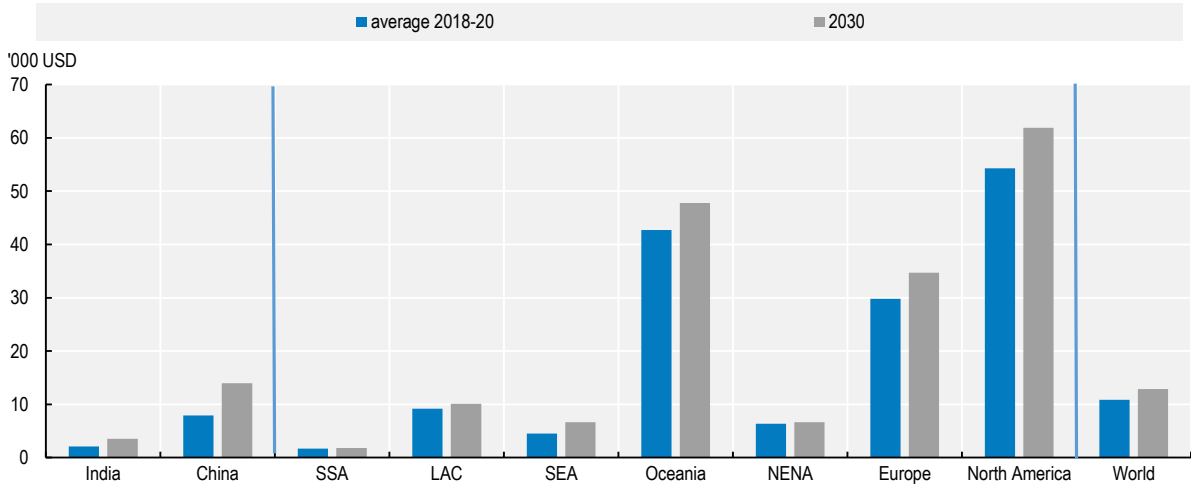
After dropping by 6% in 2020, global per capita income is expected to recover in 2021 and 2022. Over the coming decade, an average annual growth rate of 1.9% in real terms is projected. Strong growth is expected in Asia, with per capita income increasing by 5.8% p.a. in India and 5.3% p.a. in China (Figure 1.3). Growth in per capita income is also expected to be strong in Viet Nam, at 5.5% p.a. over the coming decade, and in the Philippines, Indonesia and Thailand at 4.7%, 3.8% and 3.6% p.a., respectively.

In Sub-Saharan Africa, average per capita incomes are projected to rise at a rate of 1.2% p.a. (Figure 1.3). A notable exception is the strong economic growth anticipated for Ethiopia at 7.4% p.a., while no per capita income growth is projected for Nigeria. In the Latin America and Caribbean region, average per capita income growth is projected at 1.5% p.a., with considerable differences between countries. While incomes in Brazil and Mexico will grow relatively slowly over the next decade (i.e. below 2% p.a.), countries such as Peru and Paraguay will see per capita incomes grow by around 2.8% p.a., and Colombia by 3.1% p.a. In the Near East and North Africa, average per capita income growth is projected at 1.1% p.a., led by Egypt at 3.4% p.a. and Israel at 2.5% p.a., while per capita income growth in Iran and other Near East countries is projected to be below 1% p.a.

Over the medium term, average per capita incomes are expected to rise by 1.7% p.a. and 1.4% p.a. in Europe and Oceania, respectively (Figure 1.3). These rates are close to the OECD average, where per capita income is projected to increase at around 1.5% p.a. over the coming decade. Among OECD countries, the highest growth is expected for Colombia, followed by Turkey and Korea at 2.8% and 2.6% p.a. respectively, while per capita incomes are expected to grow the slowest in Canada at 1% p.a.

Figure 1.4 decomposes the GDP growth assumptions into per capita GDP and population growth for key regions and selected countries. Globally, economic growth will be mainly driven by per capita income growth; this is especially the case in OECD countries and in China. By contrast, high population growth in Sub-Saharan Africa means that the relatively high rate of economic growth in the region (close to 3.8% p.a.) corresponds to only a modest growth in per capita terms (at around 1.2% p.a.). The same applies to a lesser extent to the Near East and North Africa region. By contrast, the modest economic growth in Europe at 1.6% p.a., where population is expected to decrease over the next ten years, would translate into a per capita income growth rate of 1.7% p.a. over the coming decade.

Figure 1.3. Per capita income



Note: SSA is Sub-Saharan Africa; LAC is Latin America and Caribbean; SEA is South-East Asia; NENA stands for Near East and North Africa, and is defined as in Chapter 2. The graph shows per capita GDP in constant 2010 US dollars.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database).

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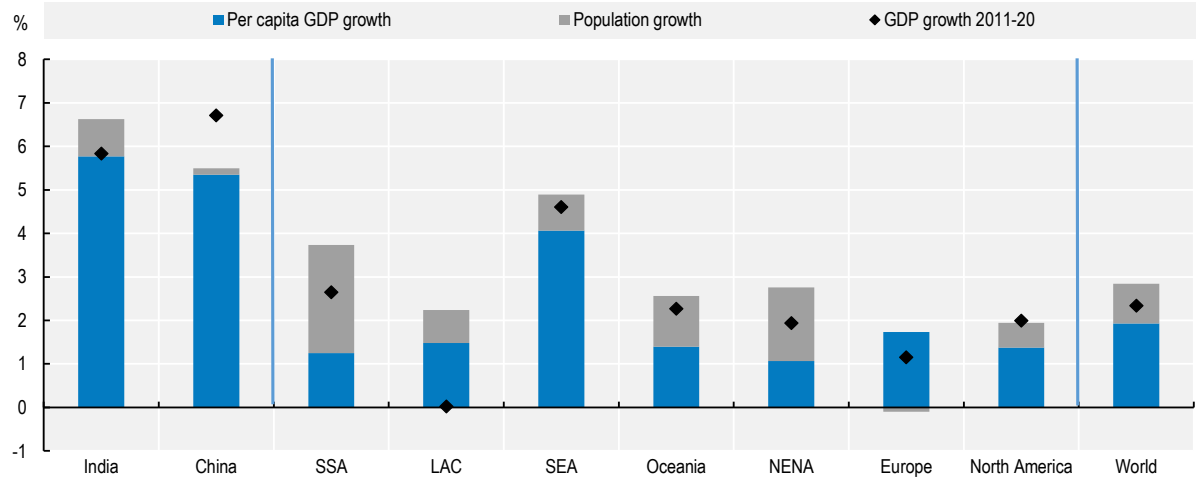
Figure 1.4. Annual GDP growth rates 2021-2030



Note: SSA is Sub-Saharan Africa; LAC is Latin America and Caribbean; SEA is South-East Asia; NENA stands for Near East and North Africa, and is defined as in Chapter 2.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database).

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1.2.4. Exchange rates and inflation

Exchange rate assumptions are based on the *OECD Economic Outlook* No. 108 (December 2020) and on the IMF *World Economic Outlook* (October 2020). Real exchange rates for the period 2021-30 are assumed to remain broadly unchanged, so that nominal exchange rates relative to the US dollar mostly reflect differences in inflation compared to the United States. Some currencies are expected to appreciate in real terms compared to the US dollar; this is the case for Argentina and Turkey, and to a lesser extent

for New Zealand, Japan, China, Chile and Mexico. By contrast, a real depreciation is expected for Norway, the Russian Federation (hereafter “Russia”), Brazil, Colombia and Australia. In non-OECD countries, real appreciation is expected in many countries most pronounced in Nigeria, Ukraine, Kazakhstan, while real depreciation is highest in Ethiopia, India, Israel, and Peru.

Inflation projections are based on the private consumption expenditure (PCE) deflator from the *OECD Economic Outlook* No. 108 (December 2020) and the *IMF World Economic Outlook* (October 2020). In OECD countries, inflation is projected to be higher than in the previous decade, at 2.9% p.a., with an annual rate of 2.2% p.a. for the United States, 1.9% p.a. for Canada, and 1.7% p.a. for the Euro zone. Among emerging economies, consumer price inflation is expected to remain high at 9.7% p.a. in Turkey and at 11.5% p.a. in Argentina, despite a strong decrease compared to the previous decade. In Russia, inflation should ease from 6.7% p.a. in the last ten years to 3.9% p.a. over the coming decade, from 5.3% p.a. to 3.8% p.a. in India, and from 6.2% p.a. to 3.2% p.a. in Brazil. By contrast, China should experience a slight increase in consumer price inflation compared to the last decade, at 2.6% p.a. In some countries (e.g. Ethiopia, Pakistan, Saudi Arabia, and Nigeria) inflation has increased significantly in 2020 and remains high in 2021 but is expected to return to lower values thereafter.

1.2.5. Input costs

Production in the *Agricultural Outlook* is guided by the evolution of a composite cost index, which covers the cost of seed, energy and fertiliser, as well as various other tradable and non-tradable inputs. It is constructed on the basis of historical cost shares for each country and commodity, which are held constant for the duration of the outlook period. Energy costs are represented by the international crude oil price expressed in domestic currency. The evolution of costs of tradable inputs such as machinery and chemicals is approximated by the development of the real exchange rate, while the evolution of costs of non-tradable inputs (mainly labour costs) are approximated by the evolution of the GDP deflator. Seed prices follow the respective crop prices, while an aggregate fertiliser price is approximated by a formula that takes crop and crude oil prices into account.

Historical data for world oil prices are based on Brent crude oil prices in 2019 obtained from the short-term update of the *OECD Economic Outlook* N°108 (December 2020). For 2020, the annual average daily spot price in 2020 was used. For the remainder of the projection period, the reference oil price used in the projections is assumed to follow the growth rate of the World Bank average oil price, which implies an increase from USD 43/barrel in 2020 to USD 74/barrel in nominal terms and USD 62/barrel in real terms in 2030.

1.2.6. Policy considerations

Policies play an important role in agricultural, biofuel and fisheries markets, for which policy reforms often change market structure. The *Outlook* assumes that policies currently in place will remain unchanged throughout the projection period providing a baseline for evaluation and analysis of future policies.

The United Kingdom officially left the European Union on 31 January 2020. On December 2020, the United Kingdom and the European Union concluded the EU-UK Trade and Cooperation Agreement, which is applicable since 1 January 2021 and sets out preferential arrangements for trade in goods and services. Data for the United Kingdom are thus reported separately from the European Union, but the *Outlook* takes the technical assumption of a stable and duty-free/quota-free trading relationship between the United Kingdom and the European Union.

The African Continental Free Trade Area (AfCFTA) officially came into force in May 2019 and trading under the agreement started on 1 January 2021. The agreement will effectively consolidate 55 countries into a single market. As of January 2021, these countries had a combined population of more than 1.3 billion people and a combined GDP of USD 3.4 trillion. The AfCFTA foresees a gradual elimination of tariffs over

the next five years for non-least developed countries (LDCs) and over the next ten years for LDCs, for 90% of the tariff lines. However, the exact tariff schedules have not yet been finalised. Therefore, the *Outlook* does not consider any tariff reductions within AfCFTA signatory countries. However, it assumes improved market efficiency within the African region, although non-tariff barriers to trade together with weak transportation links may limit the extent of potential market integration.

The Regional Comprehensive Economic Partnership (RCEP) is a free trade agreement signed in November 2020 between the ten countries of ASEAN and five countries of Asia and Pacific (China, Japan, Korea, Australia and New Zealand). As of 2020, the 15 member countries accounted for about 30% of the world's population (2.2 billion people) and 30% (USD 26.2 trillion) of global GDP. The RCEP will provide a framework aimed at lowering trade barriers and securing improved market access for goods and services. As the RCEP is not yet ratified, it is not taken into account in the projections.

Similarly, the potential effects of the trade agreement between the European Union and Mercosur states (i.e. Argentina, Brazil, Paraguay, and Uruguay) are not taken into account in the projections as ratification is still pending.

No specific assumption was made regarding the potential impact of ongoing trade tensions, e.g. between the United States and China.

This *Outlook* assumes that the restrictive measures to contain the spread of the COVID-19 pandemic will not be permanent. They are assumed to be lifted as part of the economic recovery in 2021.

1.3. Consumption

The *OECD-FAO Agricultural Outlook* projects future trends in the use of the main crop commodities (cereals, oilseeds, roots and tubers, pulses, sugar cane and sugar beet, palm oil and cotton) and livestock products (meat, dairy, egg and fish) as food, animal feed, and raw materials for biofuels and other industrial applications.

Future demand for food is directly influenced by population and demographic changes, by income growth and income distribution, and by food prices. The *Outlook* assumes that food demand will be additionally shaped by socio-cultural and lifestyle-driven changes in consumption patterns, including continuing urbanisation and rising female participation in the workforce, as well as increasing consumer awareness of health and sustainability issues. These factors will determine the size of the consumer population, the composition of their desired food basket, and their ability to purchase it. Policies influencing the price of agricultural products (e.g. fiscal measures, border measures) and, as far as possible, policies influencing consumption patterns (e.g. food labelling, regulations), are also incorporated into the assessment of future consumer demand. Taken together, these elements will determine the level and structure of food demand over the coming decade.

Demand for non-food uses of agricultural commodities is also shaped by a number of specific factors. Feed demand has two main drivers. First, the overall demand for animal products, which determines the production level of the livestock and aquaculture sectors. Second, the structure and efficiency of the production systems, which determine the amount of feed needed to produce a given output of livestock and aquaculture products.

Industrial uses of agricultural commodities (mostly for biofuel production and as input in the chemical industry) are shaped by general economic conditions, regulatory policies and technological change. Biofuel demand, for instance, is highly sensitive to changes in policies, as well as to overall demand for transport fuel, which in turn depends on the crude oil price.

After an initial economic contraction from the COVID-19 shock, the *Outlook* assumes a widespread economic recovery beginning in 2021. However, per capita incomes in 2030 are expected to remain below

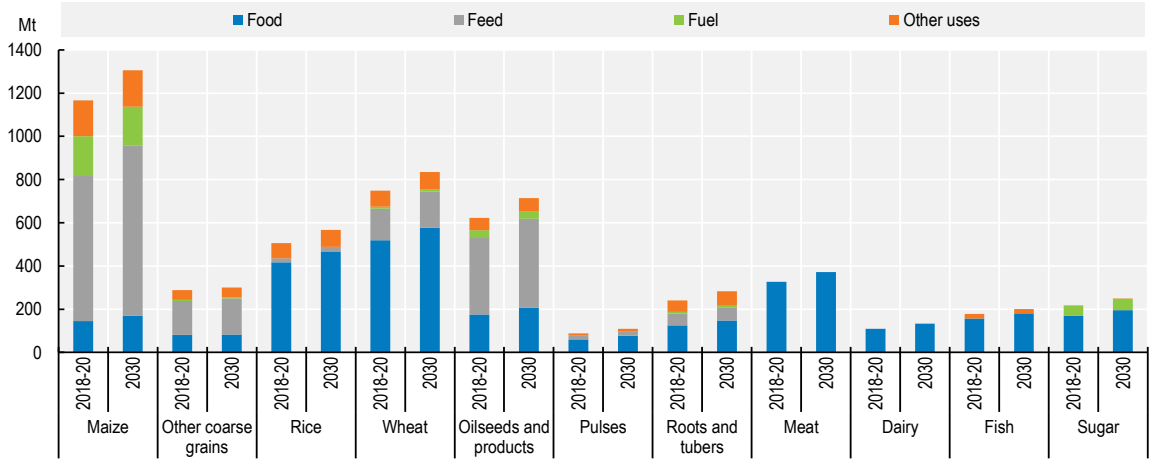
pre-COVID projections for 2030. This is expected to affect demand in low-income households and have implications for food intake and the composition of diets over the next decade. The pandemic also induced a shift away from food services and restaurants towards home eating. This behavioural change is assumed to be reverted as the economy recovers and control measures are lifted. The evolution of COVID-19 pandemic, however, adds an additional element of uncertainty to the macroeconomic assumptions underlying these projections (Section 1.2). Although the *Outlook* assumptions imply a widespread economic recovery beginning in 2021, the actual pace of recovery will largely depend on the success of national pandemic control measures (e.g. vaccination campaigns) and of policies supporting the recovery of businesses and consumer demand.

1.3.1. Adjustments expected in the structure of agricultural commodity demand

Agricultural commodity demand includes both food and non-food uses. For most agricultural commodities, global demand for food use is the main component of overall demand. However, non-food uses, mainly feed and fuel, are important for several commodities, and have experienced faster growth than food use over the last decade(s).

Over the next ten years, the shares of the different uses by commodity are not projected to change significantly, as no major shift in consumption is expected. Food will remain the primary use for rice, wheat, pulses, roots and tubers, and sugar, as well as for all animal products. Feed will continue to be the dominant use for coarse grains and oilseeds (Figure 1.5).

Figure 1.5. Global use of major commodities



Note: Crushing of oilseeds is not reported as the uses of 'vegetable oil' and 'protein meal' are included in the total; Dairy refers to all dairy products in milk solid equivalent units; Sugar biofuel use refers to sugarcane and sugarbeet, converted into sugar equivalent units.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Growth in feed use of cereals is expected to continue exceeding the rate of expansion of food use. Feed use of cereals is projected to grow at 1.2% p.a. over the coming decade as livestock production expands and intensifies in low and middle-income countries, compared to a projected growth of 1% p.a. for food use.

By contrast, recent developments in biofuel policies combined with declining fuel use in some regions suggest lower growth in biofuel production from agricultural crops. As a result, biofuel use of cereals is projected to drop over the coming decade (-0.4% p.a.), and the share of biofuels in total use of cereals, oilseeds and sugar is expected to level off or decline (Section 1.3.7).

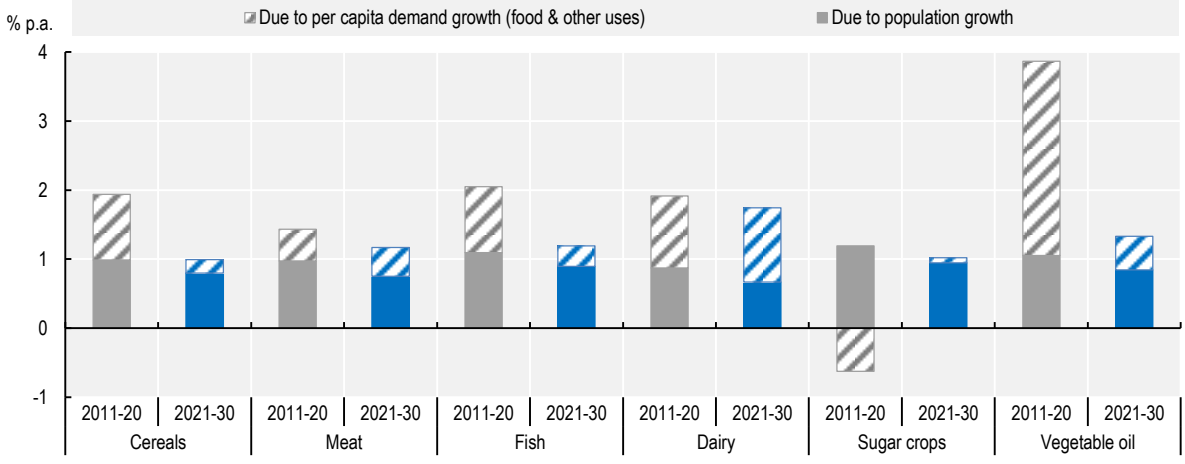
1.3.2. Agricultural demand growth is slowing and mostly driven by population growth

Global demand for agricultural commodities (including for non-food uses) is projected to grow at 1.2% p.a. over the coming decade; well below the growth experienced over the last decade (2.2% p.a.). This is mainly due to an expected slowdown in demand growth in China (0.8% p.a. compared to 2.7% p.a. over the last decade) and other emerging economies, and lower global demand for biofuels (Figure 1.6).

For cereals and fish, global demand will grow at half the rate of the past decade, while for vegetable oils less than a third of last decade's growth is expected. Vegetable oils was the fastest-growing commodity over the last ten years, partly driven by biofuel policies. Over the coming decade, the growth in demand for vegetable oils will be constrained by stagnant to declining biodiesel consumption in the two main markets, the United States and the European Union (Section 1.3.7). Food demand for vegetable oils is also projected to slow down as high-income countries and some emerging economies, including China, are approaching saturation levels.

Given the limited growth in per capita demand for most commodities, population growth will be the main determinant of overall demand growth over the coming decade. The bulk of additional demand will therefore originate in regions with high population growth such as Sub-Saharan Africa, South Asia, Near East, and North Africa. The only exception is dairy products, for which growth in demand will be mainly driven by rising per capita consumption of fresh dairy products in India.

Figure 1.6. Annual growth in demand for key commodity groups



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 (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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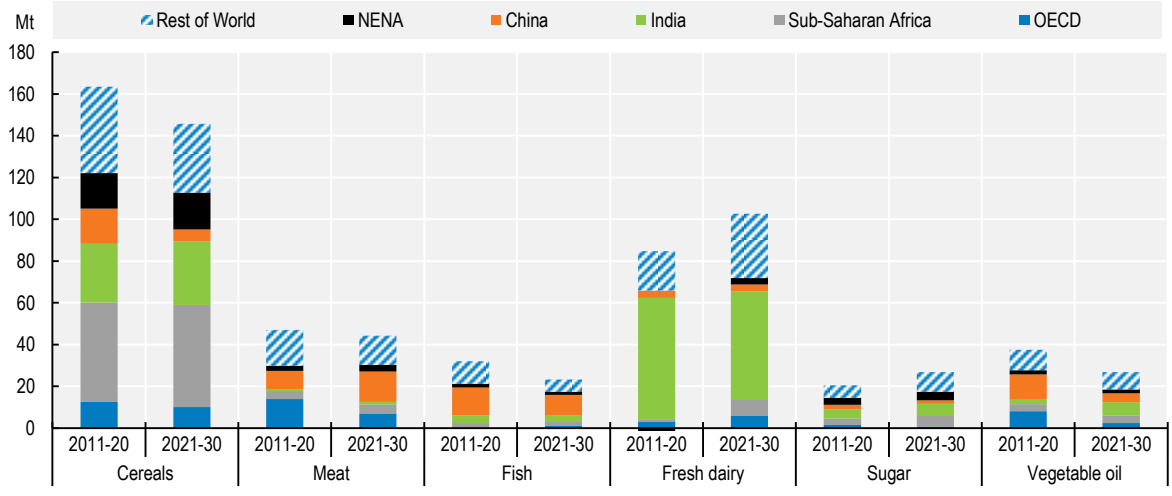
1.3.3. Low and middle income countries are the source of most food demand growth

Global food demand is projected to increase by 1.3% p.a. over the coming decade, driven by growing population and per capita incomes. Most additional demand for food will originate in low and middle-income countries, while in high-income countries it will be constrained by slow growth in population, and saturation in food consumption for several commodities.

The world population is projected to grow from an average of 7.7 billion in 2018-20 to 8.5 billion in 2030. Two-thirds of this increase is expected to occur in Sub-Saharan Africa, India and Near East and North Africa (Section 1.2). Given the significant expansion in their populations, these countries/regions will drive a large share of additional demand for food, in particular for cereals (two-thirds of additional demand), and other staples (i.e. roots and tubers, and pulses). Population growth is also expected to spur demand for sugar in Sub-Saharan Africa and Near East and North Africa, which are projected to account for 35% of additional demand over the coming decade (Figure 1.7).

Food demand is also influenced by per capita incomes. The macro-economic assumptions underlying this *Outlook* suggest growth in per capita GDP of 5.3% p.a. in China, 5.8% p.a. in India, and 4.1% p.a. in South East Asia over the coming decade (Section 1.2). With continued income growth and urbanisation, China should remain a key driver of demand for several commodities, including fish and meat. China is expected to account for 43% and 33% of additional demand for these commodities, respectively, over the next decade. In India, income growth will support growing demand for fresh dairy (50% of additional global demand) and vegetable oils. In India and South East Asia, income growth will also spur demand for sugar. This high demand growth will mainly stem from higher demand for sugar-rich confectionary products and soft drinks, mostly in urban areas.

Figure 1.7. Regional contributions to food demand growth, 2011-20 and 2021-30



Note: Each column shows the increase in global demand over a ten-year period, split by region, for food uses only. NENA stands for Near East and North Africa, and is defined as in Chapter 2.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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It should be noted that the figures presented in the *Outlook* for consumption are estimates of food availability and not of actual consumption. Quantities of food available for human consumption are higher than quantities consumed as some of the food that is potentially available to consumers is lost or wasted along the supply chain. This share is particularly high for perishable products such as dairy products and fruits and vegetables. The FAO estimates that globally about 14% of food produced is lost before reaching the retail level. An important share of food that is available to consumers is also wasted, estimated at 17% in 2019 (FAO, 2021[1]).[2] Reducing food loss and waste, as targeted by Sustainable Development Goal (SDG) 12.3, will contribute to improve food security and nutrition, and lower environmental pressures.

1.3.4. Limited convergence in diets expected over the coming decade

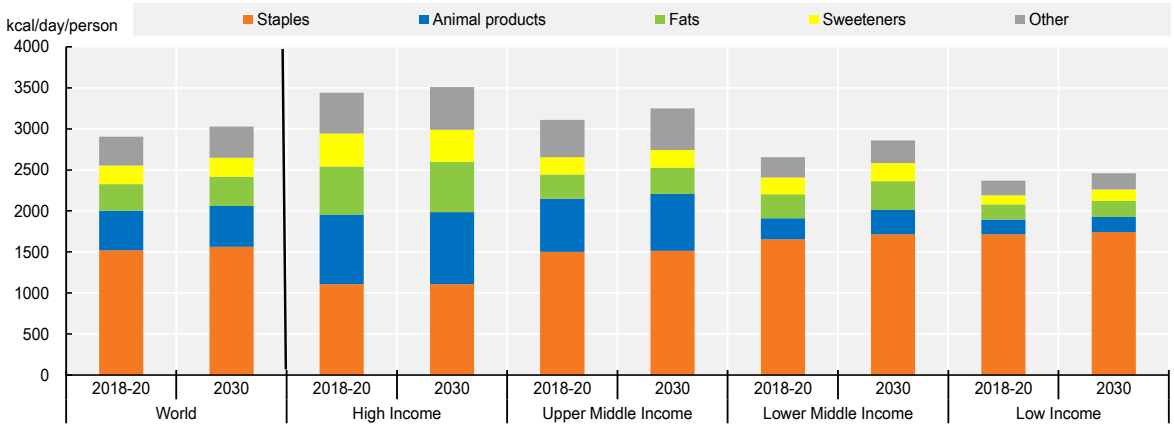
Varying income levels and income growth projections, as well as cultural preferences around diets and nutrition, will underlie continuing differences in consumption patterns between countries. By 2030, large discrepancies will continue to exist in terms of per capita availability of different commodities, as well as overall calorie and protein availabilities.

Globally, aggregate food availability is projected to grow by 4% over the projection period, reaching just over 3 025 kcal/person/day in 2030; fats and staples accounting for 60% of additional calories (Figure 1.8). By far the highest growth rate is projected for fats at 10% over the next ten years, indicating that additional efforts are needed to support a transition towards healthier diets (FAO, IFAD, UNICEF, WFP & WHO, 2020[2]). The increase in fat consumption is attributed to higher consumption of processed and convenience food, and an increasing tendency to eat outside the home. Ongoing urbanisation and rising female participation in the workforce as well as income shortages and food price inflation in the wake of the COVID-19 pandemic are assumed to underpin this development. Staples will remain the most significant food commodity group across all income groups. Nevertheless, on the account of the ongoing transition in global diets towards higher shares of fats, sugar, animal products and other foods, the share of staples in the food basket is projected to decline by 2030 for all income groups, albeit at different rates.

In high-income countries, per capita food availability will not expand significantly over the coming decade (Figure 1.8). Per capita availability of the different food groups is already at high levels and ageing populations and more sedentary lifestyles limit additional calorie requirements. However, income growth and changing consumer preferences will increase the substitution away from staples and sweeteners towards higher-value foods, including fruits and vegetables (Box 1.1), and to a lesser extent, animal products. The projected decline in per capita consumption of sweeteners reflects growing consumer concerns about the negative health effects of excessive sugar consumption. Several countries (e.g. France, United Kingdom, and Norway) have also implemented measures to discourage the consumption of caloric sweeteners over the last decade, which are assumed to remain in effect over the projection period, and to reduce demand for these products.

In upper-middle income countries, per capita food availability is expected to expand by 4.5% by 2030 (Figure 1.8). Given the foreseen high income growth and the strong preferences for meat in several of these countries, including China, 32% of additional calories will be provided by animal products, and 19% by fats. Food availability is projected to increase by almost 8% in lower-middle income countries over the coming decade (202 kcal/person/day), the largest gain of all income groups. Staples and fats will account for more than half of the increase. Per capita consumption of animal products is also expected to expand, mainly as a result of rising per capita consumption of dairy products in India (Section 1.3.5).

Figure 1.8. Per capita availability of main food groups (calorie equivalent), by country income group



Note: Estimates are based on historical time series from the FAOSTAT Food Balance Sheets database which are extended with the *Outlook* database. Products not covered in the *Outlook* are extended by trends. The 38 individual countries and 11 regional aggregates in the baseline are classified into the four income groups according to their respective per-capita income in 2018. The applied thresholds are: low: < USD 1 550, lower-middle: < USD 3 895, upper-middle: < USD 13 000, high: > USD 13 000. Staples includes cereals, roots and tubers and pulses. Animal products include meat, dairy products (excluding butter), eggs and fish. Fats include butter and vegetable oil. Sweeteners include sugar and HFCS. The category others include fruits, vegetables, and other crop and animal products.
Source: FAO (2021). FAOSTAT Food Balances Database, http://www.fao.org/faostat/en/#data/FBS; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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In low-income countries, food availability is projected to increase by 3.7% over the next ten years (89 kcal/person/day); sweeteners and staples accounting for 33% and 31% of additional calories, respectively (Figure 1.8). Average diets in low income-countries will remain heavily based on staples, which will continue to provide 70% of daily calories by 2030. Per capita consumption of sweeteners is projected to increase strongly (26%), albeit from a low base, keeping consumption levels well below those of middle and high-income countries by 2030. Growth in the consumption of animal products and other high-value foods (e.g. fruits and vegetables) will, however, remain limited due to income constraints, largely propelled by the COVID-19 pandemic. Given the higher cost of these food items, consumers in lower-middle and low-income countries will only be able to slightly increase the diversity of their diets (Box 1.1).

Box 1.1. The determinants of fruits and vegetables consumption

The United Nations has declared 2021 as the International Year of Fruits and Vegetables. The Year aims to raise awareness on the nutritional and health benefits of consuming more fruits and vegetables as part of a diversified, balanced and healthy diet and lifestyle; and to facilitate progress toward the Sustainable Development Goals.

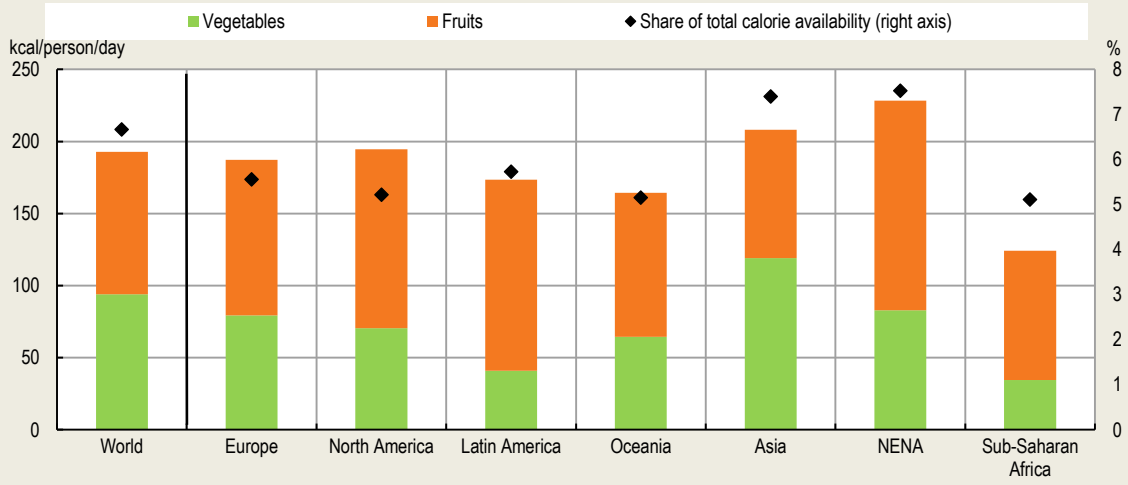
Fruits and vegetables are key constituents of a healthy diet, and their sufficient daily consumption could help prevent major diseases. In 2017, some 3.9 million deaths worldwide were attributable to not eating enough fruits and vegetables. Insufficient intake of these commodities is estimated to cause around 14% of deaths from gastro-intestinal cancer worldwide, about 11% of those due to ischemic heart disease, and about 9% of those caused by stroke.

The World Health Organization (WHO) recommends consuming at least 400 g of fruits and vegetables per day (or five portions) to reap their health and nutrition benefits. Yet, worldwide, available estimates suggest that we consume only about two-thirds of this recommended minimum amount. So why do people not eat enough fruits and vegetables?

A number of factors are influencing fruits and vegetables consumption, including availability.[1] Fruits and vegetables availability is a key factor underlying differences in the consumption of these products between countries and regions. Estimates of per capita availability of fruits and vegetables also enable the comparison of their relative importance in the diet with commodities covered in the *Outlook*.

According to the *FAO Food Balance Sheets*, globally, 580 g/person/day (or 193 kcal/person/day) of fruits and vegetables were available for human consumption in 2016-18; fruits and vegetables accounting for 6.6% of total calorie availability (Figure 1.9).

Figure 1.9. Per capita availability of fruits and vegetables in selected regions, 2016-18



Note: Vegetables do not include roots and tubers and pulses. NENA stands for Near East and North Africa, and is defined as in Chapter 2.
Source: FAO (2021). FAOSTAT Food Balances Database, http://www.fao.org/faostat/en/#data/FBS; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Fruits and vegetables availability is the highest in the Near East and North Africa and in Asia; at 228kcal/person/day and 208 kcal/person/day, respectively. In Asia, per capita availability of fruits and vegetables is particularly high in China (at 347 kcal/person/day) while it is lower in India (132 kcal/person/day); where most calories are obtained from roots and tubers, and pulses. In North America and Europe, fruits and vegetables availability is close to the world average, at 192 kcal/person/day and 187 kcal/person/day, respectively. However, regional averages also masks important differences between countries. In Europe, for instance, vegetables and especially fruits availability is higher in Southern European countries, while in Central and Eastern European countries cereals and potatoes are more available. Latin America, Oceania and Sub-Saharan Africa have lower availability of fruits and in particular of vegetables. Fruits and vegetables availability is particularly low in Sub-Saharan Africa, at 124 kcal/person/day in 2016-18; most calories available in the regions come from cereals and pulses. This mainly reflects production constraints (e.g. low productivity, lack of adequate pest control) as well as the lack of storage and packaging facilities.

Besides availability, other factors are influencing fruits and vegetables consumption and are underlying differences in consumption levels within countries. In addition to consumer preferences, several socio-

economic factors such as income, education level, gender, and household composition appear to play a significant role. Higher incomes are generally associated with greater purchases of fruits and vegetables. Fruits and vegetables can be a relatively expensive part of the diet thus many of the poorer households spend what food money they have on cheaper, energy dense staples carbohydrate, which generally cost less per calorie. According to studies based on OECD countries and EU Member States, populations with higher levels of education are also more likely to consume the recommended daily amount of fruits and vegetables and have a generally healthier diet compared to those with medium or low levels of education. Women are also more likely than men to consume at least five fruits and vegetables per day. A study conducted on eleven countries in Sub-Saharan Africa also found that households headed by women tend to spend more on fruits and vegetables than those headed by men. However, increasing female participation in the workforce over the last century has led to a reduction in the time women spend on household tasks. Full time working mothers spend less time on meal preparation, prepare fewer meals for the whole family, and generally consume less fruits and vegetables.

Given the importance of fruits and vegetables for health and nutrition, several countries have implemented policies to promote their consumption. These mainly include school-based and other environmental policies that can influence children (e.g. promotion of fruits and vegetable eating in school cafeterias), and policies that modify the costs of health-related choice and are mainly targeted to low income households (e.g. fruits and vegetables subsidies). Efforts and investments to increase the production and productivity of the fruit and vegetable sectors and to reduce losses and waste along the supply chain, are also key to increase fruits and vegetables consumption.

1. The total quantity of foodstuffs produced in a country added to the total quantity imported and adjusted to any change in stocks that may have occurred since the beginning of the reference period gives the supply available during that period.
Sources: (FAO, 2020[3]), (Placzek, 2021[4]), (OECD, 2019[5]).

1.3.5. Increasing gap in animal protein consumption between low-income countries and middle and high-income countries

High-income countries: Near saturation levels, health and sustainability concerns limit growth in animal protein consumption

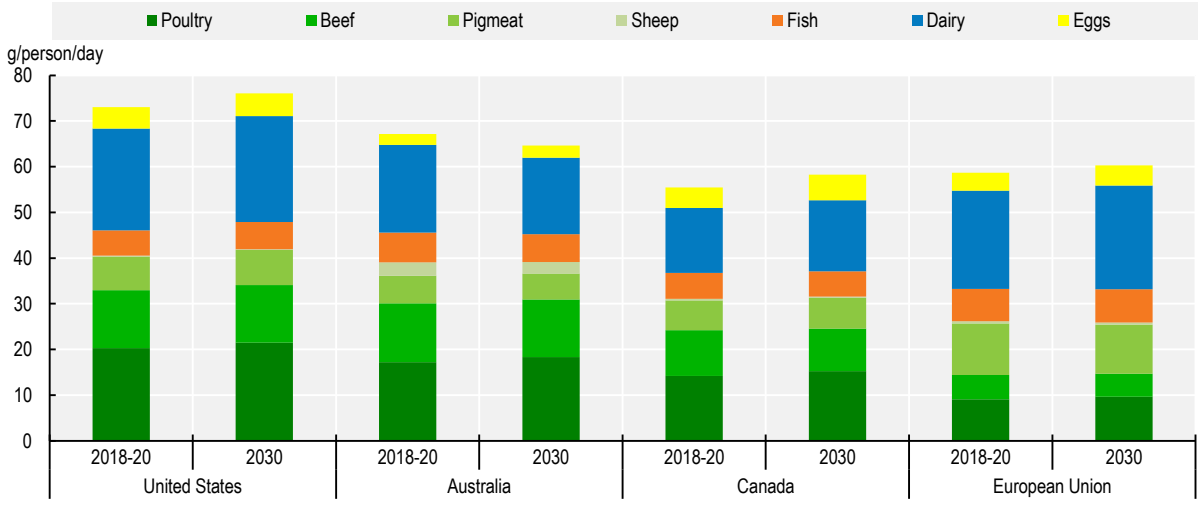
In high-income countries, per capita availability of animal protein (i.e. meat, fish, dairy, and eggs) is expected to grow slowly over the coming decade (+1.8 g/person/day or 3%). Moreover, due to health and environmental concerns, consumers are expected to increasingly replace red meat by poultry meat and dairy products. Consumers in high-income countries will also pay increasing attention to the production process, which could lead to increased consumption of local and certified organic products.

In high-income countries, the increase in poultry meat availability is projected to account for over half of additional animal protein availability over the coming decade. Demand for poultry meat is projected to grow steadily as consumers see it as a healthier and more environmentally sustainable product than beef and pigmeat. Poultry is also more affordable than other meat types, which will also contribute to growing poultry demand in middle and low-income countries.

By contrast, beef, pigmeat and sheepmeat consumption levels are expected to remain stable. Weakening demand for beef in high-income countries is due to several factors, including concerns about the climate impact of cattle production, and dietary recommendations by governments, which in several countries, advise limiting weekly intakes of red meat (OECD, 2021[6]). Most countries and regions with high per capita consumption of beef (e.g. Canada, Australia, and the European Union) will see these levels declining. Per capita consumption of pigmeat in the European Union, and of both pigmeat and sheepmeat in Australia,

are also projected to decline, as consumers switch to cheaper and healthier alternatives (mostly poultry) (Figure 1.10).

Figure 1.10. Per capita availability of animal protein in selected high-income countries



Note: Estimates are based on historical time series from the FAOSTAT Food Balance Sheets database which are extended with the Outlook database. Products not covered in the Outlook are extended by trends.
Source: FAO (2021). FAOSTAT Food Balances Database, http://www.fao.org/faostat/en/#data/FBS; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Per capita availability of dairy products will continue increasing over the coming decade (+0.7 g/person/day). High-income countries mainly consume processed dairy products including cheese, which is projected to account for almost two-thirds of the increase in dairy protein availability.

Health and environmental concerns, together with animal welfare and ethical considerations regarding eating animals are also leading to an increase in the number of vegetarian, vegan or "flexitarian" lifestyles in high-income countries, and in particular among young consumers. The share of vegetarians in the overall population is currently low, with 5% of the population in the United States and 6% in Germany describing themselves as vegetarians, for instance (Hrynowski, 2019[7]) (Heinrich-Böll-Stiftung, 2021[8]). However, this dietary trend could affect global markets if adopted by an increasing share of the population in these regions. In particular meat and dairy markets could be affected by a shift away from animal protein towards alternative protein sources. The food industry has already responded to this emerging trend by developing a range of new products and ingredients using different plant-based proteins (e.g. soy, pea), new animal sources (e.g. insects), and biotechnological innovations (e.g. cultured meat or fungal protein) (McKinsey, 2019[9]). However, at the global level, this trend is expected to be offset by rising demand for animal protein in middle-income countries.

Middle-income countries: Growing per capita incomes spur animal protein consumption

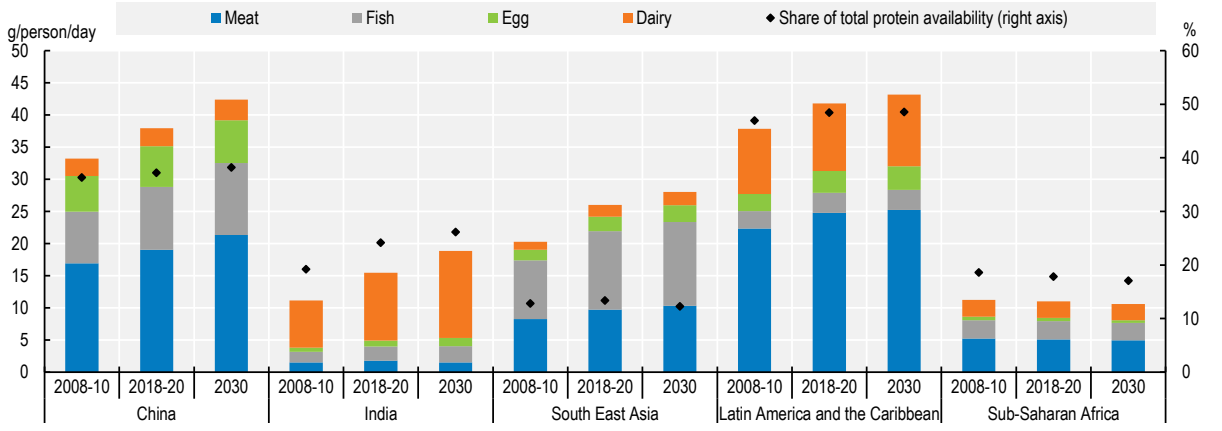
In middle-income countries, per capita availability of animal protein is projected to increase by 11% over the coming decade (+2.8 g/person/day), and to contribute to a growing share of total protein availability by 2030. However, income growth will result in higher demand for different animal products across countries and regions, depending on dietary preferences.

In China and South East Asia, meat and fish are expected to account for most of the increase in animal protein availability over the coming decade (+3.7 g/person/day and +1.4 g/person/day, respectively). The increase in meat consumption will be driven by both pigmeat and poultry in China, and entirely by poultry in South East Asia. Despite a 10% increase in per capita animal protein availability in South East Asia, the share of animal protein in overall protein availability will remain relatively low, at 12%, in 2030 (Figure 1.11).

In India, dairy products, which are an integral part of the diet, will account for 88% of the increase in animal protein availability over the coming decade (+3 g/person/day). Income growth in India will not result in higher meat consumption due to social and cultural factors; at least a quarter of the population is estimated to be vegetarian. The share of animal protein in overall protein availability will increase from 24% to 26%, over the coming decade (Figure 1.11). However, most protein will continue to come from crops, and in particular pulses, by 2030.

In Latin America, per capita consumption of animal protein is not expected to increase significantly as it is already at a high level; animal protein accounts for almost 50% of total protein availability in the region (Figure 1.11). Per capita consumption of dairy products, poultry meat and pigmeat will continue to expand over the coming decade, while beef consumption is projected to decline as consumers increasingly favour cheaper alternatives (poultry meat and to a lesser extent pigmeat).

Figure 1.11. Per capita availability of animal protein in selected middle and low-income countries/regions



Note: Estimates are based on historical time series from the FAOSTAT Food Balance Sheets database which are extended with the *Outlook* database. Products not covered in the *Outlook* are extended by trends. South East Asia includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor Leste, and Viet Nam.
Source: FAO (2021). FAOSTAT Food Balances Database, http://www.fao.org/faostat/en/#data/FBS; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Low-income countries: Slow income growth prevents growth in animal protein consumption

Low-income countries have low per capita availability of animal protein, averaging 13.8 g/person/day in 2018-20. Over the coming decade, these levels are not expected to increase significantly (+0.2 g/person/day). While this stagnation is largely due to slow income growth following the COVID-19 pandemic, supply chain issues (e.g. lack of a cold chain infrastructure) remain a constraint in some areas, whereas dietary preferences for non-animal protein sources continue to limit demand growth in others. In Sub-Saharan Africa, the availability of animal protein is even projected to slightly decline over the coming

decade, to 10.6 g/person/day in 2030 (Figure 1.11). The largest decline is expected for fish, as population growth is projected to outpace the expansion in fish supply.

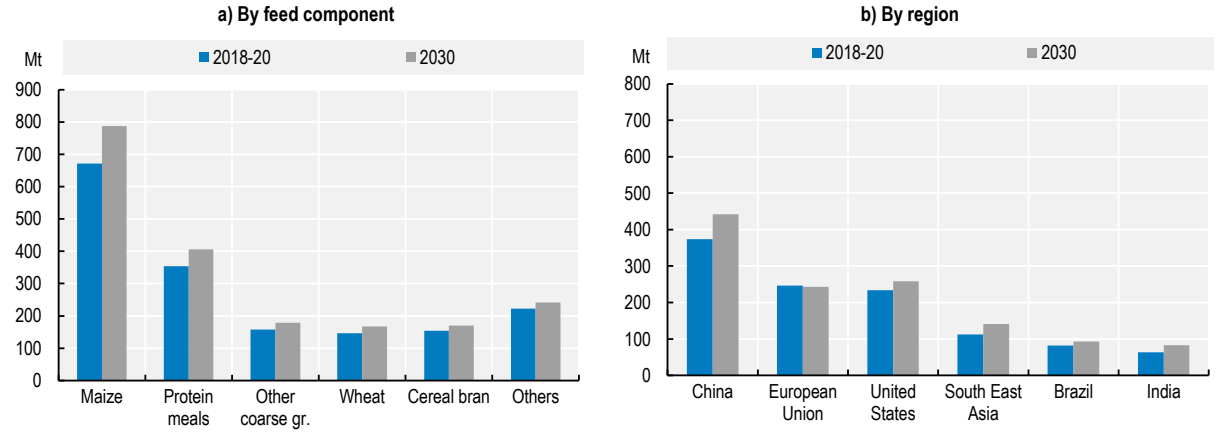
These developments in animal protein consumption will contribute to widen the gap in animal protein consumption between low-income countries and middle and high income countries over the coming decade. This gap is projected to increase by 3% to 48 g/person/day between low and high-income countries, and by 17% to 18.5 g/person/day between low and middle income countries. By contrast, the projections suggest that the gap in animal protein consumption between high and middle income countries will decline by 4%, to 30 g/person/day in 2030.

1.3.6. Feed use: Between efficiency gains and intensification

The ongoing evolution of global consumption patterns towards higher shares of animal products in diets has resulted in growing quantities of crops and other agricultural products being used as feed. In 2018-20, about 1.7 billion tonnes of cereals, protein meals and processing by products (e.g. cereals bran) were used as animal feed.[3] This amount is projected to increase by 14% over the coming decade, to reach 2 billion tonnes in 2030.

Maize and protein meal will remain the most important commodities used as feed, accounting for over 60% of total feed used by 2030 (Figure 1.12). Feed demand for maize and protein meal is projected to grow at 1.4% p.a. and 1.2% p.a., respectively, over the outlook period. Demand growth for protein meal is projected to slow down substantially compared to the last decade (+3.8% p.a. between 2011 and 2020), mainly reflecting efforts by large users (e.g. China, and the European Union) to lower the protein meal share in feed rations. In China, the liberalisation of the grain market since 2016 led to a drop in feed grain prices, which favours the use of maize (relative to protein meal) in the feed mix.

Figure 1.12. Demand for feed



Note: South East Asia includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor Leste, and Viet Nam

Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Leading feed consumers (i.e. China, the United States and the European Union) will continue to account for half of total feed demand by 2030. Still, several low and middle income countries will experience stronger growth in feed demand over the coming decade, as their livestock sectors expand and intensify (Figure 1.12).

About 30% of the additional demand for feed will originate in China, where demand is expected to grow by 1% p.a. over the projection period. China's feed demand growth is projected to slow down compared to the last decade (3.8% p.a.) due slower growth in livestock production, and improvements in feeding efficiency owing to better management practices and animal genetics. The *Outlook* assumes that the average feed use per unit of livestock product will not change significantly following hog herd rebuilding from African Swine Fever (ASF), which started in 2020. While the move away from backyard production towards larger, modern production facilities could lead to intensification in compound feed use, these facilities also have better feeding efficiency than the first generation feed-based facilities, thus enabling a reduction in feed use per unit of output. The *Outlook* assumes that these two trends will offset each other.

Slow growth in feed demand is projected in the United States (0.6% p.a.) due to feed efficiency gains in the beef and pigmeat sectors, while in the European Union, feed demand is projected to slightly decline over the coming decade (-3 Mt between 2018-20 and 2030), mainly due to a drop in demand for protein meals (-0.6% p.a.). For the European Union, this rate reflects declining pig and other livestock herd, together with gains in feeding efficiency. However, the expansion of the poultry sector will sustain feed demand in the European Union up to 2030. The extensification and diversification of livestock production systems in some countries in the European Union (e.g. organic, pasture-based, GM free), however, could further reduce demand for protein meals in the future and stimulate demand for locally produced and/or non-GM feed, including pulses and other legumes (EC, 2020[10]).

In Brazil, feed demand is expected to grow in line with livestock production, at an annual rate of 1.3% over the coming decade. High feed demand growth is projected in South East Asia, at 2.2% p.a., with the region accounting for 10% of additional feed demand over the next ten years. Demand growth will mainly be on the account of high feed demand growth in Viet Nam (2.8% p.a.) and Indonesia (2.4% p.a.) due to fast expanding poultry production and based on the expected recovery of pigmeat production following the ASF outbreak. In India, strong growth in dairy production together with feed intensification will support a 2.4% p.a. growth in feed demand over the next ten years. In India and South East Asia, demand for protein meals is projected to rise over the coming decade, by 3% p.a. and 2.5% p.a., respectively, reflecting the intensification of livestock production as these countries move towards compound feed-based livestock production.

1.3.7. Asian middle-income countries drive biofuel demand growth

Since the early 2000s, demand for biofuels has increased significantly following the implementation of policies with three main objectives: (i) support countries' commitments to reduce their carbon dioxide (CO_2) emissions, (ii) reduce the dependency on imported fossil fuels and (iii) create additional demand for feedstock crops to support domestic producers.

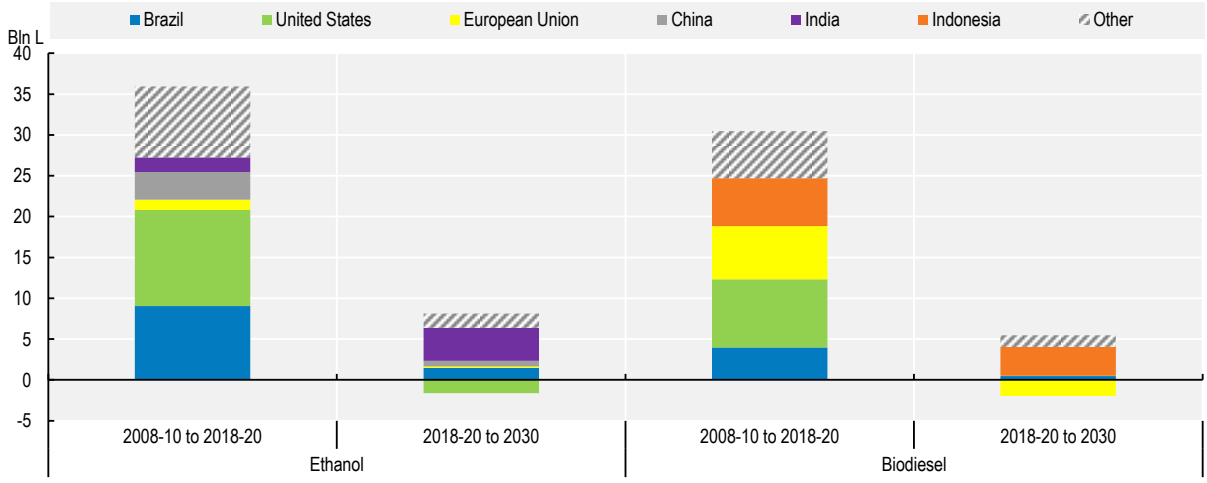
While these drivers are assumed to persist over the coming decade, global demand for biofuels is expected to slow down considerably. Based on the expected recovery of the crude oil price following the COVID-19 pandemic, biofuel demand is projected to increase by 0.5% p.a. over the coming decade; well below the growth experienced over the last decade (4% p.a.). Most additional demand will originate in middle-income countries, mainly driven by higher blending rates, while in high-income countries, demand growth will be constrained by declining transport fuel demand and reduced policy incentives. As a result, global demand for feedstock crops is projected to slow down over the next decade.

Ethanol consumption is projected to increase by 5% over the next ten years; India accounting for over 60% of additional consumption (Figure 1.13). By 2030, India's ethanol blending rate is projected to reach 8%,

supported by increasing domestic production of sugarcane-based ethanol. However, the *Outlook* assumes that the blending rate will remain below the E20 target set by the government for 2030, due to limited supply of feedstuff (mainly molasses). Ethanol consumption will also continue increasing in Brazil, although at a lower rate than over the last decade, driven by a high blend rate and growing fuel consumption. Together with Brazil's RenovaBio law, which aims to reduce fuel emissions by 10% by 2028, these factors are expected to support a 5% increase in ethanol consumption over the coming decade. Growing ethanol consumption will result in an increase in the use of sugarcane for biofuel production (+9%); biofuel maintaining its share of total sugar cane use at around 22% over the next decade. Biofuel use of molasses, the main feedstock for ethanol production in India and other Asian countries, is also projected to increase over the next ten years (+23%); with the biofuel sector increasing its share of total molasses use to 50% in 2030 (Figure 1.14).

In China and the United States, growth prospects for ethanol consumption are limited (Figure 1.13). In China, ethanol consumption will increase with higher fuel use; however, the growth rate will decrease significantly compared to the last decade. The government of China is not expected to implement a nationwide E10 mandate, as proposed in 2017, as this programme depends on maize stocks, which have been decreasing since 2017. Therefore, this *Outlook* assumes that China will maintain a lower 2% blending rate over the projection period. In the United States, declining gasoline use, together with the 10% ethanol blend wall, are projected to lead to a 3% decline (1.6 Mln L) in ethanol consumption over the next ten years. However, developments to promote higher blend rates in the United States could result in an increase in ethanol use. Biofuel use of maize –which is the main feedstock for ethanol production in China and the United States - will decrease over the coming decade (-3%), with the biofuel share of total maize use dropping from 15.8% in 2018-20 to 13.7% in 2030 (Figure 1.14).

Figure 1.13. Changes in biofuel consumption in key regions



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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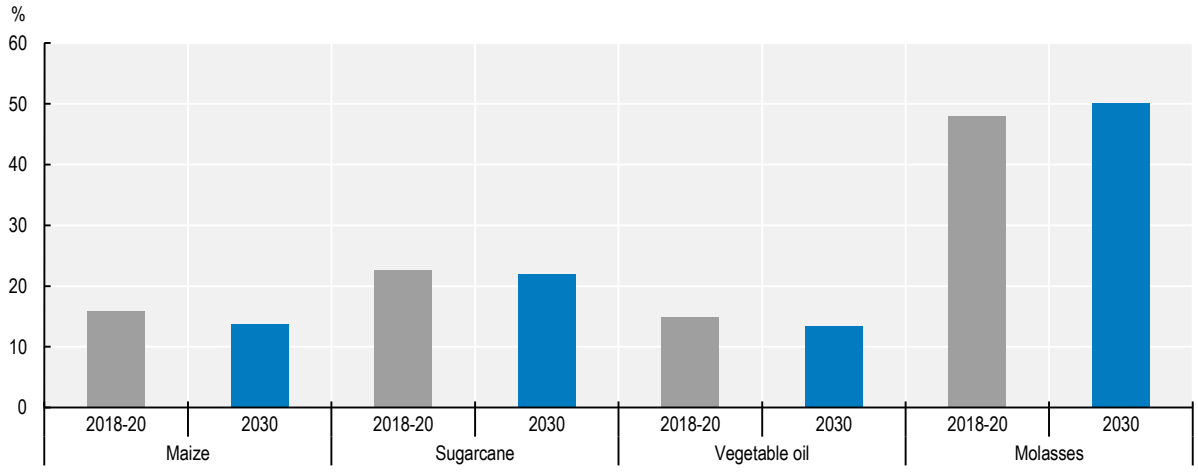
Biodiesel consumption is projected to increase by 7% over the coming decade; Indonesia accounting for two-thirds of additional consumption (Figure 1.13). The *Outlook* assumes that the government of Indonesia will successfully implement the B30 programme in 2020. The blending rate is assumed to remain fixed at 30% over the projection period, thus biodiesel demand is expected to increase along with total transportation fuel consumption. In the United States and the European Union, however, declining diesel use will constrain the growth in biodiesel consumption over the coming decade. In the European Union,

biodiesel consumption will be further affected by the Renewable Energy Directive II, which sets limits on the use of biofuel feedstock (mostly palm oil) grown in carbon-capturing ecosystems such as forests, wetland and peatland. As a result, biodiesel consumption in the European Union is projected to decline by almost 2 Mln L over the next ten years. Based on projected developments in biodiesel consumption, biofuel use of vegetable oils is expected to increase by 5% over the coming decade; however, its share in total use is projected to drop from 15% in 2018-20 to 13.5% in 2030 (Figure 1.14).

The development of electric vehicle technology and policies supporting its adoption could further constrain the growth in biofuel consumption over the coming decade. This is especially true in high-income economies such as the United States, and the European Union as well as in China where green technologies are evolving rapidly and policies have been introduced to support the deployment of electric vehicles and charging infrastructure (IEA, 2020[11]).

Figure 1.14. Share of biofuel in total use



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.4. Production

1.4.1. Low and middle-income countries drive global production growth

The *OECD-FAO Agricultural Outlook* projects future trends of production of the main livestock products (meat [beef, pork, sheet and poultry], dairy [butter, cheese, fresh dairy products, skim and whole milk powder] and eggs), fish (capture fisheries and aquaculture) and crop commodities (cereals, oilseeds, roots and tuber, pulses, sugar cane and sugar beet, palm oil and cotton). The *Outlook* projections break down agricultural output growth into its main determinants, namely growth in crop yields, area harvested intensification, cropland expansion, and growth in output per animal and herd expansion, across different sectors and regions.

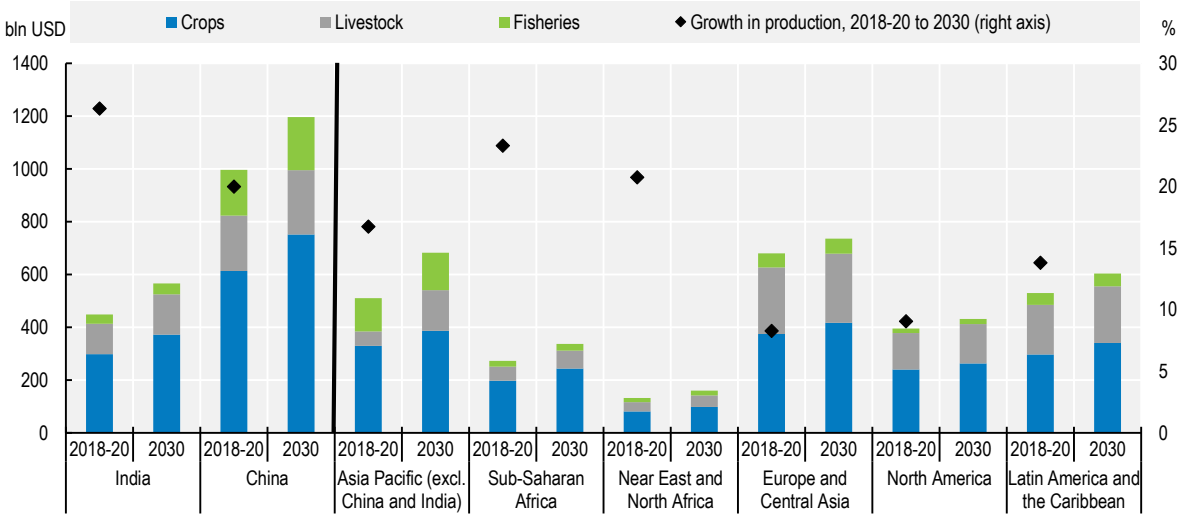
Over the coming decade, global agricultural production[4] is projected to increase by 1.4% p.a.; a slowdown compared to the growth in output experienced over the last decade (1.7% p.a.).

The projections are based on the assumption that the measures on social distancing to contain the COVID-19 pandemic will mostly end in 2021. Specifically, thereafter, it is assumed that countries will not prolong

restrictions on the movement of people, which limited the availability of agricultural labour resulting in increased production costs in several countries (International Labour Organization, 2020[12]), or the enforcement of strict health protocols, which had a strong negative effect on all labour intensive agricultural activities.

It is projected that production growth in agriculture will be predominantly located in emerging economies and low-income countries and will be driven by productivity-increasing investments in agricultural infrastructure and research and development, wider access to agricultural inputs and improved management skills in these regions. An additional driver of growth will be investments to mobilize production resources (e.g. land, irrigation water). On the other hand, growth in production in North America and in the Western European part of the Europe and Central Asia region is expected to be slower, largely due to constraints imposed by environmental policies (Figure 1.15).

Figure 1.15. Trends in global agricultural production



Note: Estimates are based on historical time series from the FAOSTAT Value of Agricultural Production domain which are extended with the *Outlook* database. Remaining products are trend-extended. The Net Value of Production uses own estimates for internal seed and feed use. Values are measured in constant 2014-2016 USD.
Source: FAO (2021). FAOSTAT Value of Agricultural Production Database, http://www.fao.org/faostat/en/#data/QV; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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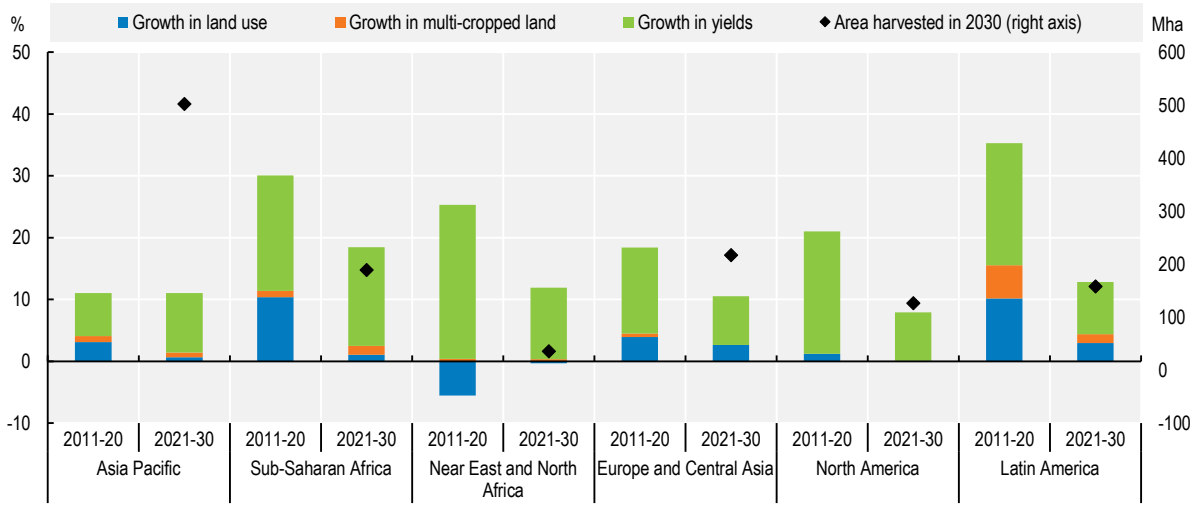
1.4.2. Yield increases drive crop production growth

Global growth in crop production is projected to total 18% over the coming decade.[5] The additional output is expected to originate mainly in the Asia and Pacific region (61%), due to developments in China (30%) and in India (16%). Latin America is expected to contribute to 10% of the additional output, while Europe and Central Asia are expected to contribute 9% together. The regional contributions of the Near East and North Africa and of Sub-Saharan Africa are expected to be around 5% each. Figure 1.16 shows the projected growth in yields, cropping intensities and total cropland for the crops covered in the *Outlook* in different regions.

Figure 1.16. Sources of growth in crop production



Note: Figure shows the decomposition of total production growth (2011-20 and 2021-30) into growth in land use, land intensification through growth in multi-cropped land, and growth in yields. It covers the following crops: cotton, maize, other coarse grains, other oilseeds, pulses, rice, roots and tubers, soybean, sugarbeet, sugarcane, wheat and palm oil.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook OECD Agriculture statistics (database)", http://dx.doi.org/10.1787/agr-outl-data-en.

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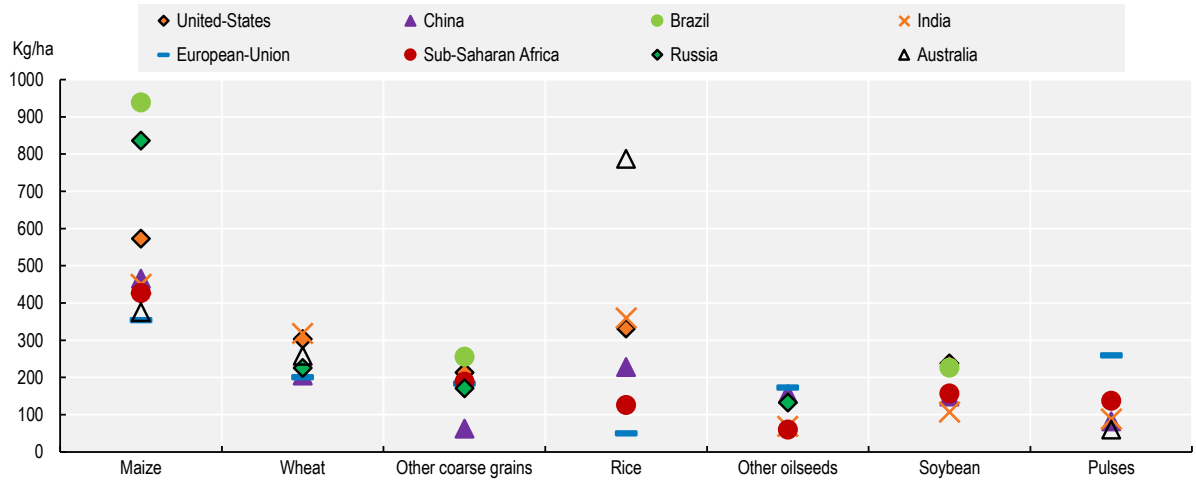
Yields

Globally, yield growth is expected to account for 88% of the overall expansion in crop production to 2030. Projected growth rates for the main agricultural commodities differ by country, due to differences in agro-climatic conditions and production technology, among others. It is generally assumed that yield gaps, which can be largely attributed to the latter are going to narrow. India and countries in Sub-Saharan Africa are expected to improve the yields of their key crops through better adapted seeds and improved crop management (Figure 1.17).

In high-income countries and emerging economies, the *Outlook* assumes that yield increases will come mainly from improvements in cultivated varieties and the adoption of precision farming technology to optimize the application of water, fertilizer and agri-chemicals (FAO, 2020[13]) (Figure 1.17). However, yield growth rates in high-income countries are expected to be on the low side. Yields in these countries are already at high levels and output growth is conditioned by environmental and food safety policies. Climate change will also affect the projected yield growth path over the coming decades; slowing it down in many regions while enhancing it in others.

In Sub-Saharan Africa, yield growth is expected to come from improved seeds and increased use of fertilizer and pesticides, as well as increased mechanisation, and from the use of extension services such as training to farmers (Figure 1.17). The assumed yield progress in the region depends critically on the continuation and expansion of government support programmes that provide farmers with services, as well as on the continuation of public and private investments in storage and transportation infrastructure to minimise on-farm losses.

Figure 1.17. Growth in projected yields for selected crops and countries 2021 to 2030



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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The production projections for Sub-Saharan Africa assume that public spending and private investments necessary to underpin this growth will occur. Any disruption of the later – for example, due to the continuation of the COVID-19 pandemic and related expenditures in sectors other than agriculture (e.g. health infrastructure) or deterioration of African countries' fiscal space due to domestic currency depreciation, increasing borrowing costs and falling tax revenues (United Nations Economic Commission for Africa, 2020[14]) – may have adverse effects on public expenditure for agriculture and as a result on the projected yields. Box 1.2 discusses the potential for growth in agricultural productivity in Africa.

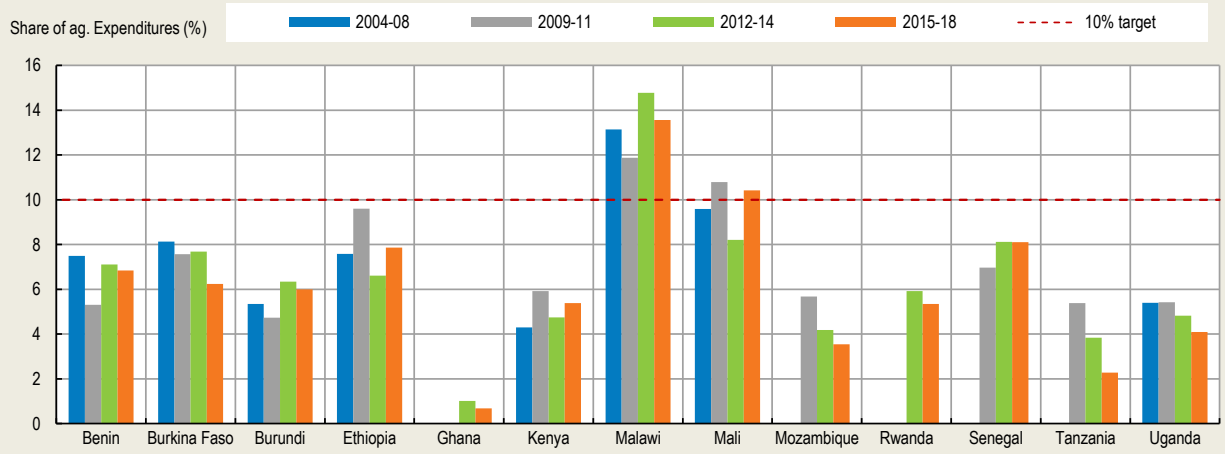
Box 1.2. Public expenditure and growth potential for agricultural productivity in Africa

Public expenditure in agriculture is a key tool to support agricultural transformation, alleviate poverty and increase food security. For countries with limited public resources and strong economic reliance on the agricultural sector, increasing public spending on agriculture is critical for improving agricultural productivity. The importance of increasing public spending on agriculture has been well acknowledged by member countries of the African Union (AU), which agreed in the 2003 Maputo Declaration to allocate at least 10% of overall public spending (i.e. national budget and private funds) to agriculture. This commitment was renewed in 2014 in the Malabo Declaration.

However, a review carried out by FAO's Monitoring and Analysing Agricultural Policies in Africa (MAFAP) programme of selected sub-Saharan African countries' expenditure trends in relation to the Comprehensive Africa Agriculture Development Programme (CAADP) commitments suggests that during 2004-2018, total public spending on agriculture in the studied countries averaged around 6% – well below the 10% target.[1] Only Malawi in all years and Mali in some years achieved the target set out by the Maputo and Malabo Declarations (Figure 1.18). Furthermore, for most of the analysed countries, public spending on agriculture has declined in recent years. This trend can be explained by the narrow fiscal space of countries to sustain increased spending on agriculture, competing development priorities, and by low budget implementation rates that led to lower actual spending compared to what had been budgeted for (during 2004-2018 approximately one-fifth of the total budget for agriculture went unspent).

Agricultural funding in Sub-Saharan Africa relies significantly on donor contributions, which accounted for an average 36% of the total agricultural expenditure in the analysed countries during 2004-2018. On average only 60% of donor funds are spent. Donor funded programmes are usually large and focused on capital investments, and they often require legislative approvals, procurement and management rules and plans that make their realization more complex.

Figure 1.18. Share of actual public expenditure on agriculture over total budget



Note: Expenditure on agriculture here is the aggregate closest to the CAADP definition and it corresponds to agricultural-specific expenditure as tracked by MAFAP, excluding transfers to food consumers (e.g. cash transfers and food aid).
Source: Pernechele, V., Fontes, F., Baborska, R., Nkuingoua, J., Pan, X. & Tuyishime, C. (2021). Public expenditure on food and agriculture: trends and challenges in Sub-Saharan Africa, FAO Publications, Rome.

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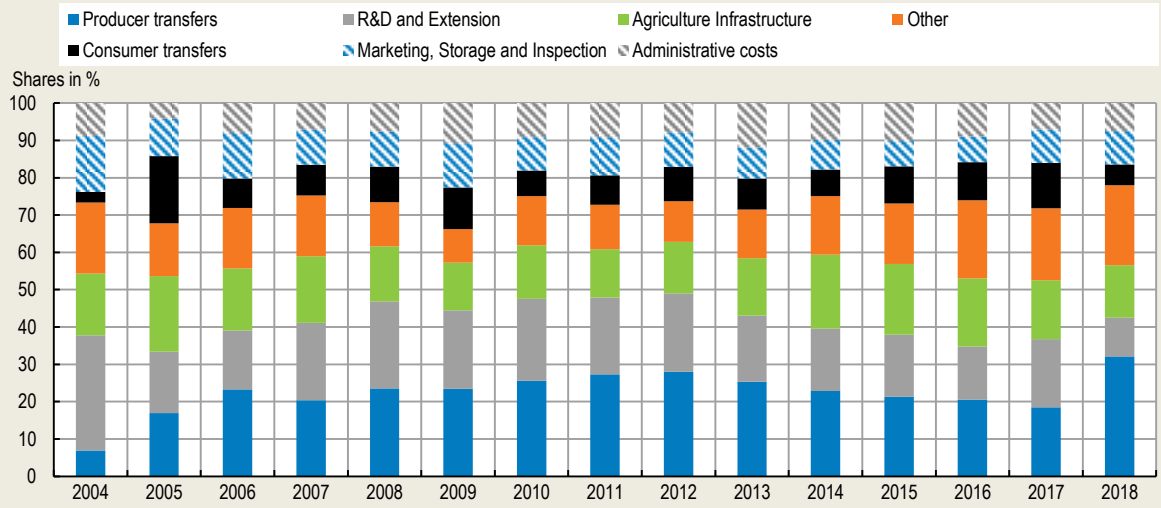
Across the analysed countries, public spending on agriculture consists mainly of transfers to agricultural producers (i.e. variable input subsidies, capital subsidies and other on-farm services) and to consumers (i.e. food aid, cash transfers and school meal programmes) (Figure 1.19). On average, during the period 2004-2018, these two types of expenditures accounted for over 30% of total spending on food and agriculture for the countries studied. Spending on research and knowledge dissemination (including extension, technical assistance and training) accounts for the second largest share, representing an average 18% of the total expenditures on food and agriculture. Investments in agricultural infrastructure, which mainly include feeder roads and off-farm irrigation, accounted for 16% of total expenditures and increased over the period 2004-2018 in Eastern and Southern African countries. Expenditures targeting other actors in the food and agricultural system, such as processors, traders or inputs suppliers, remained limited. Around 25% of the donor funding over the period 2004-2018 focused on agricultural infrastructure, such as roads and off-farm irrigation. Overall, lower execution rates and the higher volatility of donor-funded expenditures compared to national outlays have contributed to implementation issues of donor-funded projects.

The breakdown of these expenditures suggests that funding to factors that enhance land productivity the most, such as research and knowledge dissemination and agricultural infrastructure (particularly irrigation), is lagging behind. The fact that infrastructure and research outcomes require a longer-term strategy may help explain these limited expenditures, since political turnover usually occurs on a four-year cycle that leaves little time for long-term planning. The recent contraction of extension and research and development expenditures is especially worrying, given that these are recognized to have the strongest effect on agricultural growth and poverty reduction.

Figure 1.19. Trend of expenditure shares over total expenditures on food and agriculture, average for all countries by year



Source: Pernechele, V., Fontes, F., Baborska, R., Nkuingoua, J., Pan, X. & Tuyishime, C. (2021), *Public Expenditure on Food and Agriculture: Trends and Challenges in Sub-Saharan Africa*, FAO Publications, Rome.

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Increasing public agricultural expenditure in Sub-Saharan Africa and spending more on high-return investments in agricultural productivity are key challenges for the region. Major constraints include the accumulation of public debts, the effects of the COVID-19 pandemic on the global economy and on the financial space of African countries coupled with the potential contraction of donors funding and the need to increase resources allocated to healthcare and social safety nets. Regarding donor-funding, poor execution rates and slow and bureaucratic procedures are two important reasons behind donor funding variability and represent key bottlenecks in the implementation of donor projects.

These challenges can hinder prospects for agricultural production, productivity, and commercialization growth in Sub-Saharan Africa. As long as there is underinvestment in agricultural infrastructure needed for mobilizing new agricultural land (e.g. feeder and rural roads and irrigation), from both the public and private sectors, the expansion of cropland in Sub-Saharan Africa over the next decade in the *Outlook* would also be limited. Future yield increases in the *Outlook* are also constrained, as they are contingent on funding for research into new varieties, adequate training of farmers and access to agricultural extension services.

Note: 1 The MAFAP methodology is not the official tool to monitor country performance in achieving the CAADP target on agricultural public spending. In this analysis, data compiled by MAFAP is made comparable to the expenditure definition used by CAADP, by excluding certain spending categories. However, MAFAP and CAADP aggregates may still differ slightly, due to differences in the methodologies and the way these are implemented by countries to report their spending to CAADP.
Source: Pernechele, V., Fontes, F., Baborska, R., Nkuingoua, J., Pan, X. & Tuyishime, C. (2021), *Public Expenditure on Food and Agriculture: Trends and challenges in Sub-Saharan Africa*, FAO Publications, Rome.

Cropping intensity

Globally, the increase in cropping intensity is projected to account for 7% of the overall growth in global crop production to 2030. Such practices play an important role in increasing land productivity (Ray and Foley, 2013[15]).[6]

The increase in cropping intensity, shown in Figure 1.6, will be driven by the adoption of multi-cropping and new crop varieties and by investments to expand the growing season through technological

improvements (e.g. irrigation systems that allow cultivation during the dry season). Particularly in Brazil and Argentina, double-cropping of soybeans and maize and of soybeans and wheat is utilized to maximize land productivity. In Asian countries, the increase in cropping intensity will be achieved by the expansion of double-cropping of paddy rice with cereals, pulses and vegetables as the second crop. The potential for increasing cropping intensity in North America and Europe will remain limited because of agro-ecological conditions.

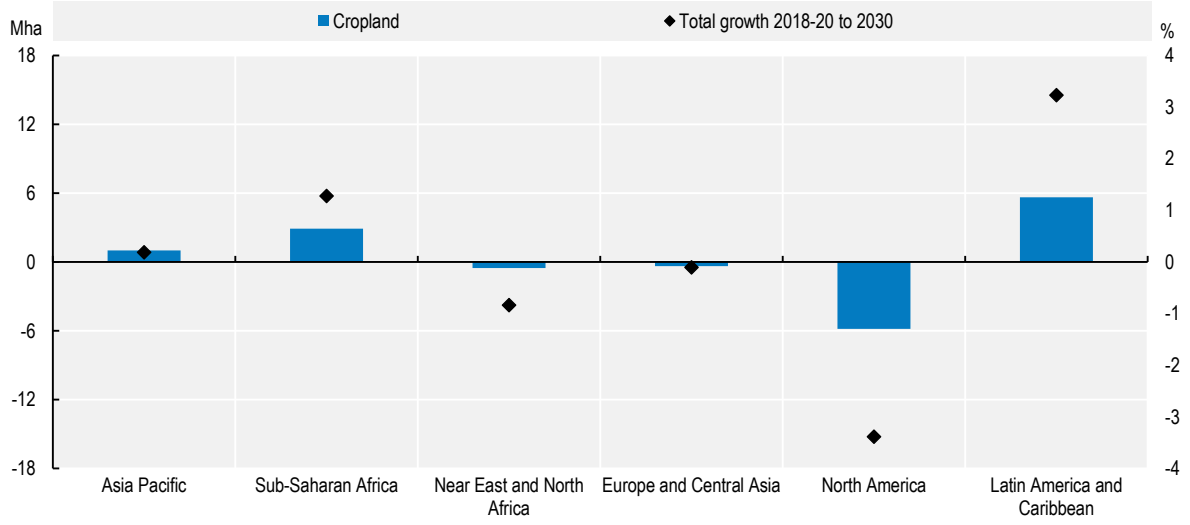
Land use

Expansion of cropland is projected to account for 6% of total growth in crop production over the next decade. The decreasing importance of cropland expansion relative to yield and cropping intensity is expected to continue in the coming decade as the transition to more intensive production systems is foreseen to continue.

Cropland is projected to expand mainly in Latin America, by 5.7 Mha over the coming decade (Figure 1.20). This is mostly because large-scale commercial farms in the region are expected to remain profitable, leading to investments in the cultivation of new land. In China, cropland is expected to expand by 1.5 Mha, mainly from conversion of pastureland into cropland.

By contrast, in regions such as the Near East and North Africa, the cultivation of additional cropland remains constrained by natural conditions. No expansion is foreseen in this region, owing to the lack, or the prohibitive cost of irrigation.

Figure 1.20. Change in cropland, 2018-20 to 2030



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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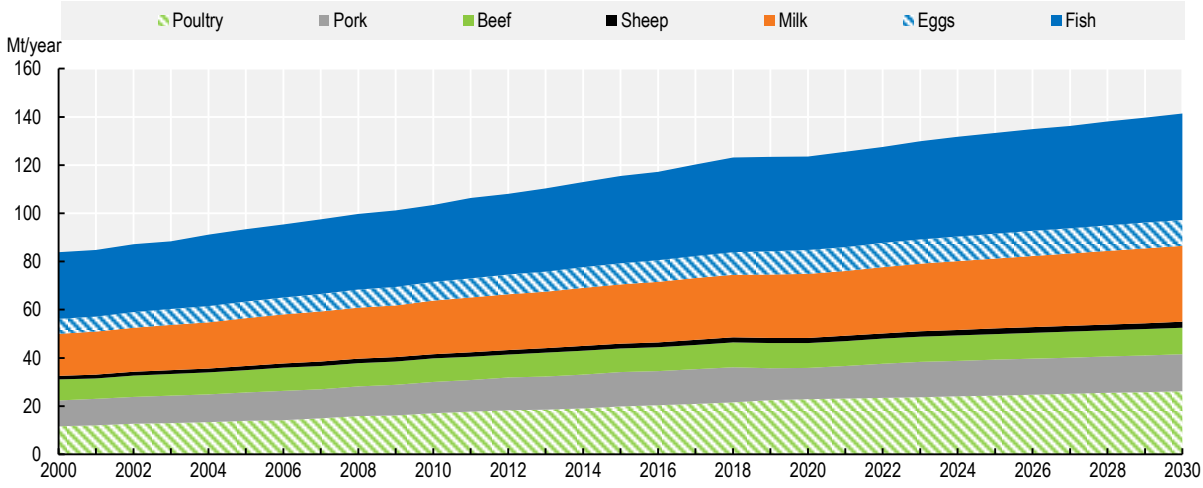
1.4.3. Livestock and fish production concentrated in a few countries

Over the outlook period, global livestock and fish production is expected to expand by 14%. Similar to growth in crop production, the majority of this growth (82%) is expected to originate in middle- and low-income countries, however, a few countries/regions will continue to dominate global livestock and fish production, namely China, India, Brazil, the United States, and the European Union.

Livestock production in Asian countries is expected to recover after the ASF outbreak subsides in 2021, while fisheries and aquaculture have already been benefitting from the supply gap in meat. Taken together, the livestock and fish sectors are projected to grow by a total of 17% over the next decade. China is expected to account for about half of the additional output of animal products in the Asia and Pacific region. Latin America is projected to expand its livestock and fish production by 15%, which accounts for 38% of global output growth, driven mostly by the expansion of Brazil's export-oriented livestock sector. Sub-Saharan Africa and the Near East and North Africa region are expected to increase their livestock and fish production by about 22% each, but from a low base, keeping their output share at about 10%.

Over the coming decade, milk and poultry outputs are projected to grow at the highest rates, at 22% and 17%, respectively (Figure 1.21). In most countries, the larger output of meat and milk will be achieved by increasing the number of animals and improving the output per animal per year. Higher output per animal in turn will be mainly achieved through more intensive feeding practices, improved genetics and better herd management practices. The following Sections highlight the projections for each livestock sub-sector.

Figure 1.21. Global livestock and fish production



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook OECD Agriculture statistics (database)", http://dx.doi.org/10.1787/agr-outl-data-en.

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1.4.4. Poultry to account for more than half of the global growth in meat production

Over the coming decade, global meat production is expected to increase by 13% (44 Mt), due to increases in the number of animals and higher output per animal.[7]

Poultry meat production is expected to account for 52% of the global growth in meat production. Favourable market conditions support the increase in poultry meat production by 17% (23 Mt), with China accounting for 13% of overall growth. Brazil is expected to account for 10% of the growth in poultry meat production, while the United States, will contribute to 12%. In Europe, production is expected to remain stable in the coming decade as no expansion of the flock is foreseen and per-animal output is also not expected to grow further.

The recovery from the ASF disease, mainly in Asian countries, will lead to an increase in pigmeat production over the coming decade assuming no zoonotic outbreaks. Global pigmeat production is expected to increase by about 14 Mt, accounting for 33% of the growth in total meat production. More than 66% of it is expected to come from the production recovery in Asian countries by 2023, particularly China and Viet Nam. In other major producing regions, mainly the Americas, pigmeat production is expected to

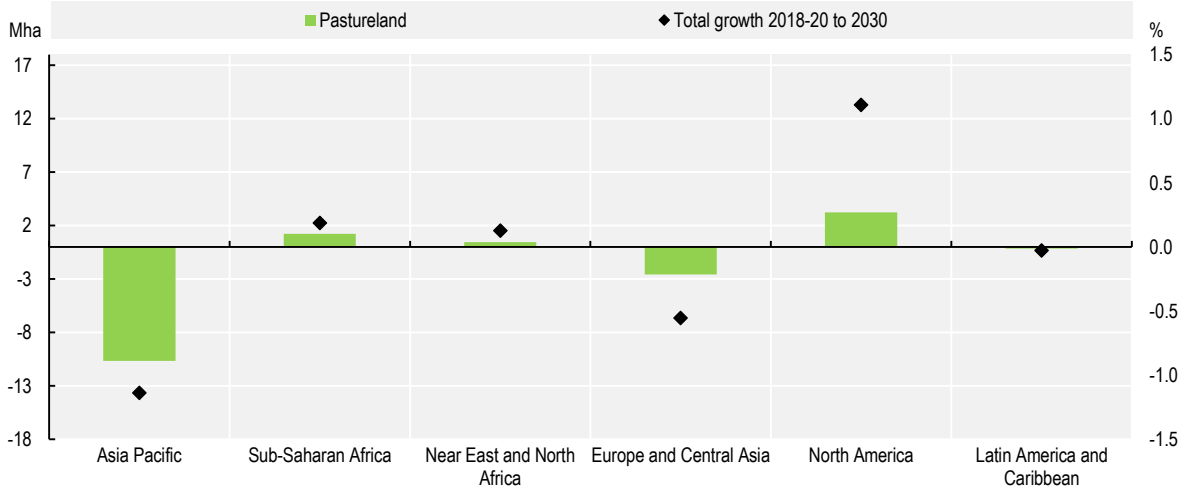
growth by about 8%, driven by improvements in animal breeding and further intensification of production systems.

Global beef production is projected to increase by only 6% (+4 Mt) over the next decade and account for 9% of the total growth in meat production. This slow growth will be mainly attributable to weak demand growth and the resulting limited growth potential, which is expected to depress investments in the Americas. Expected higher production costs are behind the projected supply reduction in suckler cows in Europe and Australia, curtailing or stalling their beef output by -7% (-0.5 Mt) and 14% (+0.3 Mt), respectively. The world's largest producing regions – North America and Latin America– will maintain their market shares throughout the next decade (at about 20% and 32% of the global beef meat production, respectively). Sub-Saharan Africa is projected to expand its pasture-based beef production by 15% over the next decade, albeit from a small base.

Finally, sheep and goat meat production is expected to expand by 16%, equivalent to 3 Mt, and accounts for 6% of the growth in total meat output over the next decade. China's production is expected to expand by 0.7 Mt. A significant production increase is expected in Sub-Saharan Africa (0.7 Mt), mainly for serving domestic demand, which is expected to account for 26% of global growth. The projected production growth in the region will be mainly driven by herd expansion, since production is based on extensive semi-nomadic systems. Herd rebuilding in New Zealand, the world's dominant sheep meat exporter, and the continuation of tight supplies in Australia, where sheep herds decreased from 2017-2020 due to adverse weather conditions, are expected to keep production at the same level as during the 2018-20 period.

Developments in the meat and dairy sectors determine the projected evolution of pastureland. In order to accommodate the increasing ruminant production (especially sheep and goats) in Sub-Saharan Africa, pastureland is expected to expand by 1.2 Mha. The projected expansion in livestock production in North America results in additional pastureland (+3.22 Mha), provided through the conversion of marginal cropland (Figure 1.22).

Figure 1.22. Change in pastureland, 2018-20 to 2030



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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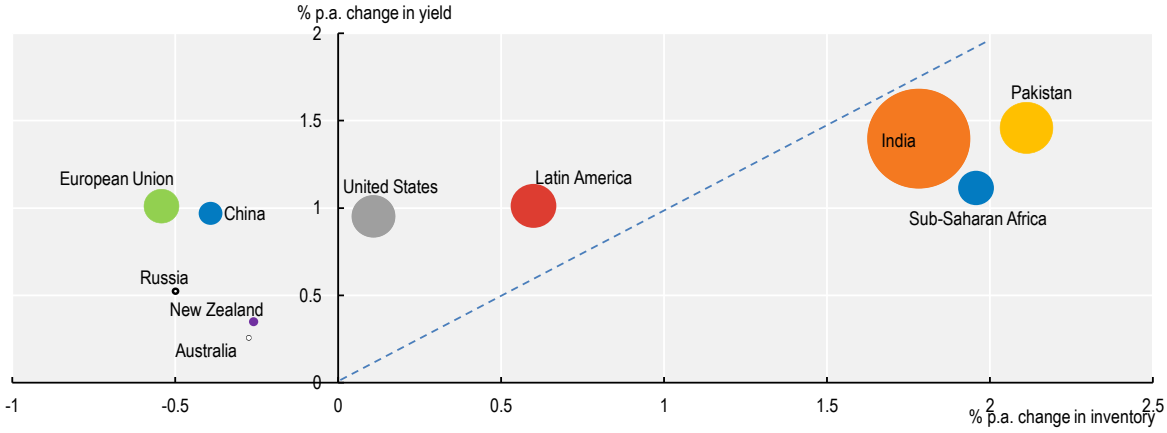
Pastureland is projected to decline by 10.7 Mha in Asia and Pacific due to the expected substitution from ruminant to non-ruminant production, particularly pigmeat (following the expected recovery from ASF) and poultry, as well as a shift of ruminant production to more feed-intensive production systems, which require less pastureland.

1.4.5. Dairy will be the fastest expanding livestock sector

Dairy is expected to be the fastest expanding livestock sector over the next decade, with global milk production projected to increase by 22%. Increased dairy production will be driven by expanding yields due to optimization of milk producing systems, improved animal health, better genetics and improved efficiencies in feeding, and expansions in the inventory of milking animals. The production increase will be largely supported by consumer demand for fresh dairy products in Asian countries. India and Pakistan are expected to account for more than 30% of global milk production by 2030. In these countries, milk is mainly produced by smallholders in extensive pastoral systems; thus, output growth will be mainly due to an increase in dairy herds (Figure 1.23). However, both countries are expected to see intensification of pasture use and as a result a limited expansion of pastureland.

Figure 1.23. Changes in inventories of dairy herds and yields, 2021 to 2030



Note: The size of the bubble reflects absolute growth in dairy production between 2018-20 and 2030.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Milk production growth among key dairy exporters, such as the European Union, the United States and New Zealand, will be constrained by tighter environmental regulations. Herds are expected to decline in the European Union and New Zealand and to remain unchanged in the United States, but milk yields are expected to grow due to improved efficiency in feeding and in grass management. In Latin America, dairy production will be driven by strong domestic demand. Output growth will be supported by strong growth in milk yields (more than 1% p.a. increase over the coming decade) together with expansion in the dairy herd (Figure 1.23).

In Sub-Saharan Africa, dairy production depends on small ruminants which implies lower milk yields. Hence, while production growth in Sub-Saharan Africa will be marked (33%), output will remain at much lower levels compared to other regions because an important share of milking animals in this region consists of small ruminants (e.g. goats), which are characterized by lower milk yields than cows. Production growth in Sub-Saharan Africa will be mainly due to herd expansion (Figure 1.23).

About 60% of fresh milk is projected to be consumed in the form of minimally processed dairy products such as fresh pasteurised milk or yoghurt. The remaining 40% will be further processed into butter, cheese, skim milk powders or whole milk powders. Production growth of butter is expected to be as high as the one of raw milk, while production of all other processed dairy products is expected to grow at lower rates. Lower cheese production growth will be driven by slower growth in food demand in Europe and North America, whereas lower production of whole milk powder (WMP) will be due to reduced demand in Asian countries.

1.4.6. Slowing growth in aquaculture limits growth of global fish production

Global fish production is projected to grow at 1.2% p.a. to 201 Mt by 2030, a relative slowdown compared to the 2.1% p.a. growth of the previous decade. The growth in fish production is primarily driven by continuing but slower progression in aquaculture production. This reflects the higher initial level of aquaculture production and the result of policies to reduce its environmental impacts in China. Aquaculture production is expected to reach 103 Mt by 2030 (+2% p.a.), while capture fisheries production is projected to total 97 Mt in 2030 (+0.4% p.a.). However, changes in government support to fisheries as a result of policy changes in China and negotiations at the World Trade Organization (WTO) may impact the growth in capture production (OECD, 2020[16]). Aquaculture production is expected to overtake capture fisheries production in 2027 and to account for 52% of all fish production by 2030.

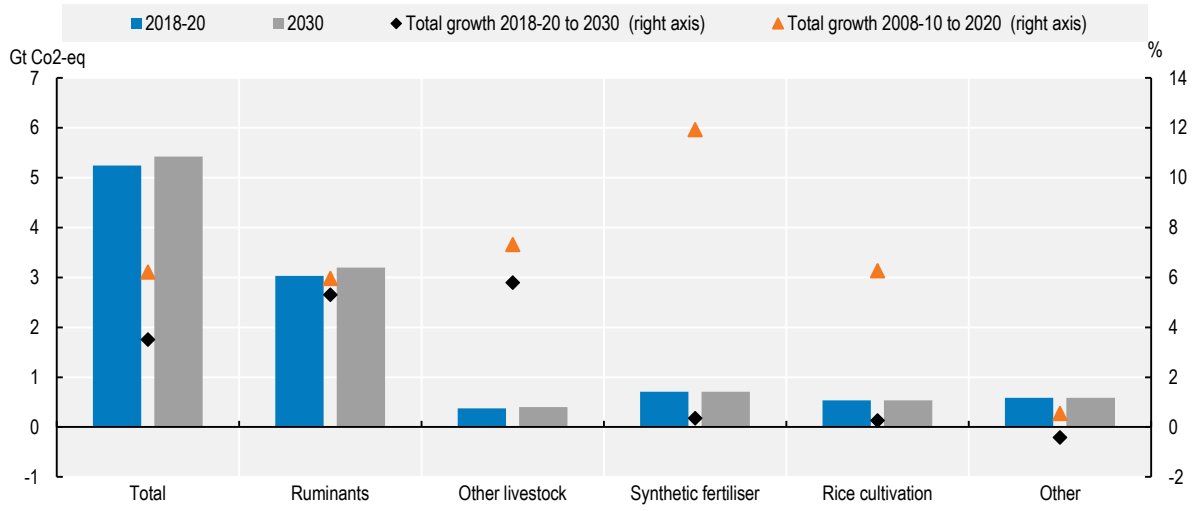
Fish production is projected to expand in all continents, with most of the growth occurring in Asia. With a projected annual growth of 1.4% p.a., the region is projected to experience the strongest growth in fish production between 2021 and 2030. Asia will consolidate its position as the main producing region, accounting for 88% of global aquaculture production and 71% of global fish production by 2030. Africa is projected to experience the second fastest growth in production, at 1.2% p.a. over the outlook period. Capture fisheries production will remain dominant in Africa but aquaculture production will expand strongly. America, Europe and Oceania, are all expected to experience growth rates under 1% p.a. by 2030. These slower growth rates reflect modest growth in capture fisheries production and the lower contribution of aquaculture to total fish production in these continents.

1.4.7. The carbon intensity of agricultural production is declining

Direct emissions from agriculture account for about 12% of global greenhouse gas (GHG) emissions. When taking into account the indirect effect of agriculture on land use change, agriculture's contribution to global GHG emissions increases from 12% to 21% (IPCC, 2019[17]). Given its large and potentially growing contribution to total emissions and the availability of cost effective mitigation options, the sector can make an important contribution, along with other sectors, to the climate stabilisation objectives of the Paris Agreement (Henderson et al., 2021[18]).

Assuming no changes in current policies and on-trend technological progress, direct agricultural GHG emissions are projected to grow by 4% between 2018-20 and 2030 (Figure 1.24).[8] Livestock will account for more than 80% of this global increase. Global land use change emissions are not projected in this *Outlook*.

Figure 1.24. Direct GHG emission from crop and livestock production, by activity



Note: Estimates are based on historical time series from the FAOSTAT Emissions Agriculture databases which are extended with the *Outlook* database. Emission types that are not related to any *Outlook* variable (organic soil cultivation and burning Savannahs) are kept constant at their latest available value. The category "other" includes direct GHG emissions from burning crop residues, burning savanna, crop residues, and cultivation of organic soils.

Source: FAO (2021). FAOSTAT Emissions-Agriculture Database, http://www.fao.org/faostat/en/#data/GT; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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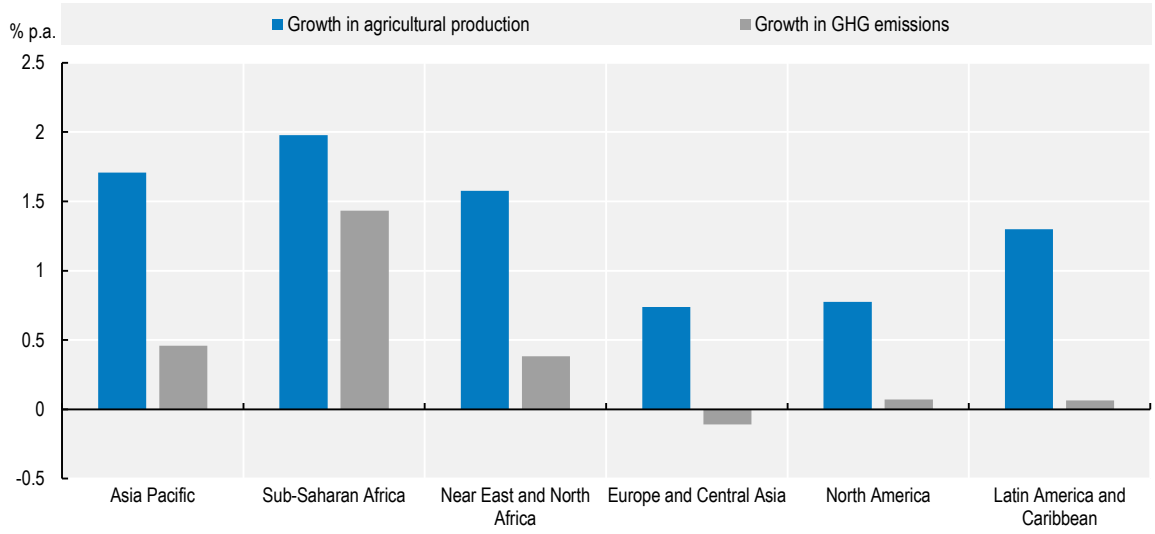
Most of the increase in direct emissions is projected to occur in middle and low-income regions due to higher output growth in production systems that are more emission intensive. In Sub-Saharan Africa, direct GHG emissions are projected to increase by 16% over the coming decade, and the region is expected to account for 62% of the total growth in direct GHG emissions from agriculture.

Global agricultural emissions are set to increase but the carbon intensity of agricultural production is expected to decrease over the next decade (Figure 1.25). In all regions, the growth in agricultural production is expected to exceed the growth in direct GHG emissions from agriculture. This development is driven by both yield improvements and a declining share of ruminant production in total agricultural production. In Europe and Central Asia, direct GHG emissions from agriculture are projected to decrease by 1% over the next decade, despite agricultural output growing by 8%. In most middle- and low-income countries slower growth in ruminant production will be the main driving factor of the reduction in the emission intensity. A further reduction in the carbon intensity of agricultural production could be achieved by large-scale adoption of emission-reducing policies, technologies and practices.

The *Outlook* assumes a continuation of current policies for mitigating GHG emissions from agriculture. However, some countries have recently set GHG emissions targets for agriculture and included the sector in national mitigation plans to help meet their commitments under the Paris Agreement (Henderson, Frezal and Flynn, 2020[19]). These targets and the policies being developed to achieve them could affect the GHG emissions projections.

Figure 1.25. Annual change in agricultural production and direct GHG emissions, 2021 to 2030



Note: This figure shows projected annual growth in direct GHG emissions from agriculture together with annual growth in the estimated net value of production of crop and livestock commodities covered in the *Outlook* (measured in constant USD 2014-16 prices). Estimates are based on historical time series from the FAOSTAT Emissions Agriculture databases which are extended with the *Outlook* database. Emission types that are not related to any *Outlook* variable (organic soil cultivation and burning Savannahs) are kept constant at their latest available value. The category "other" includes direct GHG emissions from burning crop residues, burning savanna, crop residues, and cultivation of organic soils. The Net Value of Production uses own estimates for internal seed and feed use.
Source: FAO (2021). FAOSTAT Emissions-Agriculture and Value of Agricultural Production databases, http://www.fao.org/faostat/en/#data ; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.5. Trade

Since the early 2000s, growth in agricultural trade has been facilitated by a lowering of agro-food tariffs, reforms to trade-distorting producer support, and the signing of multiple trade agreements. Agricultural trade has also been supported by strong economic growth in emerging countries, particularly in China, and by growing demand for biofuels as countries seek to reduce their CO_2 emissions and their dependence on fossil fuels. This expansion in trade has contributed to a more efficient allocation of agricultural production across countries and regions.

Over the coming decade, trade will increasingly reflect diverging demand and supply developments among trading partners. Some regions are projected to experience large population or income-driven increases in food demand but do not necessarily have the resources for a corresponding increase in agricultural output. Moreover, socio-cultural and lifestyle-driven changes in consumption patterns are transforming the profile of demand in most regions. Agricultural trade will therefore play an increasing role in ensuring global food security and nutrition over the next decade, by connecting producers to diversified consumer demand around the world.

Divergent productivity growth, climate change impacts on production, and developments in crop and animal diseases, on the other hand, will affect supply. Trade will help smooth food supply fluctuations and pool production risks across countries, acting as a buffer in case of domestic or external shocks.

In this context, a well-functioning, transparent and predictable international trading system will be essential to mitigate emerging regional imbalances and support sustainable global development, particularly with regard to meeting the SDGs. Trade has been identified as a means of implementation for achieving SDG 2,

which aims to ‘’end hunger, achieve food security and improved nutrition and promote sustainable agriculture” (Gadhok et al., 2020[20]).

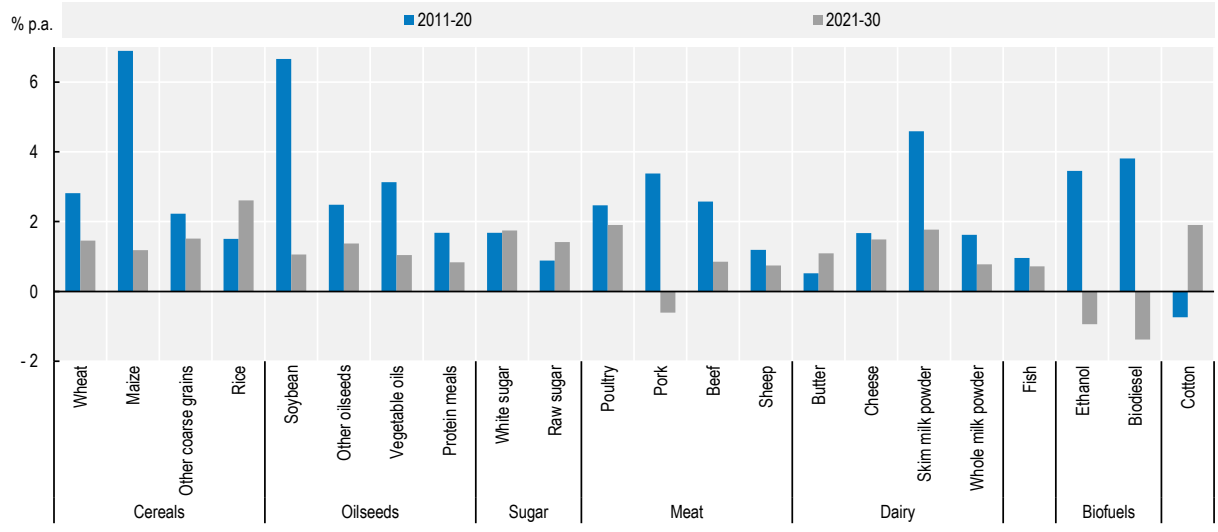
1.5.1. Growth in agricultural and fish trade is slowing

Over the coming decade, agricultural trade will continue to expand for most commodities, although at a slower pace than over the last decade due to a slowdown in demand growth in China and other emerging economies, and lower global demand for biofuels. Average trade volume for the commodities covered in this *Outlook* is projected to grow at 1.3% p.a. over the projection period, compared to 3% p.a. over the previous decade. The projections indicate a clear slowdown in trade across most commodities (Figure 1.26).

For biofuels and pigmeat, trade is expected to decline over the coming decade. The drop is biodiesel trade (-1.4% p.a.) mainly reflects declining import demand for palm oil biodiesel in the European Union and high domestic demand in Indonesia, as the country seeks to implement its B30 program. Ethanol trade is also expected to decline, albeit at a lower rate (-1% p.a.), mainly due to lower exports from the United States as its ethanol production is decreasing.

After peaking at 12 Mt in 2020, pigmeat trade is also projected to slightly decline over the coming decade (-0.6% p.a.). The outbreak of ASF in China and in several countries in Asia (e.g. Viet Nam) caused a surge in import demand for pigmeat in 2019-20, which was largely met by growing exports from the European Union, the United States, Canada, and Brazil. As China’s pigmeat production gradually recovers, pigmeat trade is expected to slow down (Frezal, Gay and Nenert, 2021[21]).

Figure 1.26. Growth in trade volumes, by commodity



Note: Annual growth rate of trade volumes as calculated from 2014-16 reference prices.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook OECD Agriculture statistics (database)", http://dx.doi.org/10.1787/agr-outl-data-en.

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Notable exceptions to the overall slowdown in agricultural trade are rice and cotton. Rice trade is projected to grow at 2.6% p.a. over the coming decade, compared to 1.5% p.a. over the last ten years. The growth in global rice trade will be supported by production surplus in India, as output is expected to grow at a higher rate than domestic demand. India’s rice surplus will be mainly directed to Sub-Saharan Africa, where rice imports are projected to increase by 90% over the next ten years. Trade in cotton is also expected to

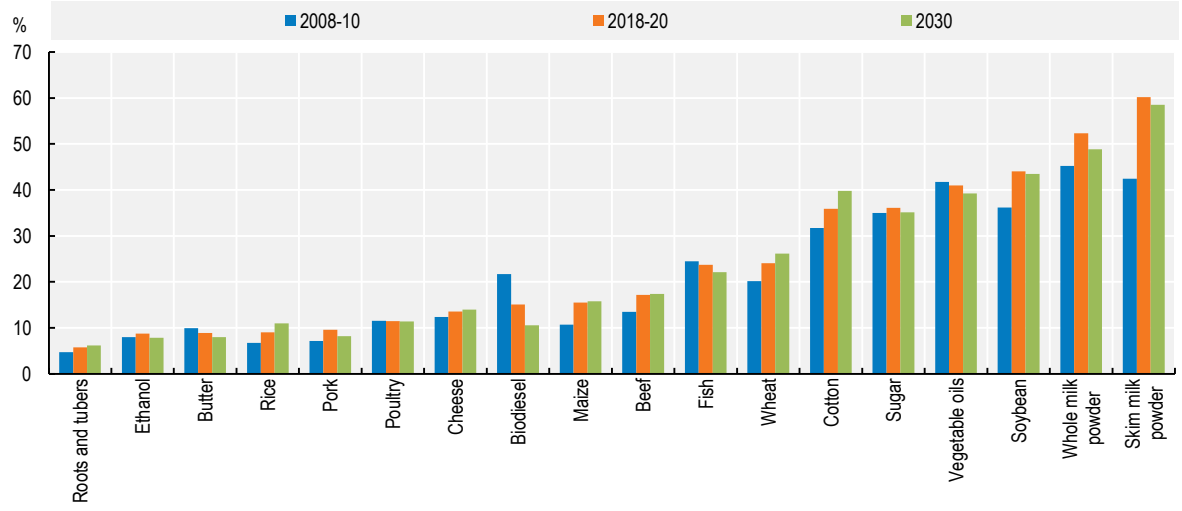
expand faster than over the last decade (+1.9% p.a.), reflecting the growing demand for raw cotton by the textile industry, which is mostly located in countries with limited production potential (e.g. Bangladesh, Viet Nam). High import demand for raw cotton will be largely met by growing exports by the top exporters i.e. the United States, Brazil, and Sub-Saharan Africa.

1.5.2. Trade relative to output is stabilising

The share of production traded for the commodities covered in the *Outlook* has been gradually increasing over time, rising from an average of 15% in 2000, to 23% in 2018-20, and reflects a trade sector that has been growing at a faster pace than agricultural production. Assuming a diminishing impact of previous trade liberalisation that boosted global agricultural trade and no major changes in policies, trade relative to production will stabilise over the next decade, as growth in trade is expected to be more closely aligned with output growth.

However, this average masks important differences in the role of trade by commodity (Figure 1.27). For many agricultural commodities the share of production traded is actually low. Only for some commodities does trade represents at least one-third of global production. This is the case for cotton, sugar, soybean, vegetable oils and milk powders, which are demanded for further processing. The share of production traded for some of these commodities has been strongly increasing over the last decade. For milk powders, this mainly reflects growing import demand for WMP in China, and skim milk powder (SMP) production surplus in the European Union and the United States, which was mainly directed to developing countries. High feed demand in China, on the other hand, caused a rise in import demand for soybean which was largely met by growing exports from the United States and Brazil. This resulted in an increase in the share of production traded for soybean over the last decade.

Figure 1.27. Share of production traded, by commodity



Note: This share is computed as exports over production (in volume).
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook OECD Agriculture statistics (database)", http://dx.doi.org/10.1787/agr-outl-data-en.

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Over the coming decade, the share of production that is traded will not change significantly for the commodities covered in the *Outlook* as no major shifts in trading patterns are expected. A number of commodities may have their export ratio decline marginally over the outlook period, reflecting either weakness in import demand, or increasing domestic use, or both, in the case of biodiesel.

1.5.3. Increasing differentiation between net exporting and net importing regions

Differences in climate and geography, including the availability of productive agricultural land, determine the pattern of comparative advantage in producing different agricultural commodities. Comparative advantage, together with differences in population density and population growth, as well as policy factors, determine 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. Over the coming decade, the differentiation between net exporting and net importing regions is expected to intensify. Established net exporters of agricultural commodities are expected to increase their trade surpluses while regions with important population growth or land or other natural resources constraints are expected to see their trade deficit widening (Figure 1.28).

Traditional suppliers increase their trade surplus

Latin America and the Caribbean is expected to reinforce its position as the world's prime supplier of agricultural commodities, with a projected increase in its net exports of 19% between 2018-20 and 2030. Increasing production of maize, soybean, beef, poultry and sugar will facilitate this expansion. Net exports from North America, the second leading supplier of agricultural commodities to world markets, are expected to expand at slower pace (by 11% between 2018-20 and 2030), due to slower output growth. Exports growth of maize and soybeans, in particular, will significantly slowdown from a rate of 5.8% p.a. in the last decade to less than 1% p.a. over the coming decade.

Figure 1.28. Net trade by region, in constant value

Note: Net trade (exports minus imports) of commodities covered in the Agricultural Outlook, measured in constant 2014-16 USD.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Europe and Central Asia have moved over time from being net importers of agricultural commodities to net exporters in 2014, partly due to a stagnating population and flat per capita consumption, which limits domestic demand. Production growth has also contributed to the improved export performance, in particular for Ukraine and Russia, which have grown in the span of a few years into competitive exporters of maize and wheat, respectively, due to significant productivity gains. Over the coming decade, net exports from the region are projected to more than double, largely due to higher exports from Russia and Ukraine.

Rising trade deficits among countries with rapid population growth and/or natural resources constraints

Net imports by the largest net importing region, Asia and Pacific, are projected to increase by 17% between 2018-20 and 2030, largely due to increasing net imports by China (11%). The Chinese agricultural trade deficit has grown steadily over the last 20 years, from USD 2.6 bln in 2000 to USD 66 bln in 2019, and peaked at USD 86 bln in 2020 (in constant 2014-16 USD), as ASF outbreaks caused a surge in China import demand. Over the coming decade, net imports by China are expected to expand at a slower pace than over the last decade due to slower growth in population, saturation in food consumption for some commodities, and efficiency gains in production.

However, the large trade deficit of the Asia and Pacific region masks important differences between countries and sub-regions. Oceania and South East Asia, for instance, are traditional net exporters of agricultural commodities, but their trade surpluses are expected to be flat over the next decade. India, on the other hand, is neither a major importer nor a major exporter, despite its size. Over the coming decade, domestic production is expected to keep up with growing population and per capita incomes, with little change in its overall trade position. The strong growth in India's consumption and production of dairy products, for instance, is expected to have little effect on global trade.

Sub-Saharan Africa and Near East and North Africa are also large net importers of agricultural commodities, in particular of cereals, which support food security both directly and through use as animal feed. Net imports by Sub-Saharan Africa are projected to rise by 75% by 2030 due to higher imports of wheat, rice, maize and soybean. Agricultural productivity growth would help improve the region's self-sufficiency and reduce his trade deficit (Box 1.2). While Sub-Saharan Africa is a large net importer of commodities covered by the *Outlook*, it is a net exporter of other agricultural products including cocoa, coffee, tea, fruits and vegetables. Net imports by the Near East and North Africa region are expected to rise to over 28% by 2030, further deepening the region's dependence on international markets. The Near East and North Africa region will remain the largest importer of basic foods on a per capita basis.

Given growing regional imbalances, the use of trade restrictive policies (e.g. export restrictions), can have detrimental effects on global food security. During the COVID-19 pandemic, international cooperation and market transparency have prevented the widespread use of these policies (OECD, 2020[22]). It is important to remember the lessons of past shocks for future production shocks, transport or supply chain disruptions. Trade restrictions have negative effects on the short-term but also in the longer term by undermining supply capacity (Box 1.3).

1.5.4. Trade plays a growing role in ensuring food security and nutrition

About 20% of calories consumed cross borders

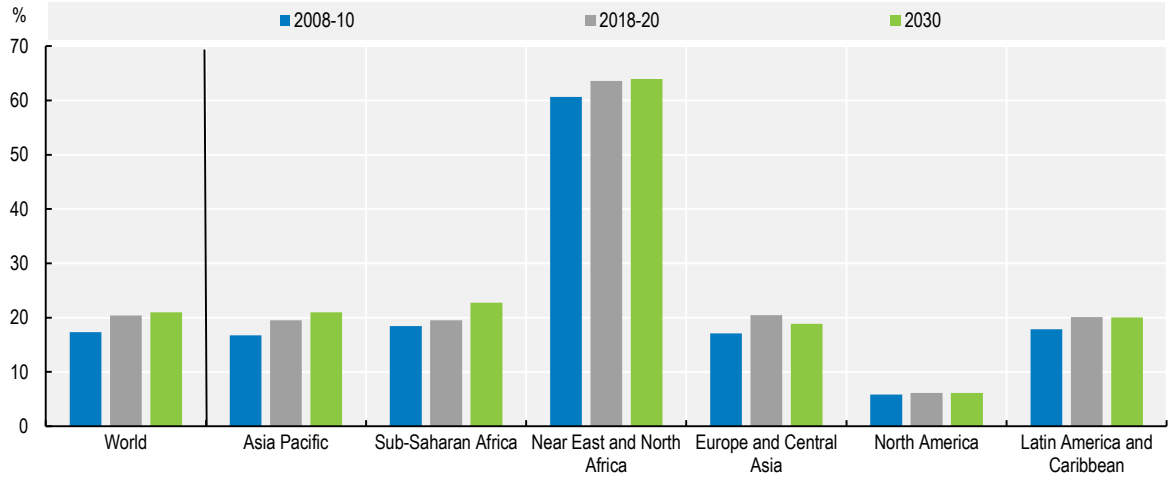
Trade can improve the availability and affordability of different foods and add to a wider choice for consumers (FAO, 2018[23]). Trade is particularly important for resource-constrained countries, which are highly dependent on the import of basic and high-value food commodities. An enabling trade environment thus increases food availability in these countries and can moderate pressures on consumer prices. Trade can also help smooth food supply and buffer domestic production shocks. In a country experiencing declines in production due to a weather-induced shortfall, for instance, trade can contribute to food security.

Figure 1.29 shows the share of imports in total calorie availability for different regions. At the global level, this share rose from 17% in 2008-10 to 20% in 2018-20, and is projected to remain broadly stable over the coming decade. However, the share of imported calories varies significantly between regions and individual countries. This share tends to be lower in large producing regions like North America; where imports account for only 6% of total calorie availability. However, even large net exporting regions import

some of their calories. In Latin America and the Caribbean, for instance, imports account for about 20% of total calorie availability. This estimate includes intra-regional trade, which is important in the region.

In Near East and North Africa, where population is growing strongly and water resource constraints limit production response, imports play a significant role in complementing domestic food production. Imports accounted for 63% of total calorie availability in the region in 2018-20; a share that is expected to slightly increase over the coming decade. In Sub-Saharan Africa, the share of imports in total calorie availability is lower, at 19% in 2018-20. However, this share is expected to reach 23% by 2030, as growth in domestic production growth will not keep up with high population growth.

Figure 1.29. Imports as a share of total calorie availability for selected regions



Note: Calculations using average calorie content of commodities included in the *Outlook*. Note that imports include feed, and availability includes processing of commodities which may be re-exported. Imports include intra-regional trade but exclude intra-EU trade.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook OECD Agriculture statistics (database)", http://dx.doi.org/10.1787/agr-outl-data-en.

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Diversified diets depend on trade

Beyond the importance of trade in facilitating global food security, trade is also central in ensuring nutrition security and in supporting diet diversification (FAO, 2018[23]). Over the coming decade, the growing demand for livestock products in low and middle-income countries will be partly met by suppliers in the developed world. Several countries in Near East and North Africa, Sub-Saharan Africa and South East Asia will see an increasing share of their demand for animal products being met by imports; particularly for commodities that cannot be produced domestically or not in sufficient quantities. In high and middle-income countries, income growth and changing consumer preferences are projected to spur imports of bananas and other tropical fruits from low-income countries, as detailed in Chapter 11.

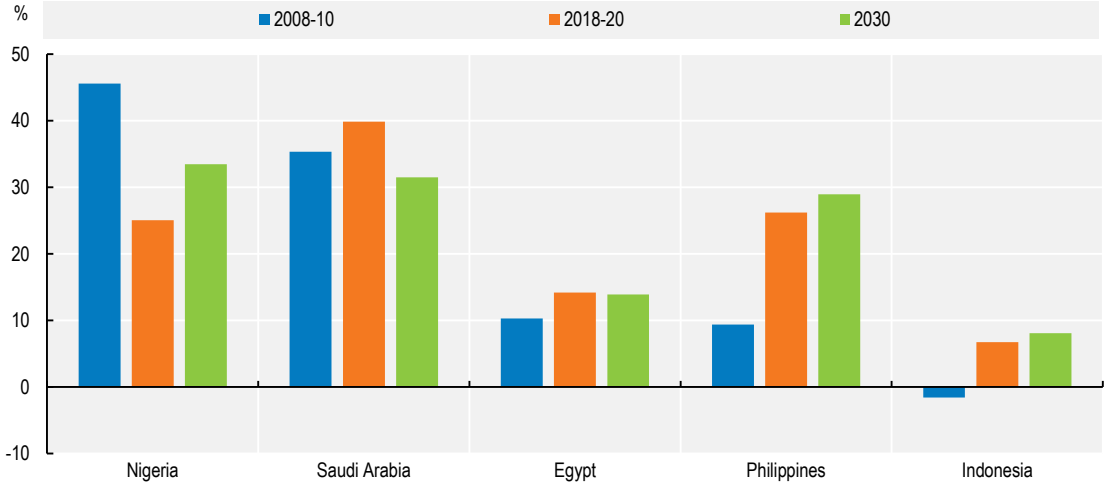
Figure 1.30 presents the share of net imports in total animal protein availability for selected countries in Near East and North Africa, Sub-Saharan Africa and South East Asia. Selected countries have a high and/or increasing share of their demand for animal protein that is being met through imports.

Nigeria is a large net importer of animal products, particularly of dairy, but also of fish and meats. The share of net imports in total animal protein availability varies depending on the balance between domestic production and demand. Demand for animal protein is driven by developments in population and more importantly in income, which in oil exporting countries are closely linked to oil revenues. High oil prices in 2007-12 triggered additional import demand for animal protein. Lower oil prices thereafter reduced import demand for animal protein, lowering the share of net imports in total animal protein availability. Over the

coming decade, this share is projected to increase again, due to the expected recovery of the oil price following the COVID-19 pandemic, and as growth in domestic production will not keep up with growing population and per capita incomes. Saudi Arabia is also highly dependent on imports of animal products (dairy in particular); net imports accounting for almost 40% of total animal protein availability in 2018-20. However, this share is expected to decline over the coming decade as Saudi Arabia has made large investments in domestic animal farming over the last 20 years to reduce its import dependency.

South East Asian countries are particularly dependent on dairy and beef imports, mainly from Oceania and the United States. The Philippines imports virtually all of its dairy products, while in Indonesia, net imports account for 60% and 50% of dairy and beef protein availability, respectively. In these two countries, the share of net imports in total animal protein availability is projected to continue increasing over the next ten years as demand growth, driven by income growth and urbanisation, will outpace the growth in domestic production. However, these countries are also investing in the expansion of domestic animal production, mostly poultry, largely supported by imported feed.

Figure 1.30. Net imports as a share of total animal protein availability for selected countries



Note: This share is computed as net imports of animal protein (in Kt/year) over total availability of animal protein (in Kt/year).
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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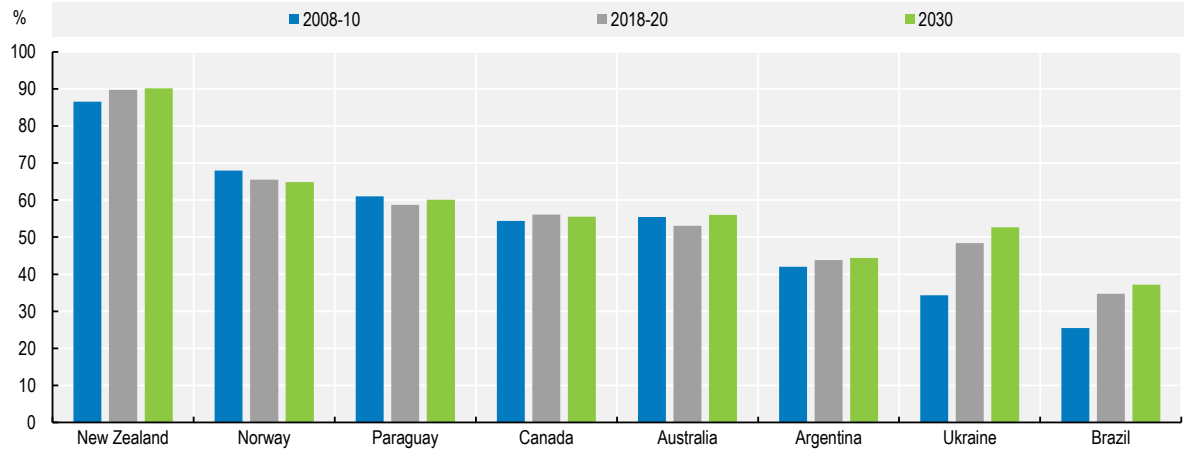
1.5.5. Exports are critical to livelihoods in many countries

For many countries, trade plays a central role in sectoral performance. Exports of some agricultural commodities account for a large share of domestic production and are therefore an important source of income and an opportunity to access growing markets without affecting local markets. However, high dependency on exports also increases exposure to international market fluctuations and shocks as well as changes in trade policies, which can adversely affect the rural or coastal sectors of these countries. Tariffs and other types of import restrictions at the international level, for instance, can affect their income prospects (Box 1.3).

As measured by the ratio of the net value of exports to net value of domestic production for the commodities included in the *Outlook*, eight countries will continue to have high dependency on international markets over the coming decade (Figure 1.31). While some of these countries, such as Canada and Brazil, export a wide set of commodities (cereals, oilseeds, animal products), some others such as New Zealand, Paraguay and Norway, depend on just a few commodities (dairy products, oilseed products and fish, respectively). Several low-income countries also have a large export dependence on a few tropical

commodities (e.g. coffee, cacao, bananas and other tropical fruits) (Chapter 11). The export performance in these countries is thus highly tied to trends and fluctuations in the revenues from that commodity. Volatile and generally declining world commodity prices (Section 1.6) can cause instability in total export earnings in commodity-dependent economies.

Figure 1.31. Exporting countries with greater than 25% dependency on foreign markets



Note: This share is computed as export value over production value in current prices.
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.5.6. Change in policies can affect trade projections

Trade has been an engine of transformation of the global agriculture and food sector. Changes in trade policies have been critical in facilitating this transformation by reducing both tariff and non-tariff barriers, which have limited the movement of goods and services. As a result of reducing trade barriers the welfare of both consumer and producers has increased through improved market efficiency.

Major developments in trade and other policies that will be negotiated and implemented over the coming decade could have important impact on agricultural trade. The *Outlook* only includes policies currently in place and holds them constant over the medium term, which constitutes a source of uncertainty, as change in policies could occur over the coming decade, thereby affecting the projections.

New trade agreements, for instance, will potentially increase intra-regional and inter-regional trade over the next ten years. The baseline only incorporates implemented and ratified bilateral trade agreements, including the African Continental Free Trade Agreement (AfCFTA), which came into force in January 2021. The AfCFTA will effectively consolidate 55 African countries into a single market. It foresees a gradual elimination of tariffs over the next five years for non-LDCs and over the next ten years for LDCs, for 90% of the tariff lines. However, the exact tariff schedules have not yet been finalised. This trade agreement offers opportunities to expand intra-African trade, which is currently very low. Only about 20% of African countries' food imports originate from other African countries, and one country – South Africa – accounts for over a third of this intra-African food trade (Fox and S. Jayne, 2020[24]). To realize the full potential of the AfCFTA, however, African countries will need to improve their agricultural productivity to compete effectively with low-cost imports from the international market. Reducing non-tariff barriers to trade, streamlining customs procedures and improving regional transportation links is also key to the success of the AfCFTA. This *Outlook* does not consider any tariff reduction within AfCFTA signatory countries over the projection period. However, it assumes improved market efficiency within the African region.

Another free trade agreement, the Regional Comprehensive Economic Partnership (RCEP), has been signed in November 2020 between the ten countries of ASEAN and five countries of Asia and Pacific (China, Japan, Korea, Australia, and New Zealand). The RCEP will provide a framework aimed at lowering trade barriers and securing improved market access for goods and services. However, as the RCEP is not yet ratified, it is not taken into account in the *Outlook* projections. This trade agreement could further reinforce existing trading relationships between signatories, which are already strong.

Similarly, the potential effects of the trade agreement between the European Union and Mercosur states (i.e. Argentina, Brazil, Paraguay and Uruguay) are not taken into account in the projections as ratification is still pending. The EU-Mercosur trade agreement will liberalise market access for agricultural goods. Mercosur duties will be gradually eliminated over the next ten years on 93% of tariff lines, while a liberalization of up to 15 years is planned for some sensitive products. In parallel, the European Union will liberalise 82% of its agricultural imports. Mercosur countries will likely benefit from lower EU tariffs and hence higher exports of meat products, fruit, orange juice, sugar and ethanol. The European Union, in turn, could benefit from higher exports of dairy products, pigmeat, wine and spirits. By contrast, some sensitive EU products such as beef, rice, poultry and sugar might see greater competition from Mercosur suppliers and increased downward pressure on prices. Following concerns about the potential negative environmental effects of this trade agreement, the European Union and Mercosur states committed to effectively implement the Paris Climate Agreement and agreed to cooperate on the climate aspects of trade between the two sides, including tackling deforestation.

While the signing of free trade agreements could boost agro-food trade over the coming decade, significant barriers to trade are expected to remain, as progress in reducing agricultural trade protection and distortive domestic support policies has largely stalled. Agricultural products in recent years still face average tariffs of around 15% (UNCTAD, 2019[25]). Moreover, several countries continue to provide income support to their farmers through measures that strongly distort farm business decisions – thereby distorting global agricultural production and trade. In 2018-20, farmers in 54 OECD and non-OECD countries received an estimated USD 540 billion per year in public support; two-thirds of this was provided through higher prices paid by consumers and payments that are coupled to production, including variable input subsidies (OECD, 2021[26]). Box 1.3 discusses the intended and unintended effects of border and beyond border policies measures for the achievement of SDG 2.

Environmental and climate policies will also impact agricultural trade over the coming decade. Carbon pricing policies (e.g. emissions taxes, emissions trading schemes and border carbon adjustments), in particular, could impose additional costs on producers and affect agricultural trade, potentially undermining food security and livelihoods. Therefore, these policies need to be designed carefully to balance competing objectives of GHG mitigation, food security and farm livelihoods (OECD, 2021[6]).

Box 1.3. Trade and the Sustainable Development Goals (SDGs)

With just under ten years to 2030, the SDG Summit in September 2019 called for a Decade of Action and delivery for sustainable development, recognizing that vulnerabilities are high and deprivations are becoming more entrenched. While some progress is being made in many places, the achievement of the Agenda 2030 is not advancing at the required speed and scale, including with regard to SDG 2, which aims to end hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Recent estimates[1] indicate that nearly 690 million people – or 8.9% of the world's population – are undernourished, with the number of people facing severe food insecurity on the rise since 2015. The COVID-19 pandemic is expected to further exacerbate the situation, at a time when 1 in 10 people in the world live under on USD 1.90 a day[2] and food systems face a number of environmental challenges,

including poor soil health, greenhouse gas (GHG) emissions, biodiversity loss, poor water management, and pollution.

Measures that affect agricultural trade and markets (both border measures and "behind-the-border" domestic support measures) can have very different implications for different SDG targets, depending on whether a country is a net exporter or importer, a small or big producer or consumer and on the way that policies are designed and implemented. In addition, the impact might be different in the short- and medium-to-long-term. It is therefore important to recognize areas in which trade-offs may exist between competing policy objectives and identify ways in which they can be addressed.

Competing priorities

Some measures generally have positive implications for the achievement of the SDG 2 targets on productivity and food security; for example, public investments in infrastructure, storage facilities or rural roads, and government support for research and extension services. On the other hand, the use of export restrictions is an example of competing priorities of a border measure, in particular between short- and longer-run objectives within the domestic market, but also between the policy objectives of two trading partners. When domestic food prices rise, governments sometimes ban or tax exports to help contain price increases. However, such measures can immediately harm poor consumers in food-importing countries, and over time, they can also create disincentives for agricultural investment in the country where the measure is applied. Similarly, cutting tariffs on foodstuffs could help diversify the supply of nutritious food and lower prices for poor consumers, but producer livelihoods could be undermined by competition from cheaper imported foods. Input and output subsidies and market price support can lower production costs, but can also disadvantage farmers in other countries, result in inefficient allocation of resources, and exacerbate environmental pressures.

Relationship with multilateral trade rules

Measures that do not typically involve transfers to individual producers, usually fall under the World Trade Organization (WTO) Green Box category and are not subject to any limitation. Such measures generally have positive implications for the achievement of SDG 2. Other measures that can have production and trade-distorting effects are subject to limits in the multilateral trading system. SDG Target 2.b calls upon countries to "*correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of export subsidies and all export measures with equivalent effect, in accordance with the Doha Development Round*". While progress has been made with the WTO Nairobi Ministerial Decision, achieving SDG 2 and resolving the trade-offs requires that governments go beyond a narrow focus on the elimination of export subsidies. Doing so could help ensure that trade policies contribute to fast-tracking progress on the food and agriculture components of the 2030 Agenda. Promoting coherence and alignment between different policies is essential in this effort and can ensure that trade supports the COVID-19 recovery.

Notes: 1. FAO, IFAD, UNICEF, WFP and WHO (2020), T*he State of Food Security and Nutrition in the World 2020: Transforming food systems for affordable healthy diets*, FAO, Rome, https://doi.org/10.4060/ca9692en
2. World Bank (2020), *Poverty and Shared Prosperity 2020: Reversals of Fortune*, World Bank, Washington, DC. doi: 10.1596/978-1-4648-1602-4.

Source: Gadhok et al. (2020[20]).

1.6. Prices

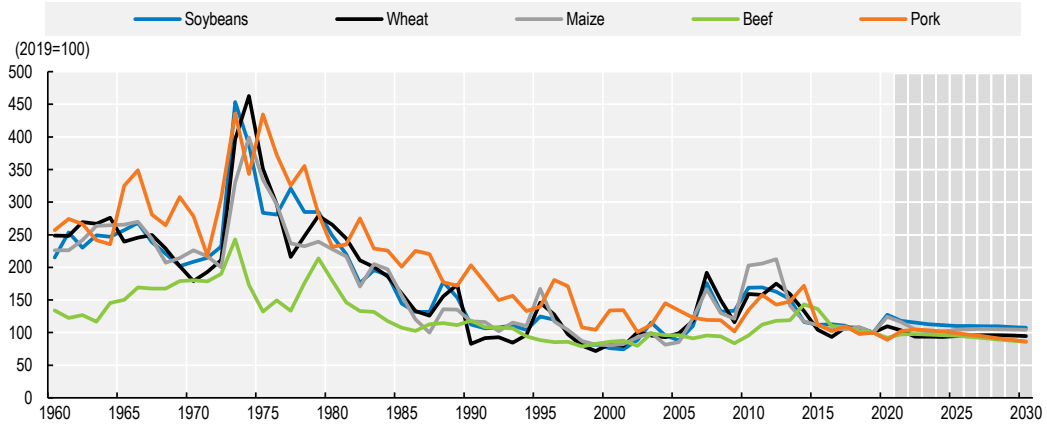
The *Outlook* uses prices observed at major markets as the international reference prices to characterise the market situation for each commodity. In addition to market fundamentals, current prices are influenced by the effects of a number of factors (diseases such as the COVID-19 pandemic, weather, natural disasters, policy changes, etc.) and are projected to adjust during the following years; whereas in the later

years of the projection period, price projections are determined solely by fundamental supply and demand factors. Variability around the projected baseline prices is explored in a partial stochastic simulation analysis at the end of the section.

1.6.1. Historical price trends

Over the coming decade, real agricultural prices (i.e. adjusted for inflation) of most commodities covered in the *Outlook* are projected to decline (Figure 1.32). Prices of agricultural commodities have been following an overall declining trend since the 1960s. This has been the result of productivity improvements in agriculture and related industries, lowering the marginal production costs of the main food commodities. The green revolution during the 1960s and the emergence of new technologies during the 1990s resulted in substantial yield increases in major producing countries. Significantly reduced marginal production costs were bidding down prices despite global population- and income-induced food demand growth. Deviations from the general trend, such as the price spike during the oil crisis in the 1970s or a number of price peaks during 2007-14, were temporary and did not alter the long-term declining trend.

Figure 1.32. Long-term evolution of commodity prices, in real terms



Note: Historical data for soybeans, maize and beef from World Bank, "World Commodity Price Data" (1960-1989). Historical data for pork from USDA QuickStats (1960-1989).
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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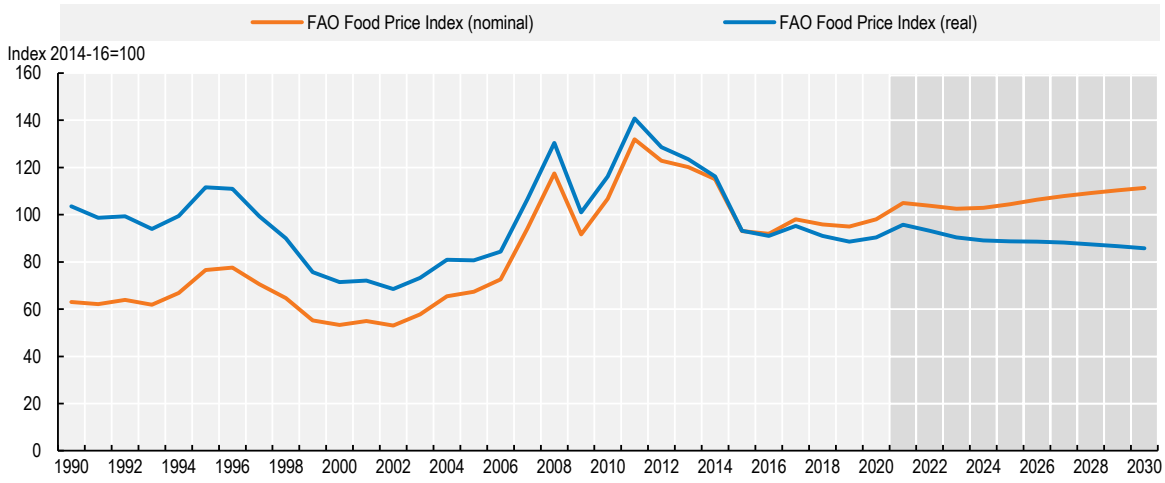
1.6.2. Main drivers of medium-term price trends

The FAO Food Price Index (FPI) summarizes developments in the international reference prices of major traded food commodities in a single indicator (Figure 1.33).[9]

The baseline projections of the FPI are consistent with fundamental supply and demand conditions expected over the coming decade, which consider income and population growth combined with the prevailing consumer preferences on the demand side, and continued productivity increases on the supply side. Over the medium term, it is further assumed that at the global level, the mobilization of natural resources will continue to be possible at declining real prices and the expansion and intensification of production capacity will not be permanently constrained from reaching the limits of projected demand. The assumptions on supply and demand include an efficient and sustainable global trading system over the medium-term. The impacts of deviations from these baseline assumptions on commodity prices are explored with the help of stochastic simulations.

Figure 1.33. 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 *OECD-FAO Agricultural Outlook* baseline. Real values are obtained by deflating the FAO Food Price Index by the US GDP deflator (2014-16=1).
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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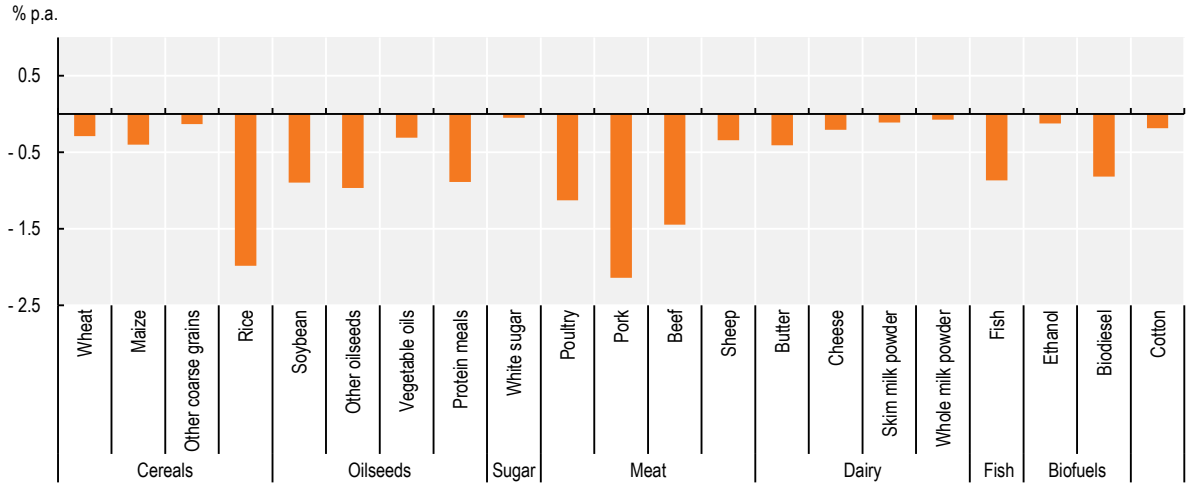
The cereal prices used in the *Outlook* are projected to maintain, or return to, their established ratios during the outlook period (Figure 1.35). Deviations are assumed to be temporary and fundamental relationships will be restored once the source of the shock (e.g. unfavourable weather in major rice producing countries) subsides. The expected increase in global maize production, supplemented by the release of stocks, will be sufficient to meet the growing global food, feed and biofuel demand at a declining real international reference price. The projected decline in the reference price for wheat is based on abundant supplies from the Black Sea region and slow growing global food demand. Due to unfavourable weather in some rice exporters, as well as temporary export restrictions and logistical bottlenecks, the starting real rice export price was significantly above trend. Assuming a return to normal growing and logistical conditions, it is expected to decrease to trend level by 2023, with declines thereafter promoted by ample global availabilities and intensifying competition for markets amongst exporters. Real prices of other coarse grains (rye, oats, barley, sorghum) are set to increase slightly, due to sustained import demand, mainly from China, where they are used to supplement TRQ-constrained maize imports. This demand is not fully offset by productivity growth in major producing regions over the medium-term, moving prices up.

1.6.3. Commodity price trends

Figure 1.34. Average annual real price change for agricultural commodities, 2021-30



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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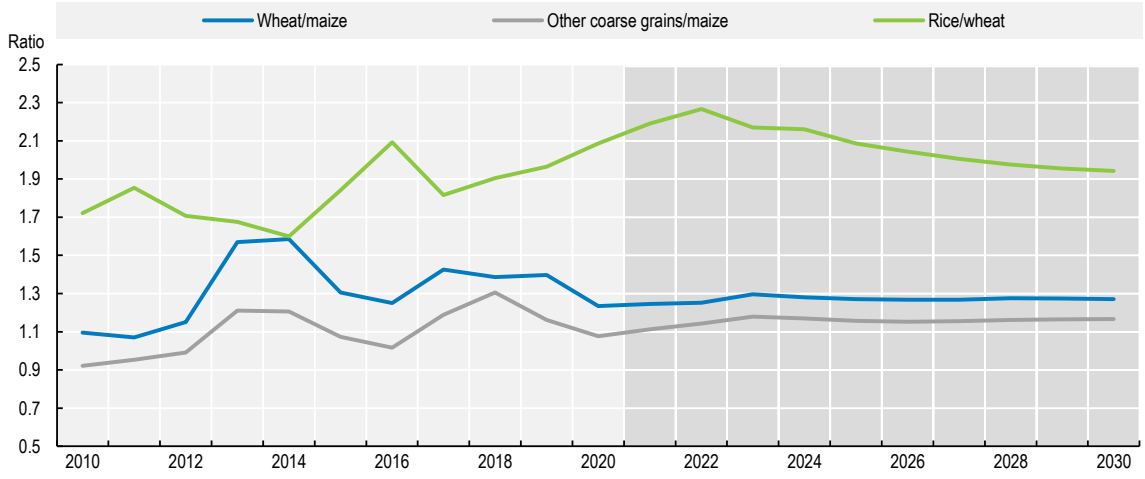
Figure 1.35. Cereals' price ratios



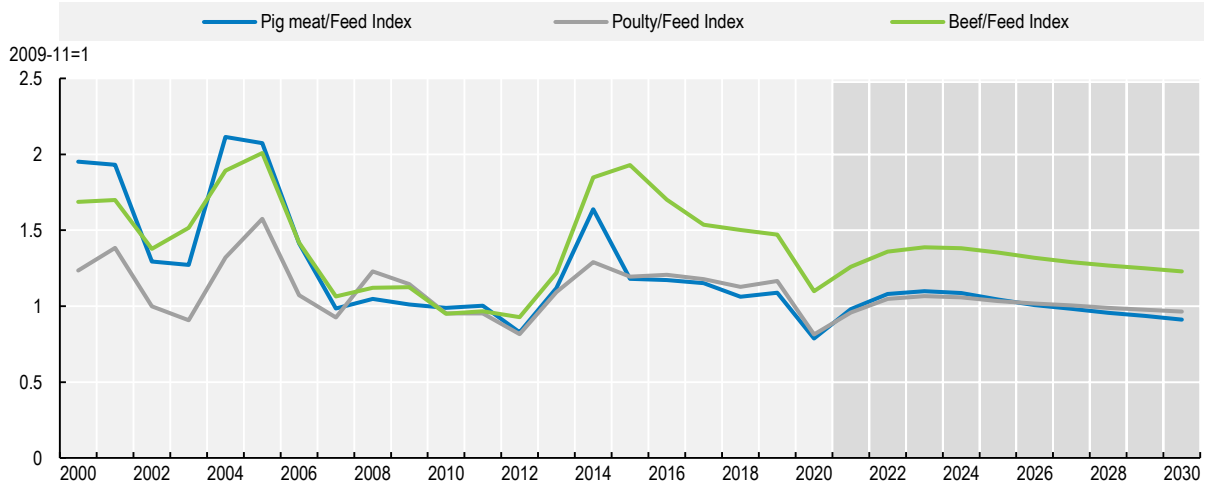
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink https://stat.link/w29l4f

Real prices of oilseeds and oilseed products increased above trend in the second half of 2020 partly due to high import demand for soybeans related to the rebuilding of hog herds in China. They are expected to return to trend levels in the early years of the outlook period, reflecting an increase in global supply, based on average production prospects in major producing countries and the gradual elimination of COVID-19-related logistics constraints (FAO, 2021[27]). After this correction, the declining price trend is expected to slow. Prices of vegetable oils are going to strengthen relative to protein meal, mainly based on the expectation of a slowdown in the global production growth of palm oil.

The projected trends in real prices of the four different types of meat covered by the *Outlook* are driven by two distinct factors (Figure 1.36).[10] In the early years, the recovery of the industry from the ASF supply shock dominates. As supplies recover, pork prices in particular fall back to their trend levels. Prices of other meats had also been elevated due to substitution effects, but will decrease to a lesser extent. Once prices have returned to their long-term trends in 2023, fundamental market conditions will take over again. They are characterised by a combination of slowing global demand growth for meat, and in particular for red meats, and falling real feed prices due to continued productivity growth in the crop sector. The limited sheep meat exports from Australia and New Zealand are seen as the main factor supporting the international sheep meat price.

Figure 1.36. Meat to feed nominal price ratios

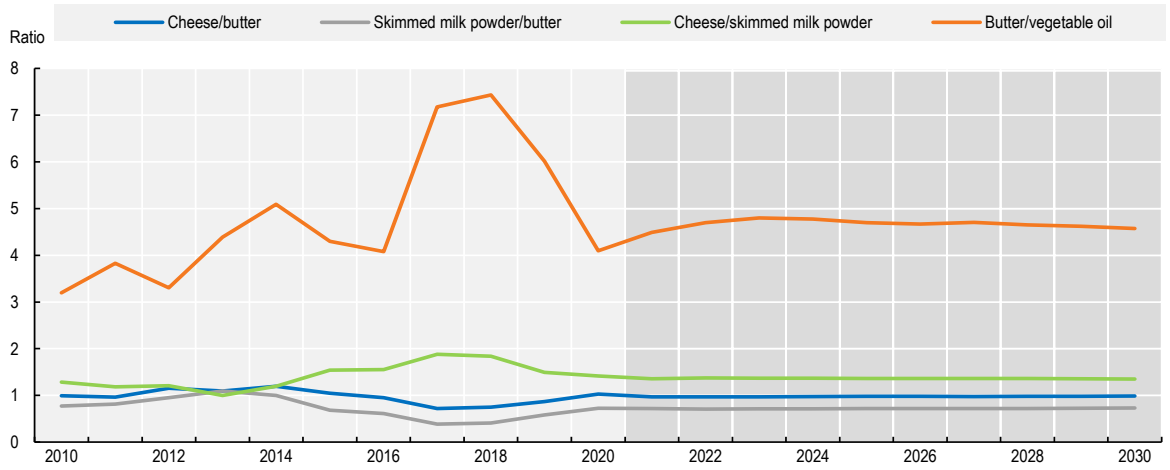


Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink https://stat.link/6tf8hm

Global developments in the dairy sector are mainly characterised by the changes in the international prices of butter and SMP, which are seen as proxies for the value of milk fat and non-fat milk solids, respectively (Figure 1.37). SMP prices were not significantly affected by the pandemic in 2020 and they are expected to remain flat based on the projected market conditions for the next decade. Weakening demand combined with the effect of the supply response to the price peak in 2017 have led to a return of the butter price close to the historical relationships with SMP and vegetable oil. Both ratios are expected to remain stable throughout the projection period. Real prices of cheese and WMP reflect butter and SMP price developments.

Figure 1.37. Dairy price ratios



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

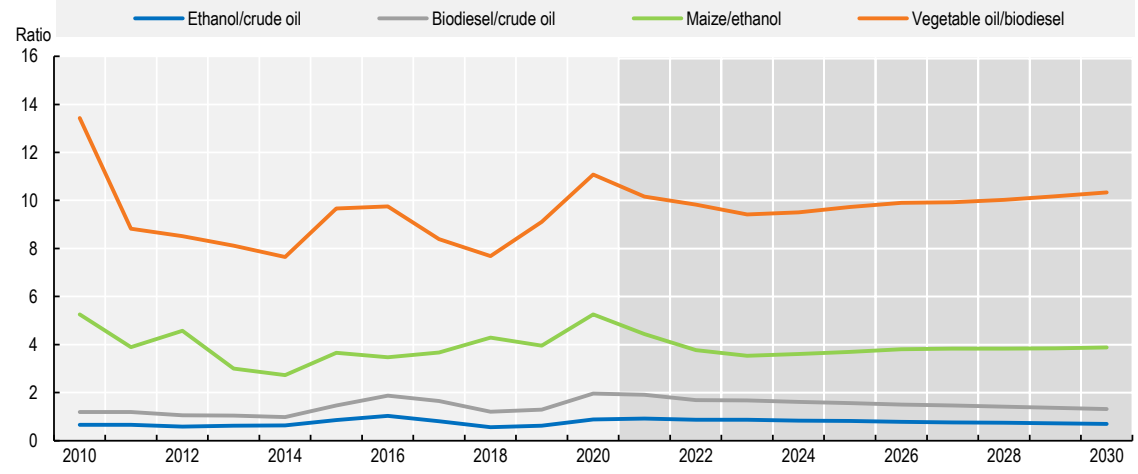
StatLink https://stat.link/qtfa92

Real sugar prices were elevated at the beginning of the outlook period, due to production shortfalls in recent years. Based on the assumed recovery in global production, prices are projected to drop in 2021. Expected productivity improvements in the following years are going to outweigh increases in global sugar demand and prices are projected to remain flat over the next decade (Figure 1.34).

The projected supply and demand situation for fish sees real fish prices decline (Figure 1.34). In the first years of the projection period, the decline is expected due to reduced demand for fish following the COVID-19 pandemic. Thereafter, the reduction is driven by policy changes in China, which will lead to strong growth in domestic production.

After lifting of the COVID-19 related movement restrictions assumed in 2021, the expected recovery of biofuel demand is going to support the recovery of biodiesel and ethanol prices in the early years of the outlook. Once global biofuel demand stabilizes, real prices are expected to resume their long-run declining trend interplaying with their major feedstocks (Figure 1.38).

Figure 1.38. Biofuel price ratios



Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink https://stat.link/rka9eb

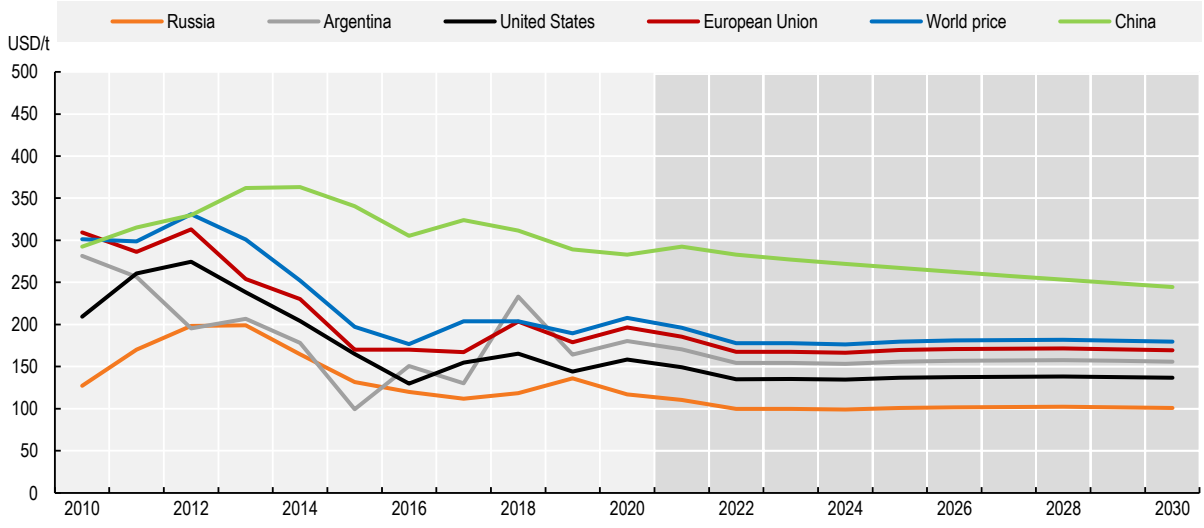
1.6.4. Transmission of price signals within the global food system

International reference prices are used in the *Outlook* to characterize global markets, but their actual impact on the decisions of producers and consumers is thought to be indirect. Production and food purchasing decisions are mainly made according to domestic producer and consumer prices. While each individual producer or consumer acts as a price taker, their aggregate behaviour in domestic markets determines the domestic reference prices. Globally aggregated production and consumption decisions drive international reference prices. The formation and transmission of these price signals depend on the integration of domestic markets into the global trading system, currency movements and the cost of trade.

How price signals are transmitted between domestic and international markets depends on the share of the domestic consumption that is imported or of the domestic production that is exported, as well as on the responsiveness of domestic prices to trade. In countries with a well-developed trade infrastructure and/or high substitutability of traded for domestic products, domestic market shocks are absorbed quickly by the global market through trade, and domestic prices are not affected, as long as the country's global market share is small. Major producer and consumer countries transmit their domestic market trends and variability more directly into the global market. By contrast, countries with only very limited interaction with the global market, i.e. those with a high self-sufficiency rate, are mostly shielded from shocks that are transmitted by global price movements, but they are more exposed to domestic shocks.

The baseline projections are based on considerations of both situations. Market integration and the resulting price transmission varies significantly by commodity and country/region. Cereal and oilseeds markets tend to be more globalized than markets for livestock products. The trade section illustrated the differences in the role of trade between commodities and countries. Figure 1.39 illustrates differences in trends and levels between the global reference price and respective domestic producer prices.

Figure 1.39. International reference vs domestic producer real prices for wheat



Note: Real prices are nominal prices deflated by the US GDP deflator (2020=1).
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

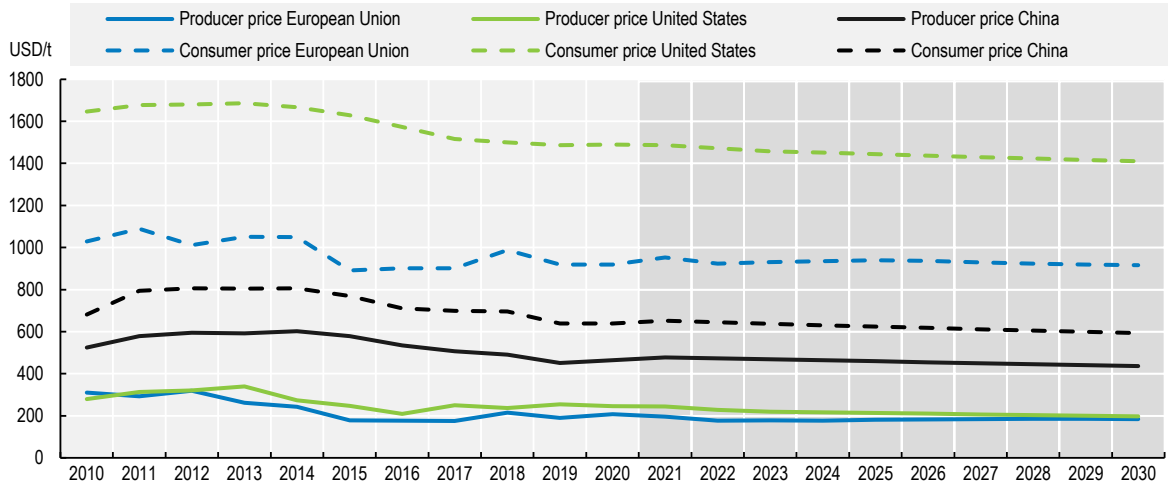
StatLink https://stat.link/bugqy6

In net exporting countries, e.g. Russia, domestic producer prices tend to be below the global level, as marketing and transportation costs have to be deducted from the port price. In net importing countries, e.g. China, these components are added. Producer support instruments, tariffs and other costs of trade may further widen the gap. As Figure 1.39 illustrates, the projected trajectories of global and domestic prices may differ, because the various components of domestic prices are driven by different factors.

Real exchange rate movements between the US dollar denominating the international reference prices and individual country currencies also influence the transmission of price signals from international to domestic markets. Countries with appreciating real currencies, like Argentina, Turkey, Nigeria, or Ukraine, will see real prices fall even stronger in their local currency, while in countries with real depreciation, like Norway, Russia or India, the declining real price trend will be mitigated.

Another aspect to consider is the wedge between producer and consumer prices. International commodity reference prices are more directly linked to the decision making process of producers than consumer prices, which contain additional components to account for processing and marketing margins. Their share varies by commodity and developmental status of a country. The larger these components are, the less responsive the consumer prices are to commodity price movements. Figure 1.40 illustrates the projected differences between real producer and consumer prices in selected markets. As these examples show, the projected price signals to consumers and producers may differ significantly.

Figure 1.40. Consumer and producer prices in selected rice markets



Note: Real prices are nominal prices deflated by the US GDP deflator (2020=1).
Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink https://stat.link/f1posj

1.6.5. Uncertainties

The deterministic baseline price projections presented in this *Outlook* result from the interplay of fundamental supply and demand factors under normal weather, macroeconomic and policy conditions. While the *Outlook* is based on the best information available, there is unavoidably a degree of uncertainty attached to the projections and to the underlying assumptions, particularly linked to emerging developments in demand and supply, summarised in Box 1.4. Furthermore, this assumption of 'normality' results in a smooth trajectory for most projected variables, deviations from the assumed trends result in price volatility. To assess the impact of such deviations, a partial stochastic analysis (PSA) was performed on the baseline projections. The PSA simulates the potential future variability of main price determinants

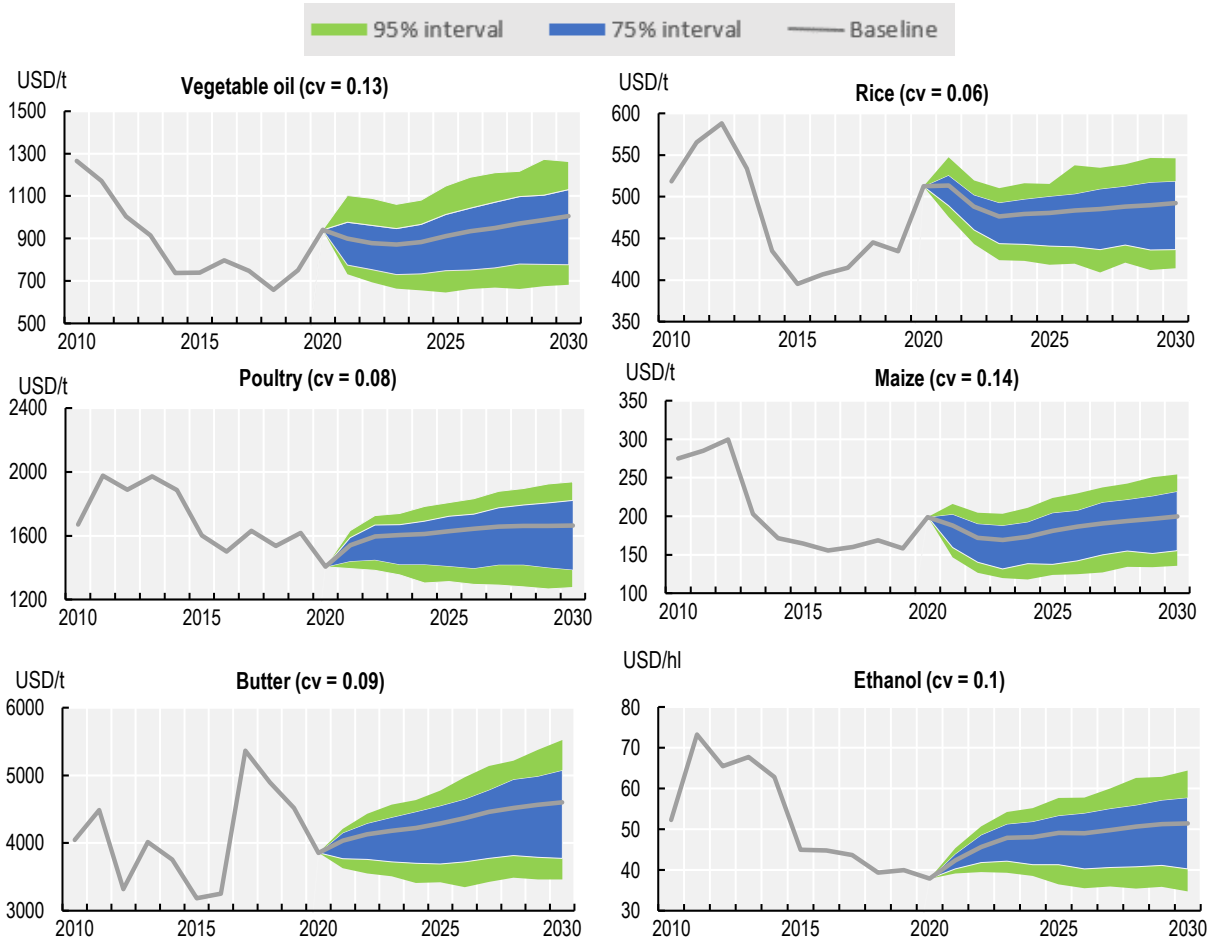
using observed past variability. The analysis includes global macroeconomic drivers and specific agricultural crop yields. Variability related to animal diseases or policy changes is not considered. The aggregated results of multiple PSA simulations indicate the sensitivity of the baseline price paths (Figure 1.41). With a likelihood of 75%, prices will remain within the blue range in any given year, while they are expected to remain with a probability of 95% within the green range. An extreme event that would cause a price to fall entirely outside these ranges occurs with a probability of 40% at least once during the projection period.

Overall, the price variability range tends to be larger around crops than livestock products, given the susceptibility of crop yields to weather conditions. The price of rice varies the least among the *Outlook* crops, as it is typically less prone to weather shocks than other crops. Crops that are grown in crop rotation systems, such as maize and soybeans in the Americas, show similar levels of variation.

In general, prices of livestock products are less susceptible to weather shocks because feed price variability is not fully transmitted, mainly due to substitutability between different feeds. Nevertheless, the pasture-based dairy sector in New Zealand does not benefit from this possibility and therefore shows a high price volatility. Due to the dominant role of New Zealand in international dairy markets, this volatility is transmitted to global markets.

The variability in ethanol and biodiesel prices is closely related to that of the crude oil price, because of the complementary consumption relationship. They are additionally influenced by the variability in feedstock prices, mainly maize, sugar cane and vegetable oils. The respective effects can offset or amplify each other.

Figure 1.41. Baseline and stochastic intervals for selected international reference prices



First years' evolution of nominal prices for selected commodities

Note: Expected evolution of nominal prices under the baseline scenario of the Outlook (solid line) in relation to the stochastic outcomes shown in the green (macro and yields) and blue (macro) 90% confidence intervals.

Source: OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink https://stat.link/ckam34

Box 1.4. Beyond the conventional Outlook: Assessing agri-food systems transformation

The *Outlook* presents a plausible medium-term scenario, extending past supply and demand patterns and assuming normal weather and no change to policies for the next ten years. In addition, alternative developments to achieve access to safe, healthy, and nutritious food for a growing world population, while at the same time using natural resources more sustainably and making an effective contribution to climate change adaptation and mitigation is closely monitored.

While the *Outlook* assumes an evolution of consumption patterns along past trends, a number of developments may contribute to larger shifts in consumption patterns in the coming years. The projections account for emerging societal, health and environmental concerns advocating for lower consumption of animal-based products, in particular red meat, which are beginning to shape consumption patterns, especially among young consumers in high-income countries (Mensink, Lage Barbosa and Brettschneider, 2016[28]). Enhanced consumer awareness, but also policy measures promoting healthy diets, together with technology and innovation, are expected to further increase consumers' interest in alternative protein sources, such as plant-based proteins (soy, pea), new animal sources (insects), or biotechnological innovations (cultured meat or fungal protein) (Van Huis et al., 2013[29]; McKinsey, 2019[9]; Ismail et al., 2020[30]). However, expected consumption shares of these products over the coming decade are still very small (Witte et al., 2021[31]), so the *Outlook* does not specifically account for them. The complex implications of such developments for global agri-food systems are not yet clear (J. Vermeulen et al., 2020[32]) and the scope of the *Outlook* analyses would have to be broadened to incorporate drivers and impacts of such shifts.

On the production side, the *Outlook* also assumes technological developments to follow past trends. However, an array of alternative approaches currently under development might have potential for large-scale applications. Precision farming technology, biotechnology, hydroponics or vertical farming (FAO, 2021[33]) provide opportunities to increase the productivity of labour, land, water and other inputs, which could transform agricultural production. Most of these technologies are still in the niche or experimental stage and are not expected to significantly impact production trends in the coming decade. The *Outlook* analyses, however, do account for a trend reversal due to tightening resource constraints and policy induced technological restrictions expected to result in productivity declines in certain regions.

Emerging and alternative consumption and production trends are carefully monitored and their potential impact on global agri-food systems is continuously assessed, so relevant developments can be incorporated into future editions of the *Outlook*. OECD and FAO, in close collaboration with their partners, are preparing the empirical evidence base and modelling foundation necessary to expand the *Outlook* projections beyond the conventional food and agriculture sectors.

Sources: (FAO, IFAD, UNICEF, WFP & WHO, 2020[2]), (FAO, 2021[33]), (Van Huis et al., 2013[29]), (McKinsey, 2019[9]), (Witte et al., 2021[31]), (J. Vermeulen et al., 2020[32]), (Ismail et al., 2020[30]), (Mensink, Lage Barbosa and Brettschneider, 2016[28]).

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Notes

[1] The OECD and IMF have recently revised their global GDP projections for 2021 upward of more than 1 percentage point from the December and October projections (OECD, 2021[35]) (International Monetary Fund, 2021[34]).

[2] Food loss and waste is defined by the FAO as the decrease in quantity or quality of food along the food supply chain.

[3] Feed use includes commercial feed use and direct feeding of crops.

[4] Hereafter agricultural production refers to crop, livestock and fish production.

[5] This figure refers to the growth of the net value of crop commodities covered in the *Outlook*, whereby the net value is expressed in billion USD, measured at constant 2014-16 prices.

[6] Cropping intensity refers to the average number of harvests in a year, it is calculated as the ratio of area harvested to cropland.

[7] This includes higher slaughter weights, shorter finishing times and higher reproductive rates.

[8] The emissions counted refer to those from livestock production, use of synthetic fertilizers, rice cultivation, burning of crop residues and savannahs, use of crop residues and cultivation of organic soils. Land conversion, however, is the biggest emitter.

[9] For a description of the index and its components please refer to the special features on the FFPI in (FAO, 2013[37]) and (FAO, 2020[36]). The *Outlook* uses the US GDP deflator (2014-2016=1) to obtain the index in real terms. As a result, the real FFPI in the *Outlook* is different from what is published in (FAO, 2020[36]).

[10] The four types of meat covered by the *Outlook* are: beef meat, pig meat, poultry meat and sheep and goats meat.