1 Agricultural and food markets: Trends and prospects

This chapter presents the trends and prospects of the *OECD-FAO Agricultural Outlook 2023-2032* derived from the medium-term projections of the most globally produced, consumed and traded agricultural and fish commodities. Following a description of the macroeconomic and policy assumptions underlying the projections, it highlights the key findings for the consumption, production, trade, and prices of those commodities for the period 2023 to 2032. Agricultural demand is projected to grow more slowly over the coming decade due to the foreseen slowdown in population and per capita income growth. Production of agricultural commodities is also projected to grow at a slower pace. The reduced growth incentives are not only driven by a weakening global demand for agricultural products but by decelerating productivity growth resulting from increased input prices, notably fertilisers, and tightening of environmental regulations. The expected developments in global demand and supply will keep real agricultural prices on a slightly declining trend over the next decade. International trade will remain essential for food security in food-importing countries and for the livelihoods of workers along the food supply chains in food-exporting countries. There is a growing risk that weather variability, animal and plant diseases, changing input prices, macro-economic developments, and other policy uncertainties will lead to deviations in market outcomes from the current projections.

The *OECD-FAO Agricultural Outlook* 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). It presents a consistent baseline scenario for the evolution of agricultural commodity and fish markets at national, regional, and global levels for the period 2023 to 2032. This baseline scenario incorporates the commodity, policy, and country expertise of both organisations, as well as input from collaborating Member countries and international commodity bodies.

The baseline projections are based on the OECD-FAO Aglink-Cosimo model, which links sectors and countries covered in the *Outlook* to ensure consistency and global equilibrium across all markets. The 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 1.1.

The projections are based on a short-term assessment of the Russian Federation's (hereafter "Russia") war against Ukraine, no evaluation of medium-term market prospects in the region can be provided at this time.

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

The *Outlook* contains four parts:

- *Part 1*: *Agricultural and food markets: Trends and prospects.* Following the description of the macroeconomic and policy assumptions underlying the projections (Section 1.1), this chapter presents the main findings of the *Outlook*. It highlights key projections and provides insights into the main outcomes and challenges facing agri-food systems over the coming decade. The chapter presents trends and prospects for consumption (Section 1.2), production (Section 1.3), trade (Section 1.4), and prices (Section 1.5).
- *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, which is split into Developed and East Asia (Section 2.1) and South and Southeast Asia (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 consumption, production, trade, and prices 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 (Chapter8), 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 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 (2032) relative to a three-year base period (2020-22). The statistical annex is not part of the printed version of the *Outlook* but can be accessed online.

Figure 1.1. Market conditions for key commodities

Current market conditions

Cereal: Global wheat production and stocks have increased, while production of maize and other coarse grains has not been sufficient to meet demand. Rice production was above-average level, while prices remain relatively high. Wheat and coarse grain prices in 2021/2022 were the highest recorded in the past 20 years, but began to fall in late July 2022 as an agreement was reached on the Black Sea Grain Initiative.

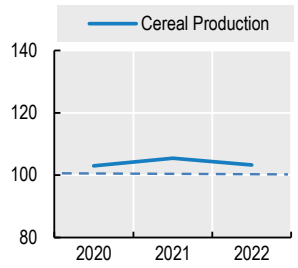
Oilseed: International prices for oilseeds have dropped from the record highs observed in 2022 but remain above average levels of recent years. The price declines were chiefly underpinned by global output recoveries of soybean and rapeseed, despite sunflower seed production losses in Ukraine and reduced prospects for soybeans in Argentina. Global vegetable oil markets saw a steep decline in prices, mainly fueled by improving exportable supplies of palm oil from Indonesia and Malaysia.

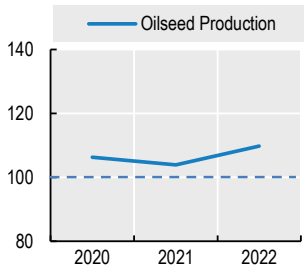
Sugar: Global demand to increase in the current season, although at a slower pace due to slowing economic growth. Despite the recovery in Brazil, the main world sugar supplier, declining production prospects in other key exporters along with high input costs is likely to partly offset the overall downward pressure on international sugar prices.

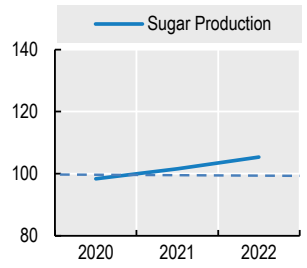
Meat: In 2022, international meat prices remained high, except for sheep meat, which saw a slight decline due to weakened import demand from China. However, various factors such as animal diseases, increasing input costs, and extreme weather conditions acted as obstacles to meat production growth. Despite these challenges, there was an overall expansion in meat production, mainly driven by increased output in Asia, notably a surge in pig meat production in China.

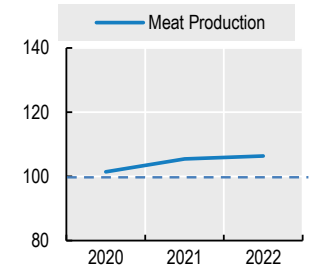
Production index

Average 2013-2022 = 100



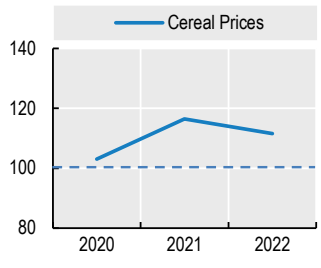


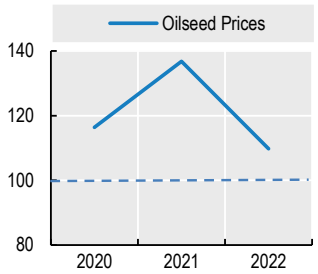


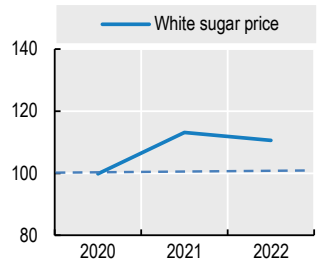


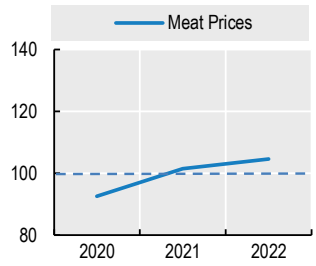
Real Price Index

Average 2013-2022 = 100

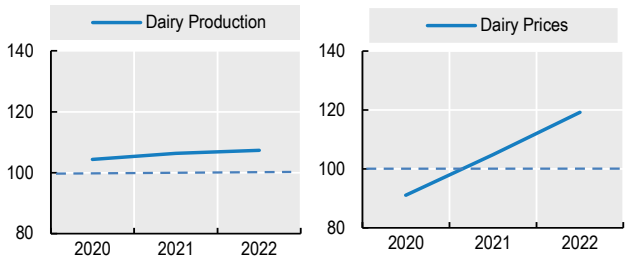




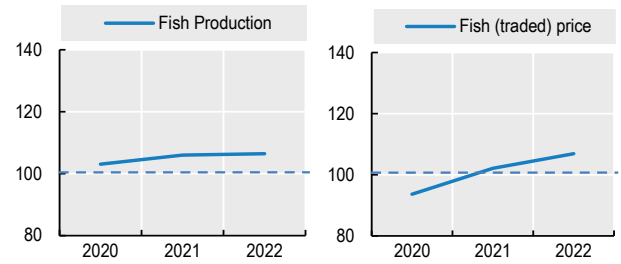




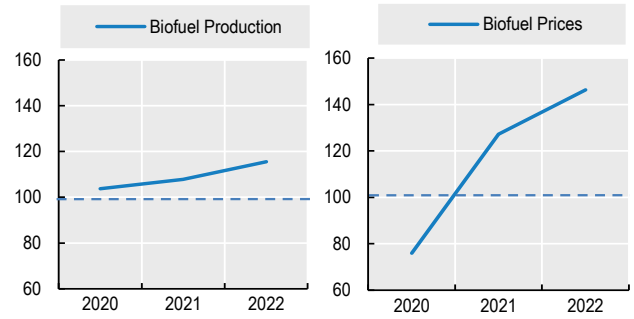
Dairy: International dairy prices increased by 20% in 2022 but started to decline towards the end of 2022. Increasing input cost were one of the main drivers of price increase. Domestic prices often show a slightly different development as only a small share of milk is internationally traded. Milk production increased globally slower in 2022 than in previous years. World trade in dairy products declined, mainly due to lower imports by China.



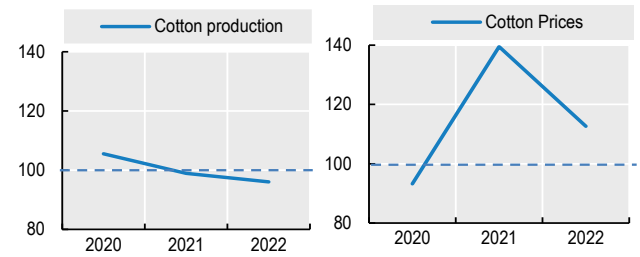
Fish: Fish: After a strong recovery in 2021, world fish consumption continued to expand in 2022 driven by the global economic recovery, while fish production rose only marginally. International fish prices, which had risen significantly in 2021, continued doing so in 2022 driven by increased demand and higher production costs, reaching levels just under the record highs of the early 1990s.



Biofuels: In 2022, biofuels consumption increased, offsetting for the decrease that was caused by the drop of global transport fuel use during the COVID-19 pandemic. The ethanol market nearly came back to levels witnessed in 2019. The biodiesel market recovered as well, but was less affected by the pandemic. Biofuels world prices increased owing to higher production costs of production.



Cotton: In 2022, global consumption decreased in most of the major textile-producing countries as a consequence of economic uncertainty, inflation and high depreciation against US dollar. As a result, international prices dropped in the second half of 2022, after reaching an eleven-year high in May 2022. World cotton production slightly decreased mainly reflecting reduced outputs in the United States and Pakistan.



Note: All graphs expressed as an index where the average of the past decade (2013-2022) is set to 100. Production refers to global production 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 (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.1. Macroeconomic and policy assumptions

1.1.1. The main assumptions underlying the baseline projections

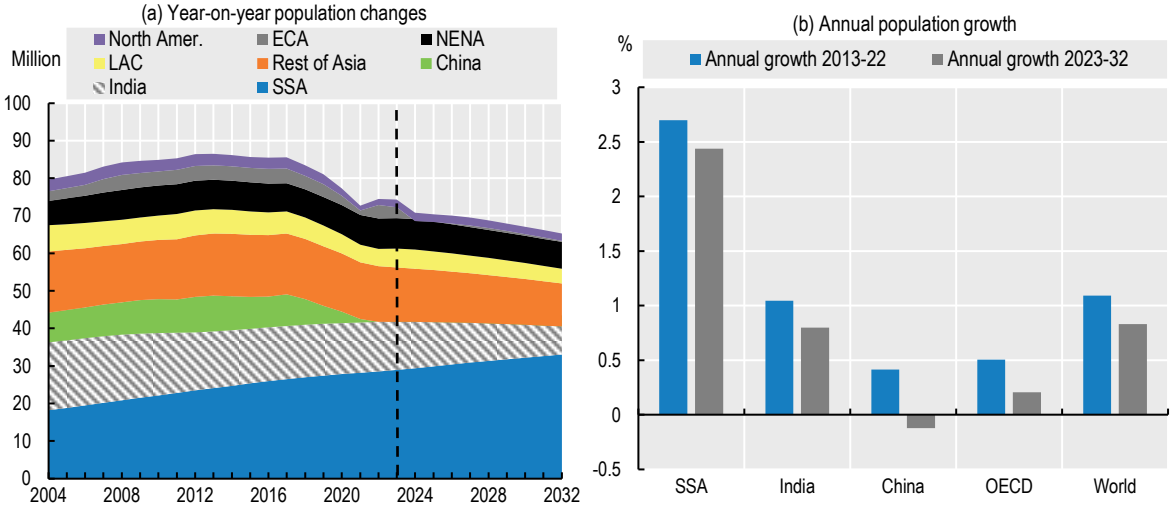
This *Outlook* presents a consistent baseline scenario for the medium-term evolution of agricultural and fish commodity markets, based on a set of macro-economic, policy and demographic assumptions. The main assumptions underlying the projections are highlighted in this section. Detailed data are available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

1.1.2. Population growth

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

Over the projection period, world population is expected to grow from 7.9 billion in 2022 to 8.6 billion people in 2032. This corresponds to an average annual growth rate of 0.8%, a slowdown compared to the 1.1% p.a. rate experienced over the last decade. Population growth is concentrated in low-income countries, particularly Sub-Saharan Africa which is expected to have the fastest growth at 2.4% p.a. over the coming decade. The population of the People's Republic of China (hereafter "China") declined for the first time in 2022 (according to the 2022 Revision of the United Nations *Population Prospects)*and is expected to decline further over the projection period to 1.41 billion inhabitants in 2032. With a population of 1.52 billion people in 2032, India is expected to overtake China in 2024 as the most populous country of the world. The populations of several European countries, Japan, and Korea are expected to decline during the projection period.

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 (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.1.3. GDP growth and per capita income growth

National GDP and per capita income estimates for the coming decade are based on the *IMF World Economic Outlook* (October 2022). Per capita incomes are expressed in constant 2010 United States dollars.

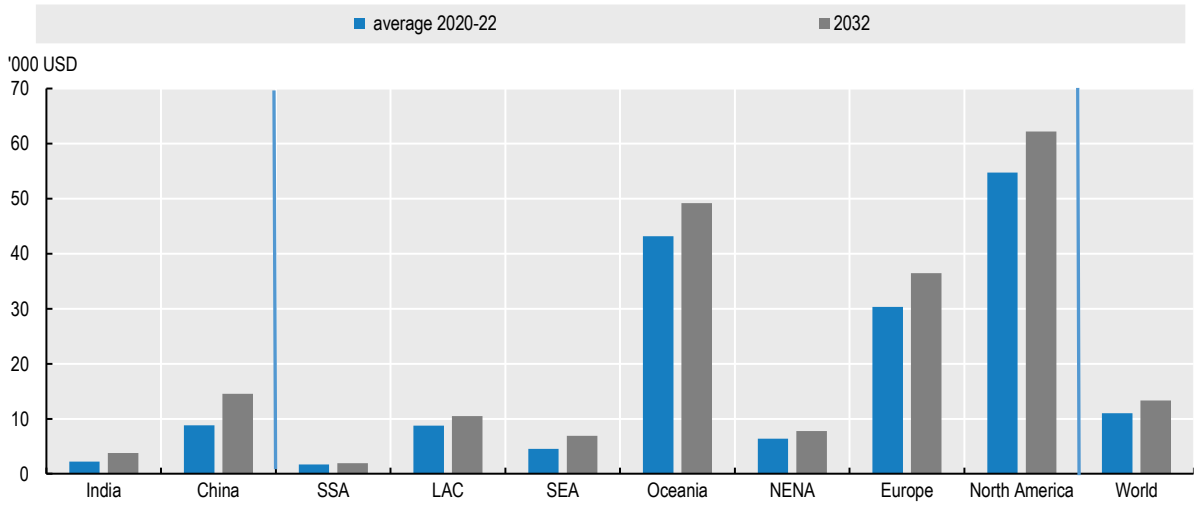
Following a decline from 5.8% in 2021 to 3% in 2022, global GDP growth is expected to continue to slow down in 2023 and to stabilise at an average rate of 2.6% over the next decade. Over the period 2023-32, GDP will continue to grow the strongest in the Asia Pacific region, in particular in India, China and Southeast Asia. In Sub-Saharan Africa, and the Near East and North Africa, average GDP growth is projected to be higher than the global average, whereas that of Latin America and Caribbean and OECD countries is projected to be lower.

National average per-capita income is approximated in this *Outlook* using per capita real 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* 2022 report, national economic growth is unevenly distributed. This is particularly the case with Sub-Saharan countries, where the incomes of the poorest 40% of the population have lagged average income growth. For this reason, national average food demand projections in this *Outlook* can deviate from what might be expected based on average income growth. In addition, the COVID-19 pandemic has deepened income inequalities within countries; the percentage income losses of the poorest are estimated to be double those of the richest, thereby delaying access to high-value food products for the poorest populations whose primary source of calories is derived from staples.

After a recovery in 2021, global per capita income growth was 2% p.a. in 2022 and is expected to weaken in 2023 to 1% p.a. Over the next decade, an average annual growth rate of 1.7% p.a. in real terms is projected. Strong per capita income growth is expected in Asia, especially in Viet Nam (5.6% p.a.), India (5% p.a.), China (4.7% p.a.), the Philippines (4.5% p.a.), Indonesia (4% p.a.), and Thailand (3% p.a.). In Sub-Saharan Africa, average per capita incomes are projected to grow slowly at 1.1% p.a. over the coming decade. Strong population growth limits the real per capita income increase in Sub-Saharan Africa. Ethiopia is expected to experience robust growth at 4% p.a. due to a very low base and increasing economic stability. In Latin America and the Caribbean, average per capita income growth is projected at 1.6% p.a., with smaller regional variations. In the Near East and North Africa region, average per capita income growth is projected at 1.7% p.a., led by the Near East region and Egypt. In OECD countries, per capita income is projected to increase on average at around 1.4% p.a.

Figure 1.3 decomposes the GDP growth projections 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 China. By contrast, high population growth in Sub-Saharan Africa means that the relatively high rate of economic growth in the region (3.6% p.a.) corresponds to only a modest growth in per capita terms (at around 1.1% p.a.). The same applies to a lesser extent to the Near East and North Africa region. The modest economic growth in Europe at 1.5% p.a., where the population is expected to decrease over the next ten years, translates 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 Southeast 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 (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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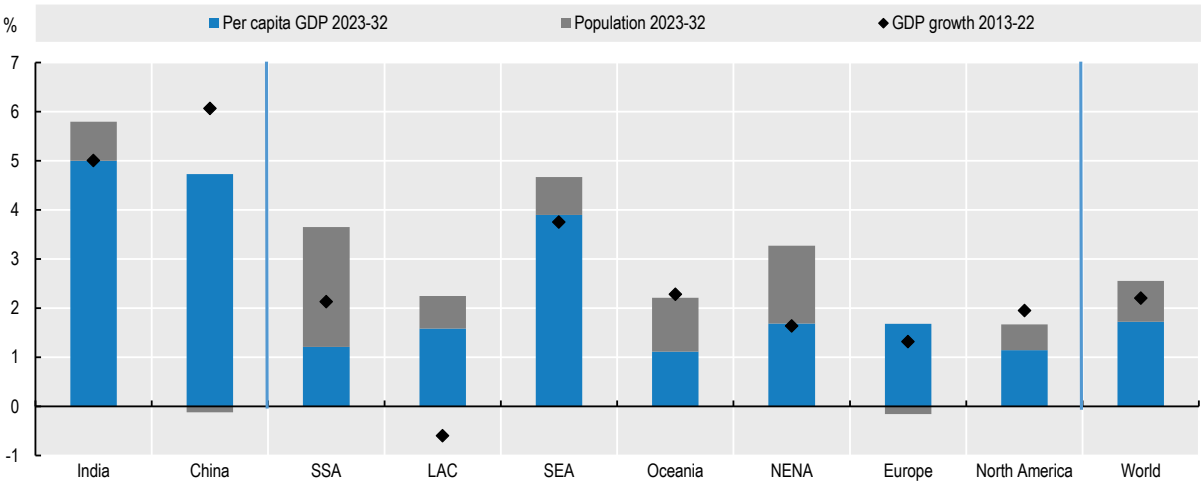
Figure 1.4. Annual GDP growth rates



Note: SSA is Sub-Saharan Africa; LAC is Latin America and Caribbean; SEA is Southeast Asia; NENA stands for Near East and North Africa, and is defined as in Chapter 2.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.1.4. Exchange rates and inflation

Exchange rate assumptions are based on the *IMF World Economic Outlook* (October 2022). Some currencies are expected to appreciate in real terms compared to the United States dollar; this is the case for Brazil, Mexico, Chile, Argentina, and Paraguay, for which exports should be relatively less competitive

on the international markets over the next decade. A very strong real appreciation is also expected in Nigeria, Ethiopia, and Ukraine, whereas a real depreciation is expected for South Africa, Japan, Korea, Norway, Australia, China, and the European Union.

Inflation projections are based on the private consumption expenditure (PCE) deflator from the *IMF World Economic Outlook* (October 2022). Despite high inflation rates in all countries in 2022, projected rates are expected to slow down in 2023 and over the next ten years through tighter monetary policies. In OECD countries, following an inflation rate of 13% in 2022, this is projected to ease at 4.4% p.a. over the coming decade, with an annual inflation rate of 2% p.a. for the United States, 2% p.a. for Canada, and 2.1% p.a. for the Euro zone. Among emerging economies, consumer price inflation is expected to remain high at 10.3% p.a. in Türkiye and 9.1% p.a. in Argentina, despite a strong decrease compared to the previous decade. Inflation should ease in India, from 4.8% p.a. to 3.8% p.a. and in Brazil, from 5.9% p.a. to 3.1% p.a. By contrast, China should experience the same rate of consumer price inflation (2% p.a.) as over the last decade. Inflation is projected to remain high in Sub-Saharan Africa, Ethiopia (12.6% p.a.), Nigeria (9.5% p.a.) and Ghana (6.9% p.a.). High inflation is also expected in Egypt (6.5% p.a.) and Pakistan (6.5% p.a.).

1.1.5. Input costs

Production projections in the *Outlook* incorporate a composite cost index which covers seeds and energy, as well as various other tradable and non-tradable inputs. It is based on historical cost shares for each country and commodity, and 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. Costs of tradable inputs such as machinery and chemicals are approximated by the evolution of the real exchange rate, while the costs of non-tradable inputs (mainly labour) are approximated by the progress of the GDP deflator. Seed prices follow respective crop prices. Fertiliser costs, which are not included in the composite cost index, are explicit in yield and land allocation equations. Three fertiliser types are distinguished: nitrate, phosphate, and potassium. The quantities applied to single crops are decision variables, while prices are linked to crop and crude oil prices.

Historical data for world oil prices are based on Brent crude oil prices in 2021, taken from the short-term update of the *OECD Economic Outlook* N°112 (December 2022). For 2022, the annual average daily spot price in 2022 was used, while the December average daily spot price is used for 2023. For the remainder of the projection period, the reference oil price used in the projections is assumed to remain constant in real terms. After a decrease from USD 98/barrel in 2022 to USD 82/barrel in 2023 (USD 77/barrel and USD 63/barrel respectively in real terms), the oil price is assumed to increase to USD 98/barrel in nominal terms and USD 63/barrel in real terms in 2032.

1.1.6. Policy

Policies play a significant role in agricultural, biofuel, and fisheries markets, and policy reforms may therefore trigger changes in market structures. The *Outlook* assumes that policies currently in place will remain unchanged throughout the projection period, thus providing a useful benchmark for the evaluation and analysis of future policy changes.

The projections of the *Outlook* take into account the reform of the European Union (EU) Common Agricultural Policy (CAP) – which came into force at the beginning of 2023 – as EU Member States have submitted their CAP strategic plans to the Commission. However, several policy initiatives, notably under the European Green Deal and in particular the targets of the Farm to Fork and Biodiversity strategies and for which legislation is in preparation, are not reflected in the baseline because their objectives have not yet been quantified in detail. Therefore, in the case of the EU, only free trade agreements that had been ratified up to the end of September 2022 are considered, while others (e.g. EU-Mercosur) are pending.

The relationship between the EU-27 and the United Kingdom (UK) is based on the EU-UK Trade and Cooperation Agreement provisionally applied from 1 January 2021. A duty-free/quota-free trade relationship between the European Union and the United Kingdom is assumed.

The free trade agreements considered in the *Outlook* for regions other than the European Union are those ratified by the end of December 2022 (e.g. Association of Southeast Asian Nations, United States-Mexico-Canada Agreement (USMCA), African Continental Free Trade Area, Regional Comprehensive Economic Partnership).

The United States Inflation Reduction Act (IRA) of 2022, which includes funds for agriculture-related programs, is not considered in its entirety in the *Outlook* because the implementation of many provisions will not be effective immediately. However, the model considers the fact that the IRA has extended and increased production targets already in place in 2022 for renewable fuel programs and biomass-based diesel tax credits at both the state and federal levels.

1.2. Consumption

The *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), livestock products (meat, dairy, eggs, and fish),[1] and their by-products[2] as food, animal feed, raw materials for biofuels and other industrial uses. The demand for food and non-food uses of agricultural commodities and their changing components is projected based on an assessment of the main driving factors: population dynamics, disposable incomes, prices, consumer preferences and policies. The baseline thereby covers the final use of minimally processed crops, but also includes first level processing, such as the crush of oilseeds and the subsequent use of the derived products as food, feed and biofuel. Accounting for direct feed use of cereals, as well as the use of processed products such as protein meal, fishmeal, cereal bran, and other by-products in the livestock sector allows the *Outlook* to identify the sector's net contribution to human nutrition and to gauge the potential impact of developments on global food and nutrition security.

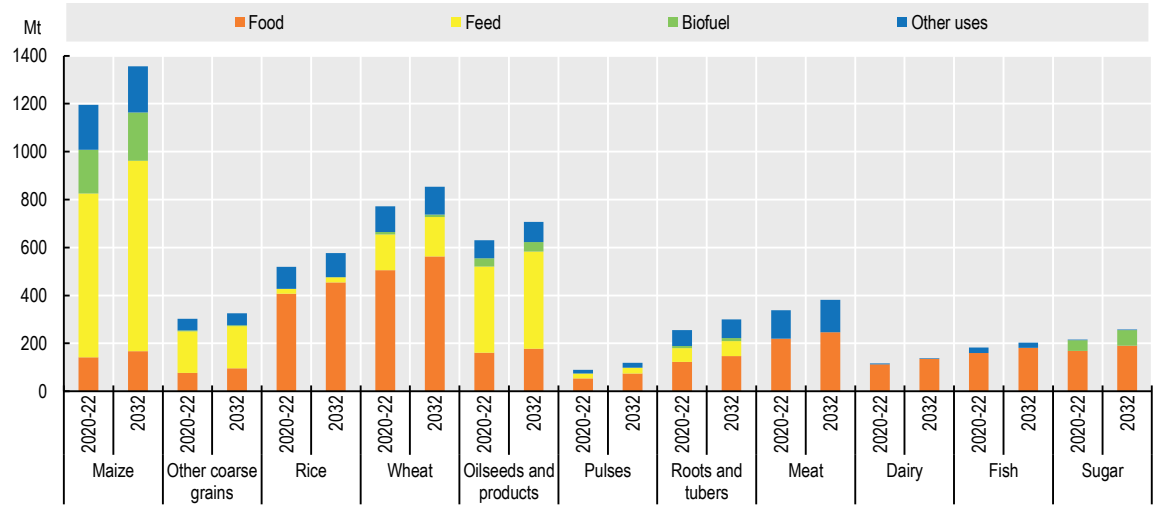
1.2.1. Population and income growth remain key drivers of demand for agricultural commodities

Over the decade to 2032, the evolving energy and nutrition requirements of a growing and increasingly affluent global population are expected to be the key drivers of demand for agricultural commodities. The macroeconomic assumptions underlying the projections suggest a slowdown in global population growth alongside a decline in the population of China. Meanwhile, global economic growth will result in per capita income growth in most parts of the world. Projected rates of inflation are expected to slow down in 2023 and over the next ten years. However, economic developments and their respective impacts will vary by country. Furthermore, while global reference prices are expected to decline slightly in real terms, there is uncertainty how international price signals will transmit to domestic consumer prices and thereby impact demand at the local level. In addition, diverging population dynamics in different countries and regions, income-driven divergences in consumer preferences, and rapid urbanisation in many emerging economies will mean that consumption trends will also vary by country and region. Policy developments and social factors, alongside risks and uncertainties, are similarly likely to affect consumption to differing extents and outcomes at the local level, most importantly as income growth and distribution will continue to remain uneven across and within regions and countries. For example, in low-income countries where the share of food in household expenditures is high, income and food price shocks will have disproportionately larger consequences for consumption than in high-income countries. Preferences shaped by local culture and tradition will continue to lead to differences in demand for agricultural commodities among different regions and income classifications. Health and sustainability concerns are expected to increasingly shape the demand for food in affluent and emerging regions.

Food remains the primary use for basic agricultural crop commodities, currently accounting for 49% of quantities consumed at the global level. However, in recent decades feed and fuel uses have gained in importance. Prominently, growth in the global production of animal products has necessitated a substantially higher allocation of crops to feed, which currently accounts for 26% of total global use. Biofuels and industrial applications, meanwhile, currently consume an estimated 8% of global agricultural crop output.

Amidst a globally rising production of animal products over the *Outlook* period 2023-2032, growth in the non-food use of crops is expected to continue to outpace growth in food use, due to intensifying livestock practices and increasing demand for biofuel. Growth in feed use will be particularly pronounced in maize and oilseeds, the two foremost feed components (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 sugar beet, converted into sugar equivalent units.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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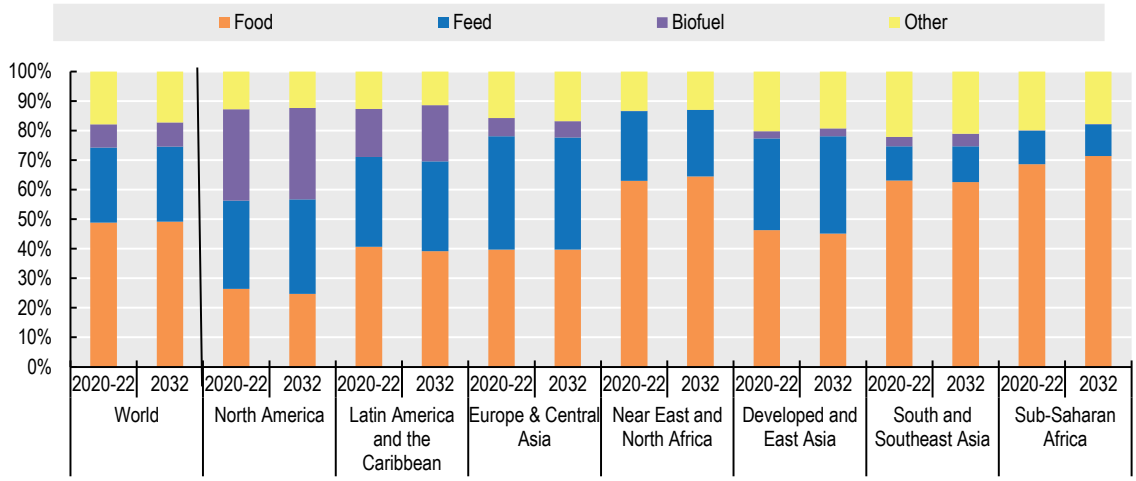
1.2.2. Geographic differences in using agricultural commodities

The use of agricultural commodities varies substantially by country and region (Figure 1.6). Most strikingly, the share of food use in Sub-Saharan Africa has remained above that of all other world regions, accounting for 69% of total use of agricultural commodities at present. This share is predicted to rise to 71% by the end of the *Outlook* period, as population growth is expected to have a larger effect on agricultural commodity demand than income growth, resulting in a larger expansion in the consumption of staple foods than of animal products across the region. At the other end of the spectrum is the distribution of agricultural commodities in North America, where food accounts for only 26% of total use, less than the share of feed or biofuels. The size as well as the feed-intensive production technology of the region's livestock sector require a high use of agricultural commodities as feed. Increases in the feed use of agricultural commodities are also expected in Latin America and the Caribbean and the Near East and North Africa regions over the *Outlook* period, in part due to growth in production to satisfy the income-driven growth in the domestic consumption of animal products, but more importantly due to meat export growth.

Figure 1.6. Use of agricultural commodities by type and region



Note: the shares are calculated from the data in calories equivalent.
Source: FAO (2023). FAOSTAT Food Balances Database, http://www.fao.org/faostat/en/#data/FBS; OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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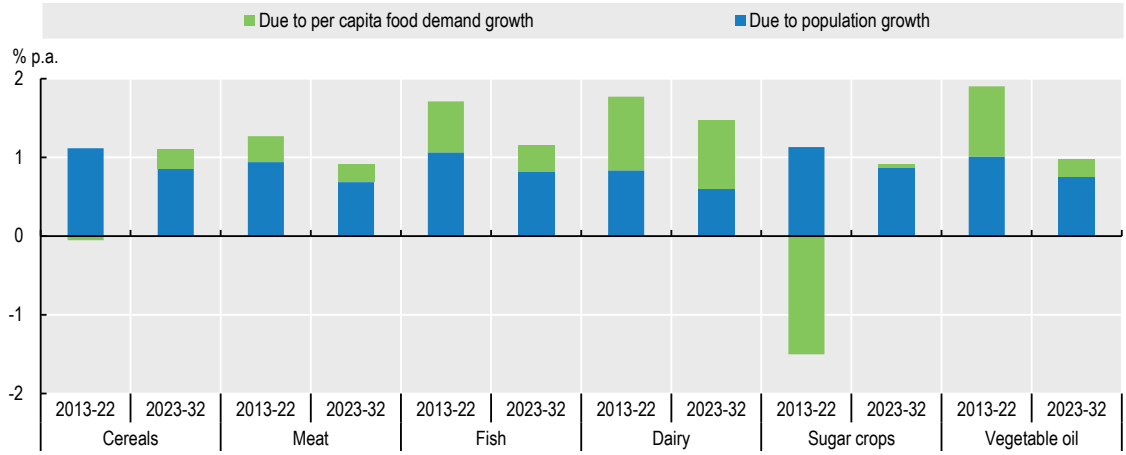
1.2.3. Key drivers of food demand for agricultural commodities

Under the baseline assumptions, population growth will continue to be the main factor shaping food demand at the global level, driven predominantly by the increasing consumption requirements of rising populations in Sub-Saharan Africa, India and the Near East and North Africa region. The projected developments in the global use of staples and fish will primarily be determined by population growth, while consumption growth of higher value products, especially fresh dairy, meat, and sugar will to large extent be fuelled by income-driven growth in per capita consumption (Figure 1.7). However, based on demographic and economic projections, global consumption of agricultural commodities, with the exception of sugar, is expected to expand less rapidly over the *Outlook* period than over the previous decade.

Figure 1.7. Average annual growth in demand for key commodity groups, 2013-22 and 2023-32



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 food demand.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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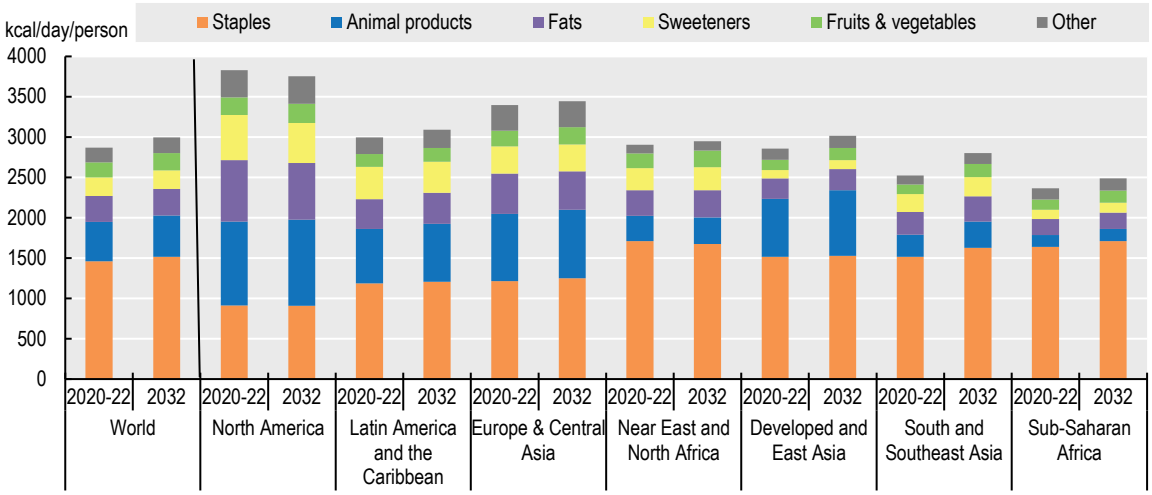
1.2.4. Global outlook for food use of agricultural commodities

Due to the increase of the global population as well as gains in per capita income in all regions, total consumption of the food commodities covered in this *Outlook* is expected to rise by 15%. Overall, Asia will continue to play the most significant role in shaping global demand for food over the outlook period (Figure 1.9). The projected population increase in India as well as significant growth in per capita incomes in both India and China are expected to contribute significantly to growth in the consumption of all food commodities covered in the *Outlook*.

Global consumption of staples, the most significant source of calories, is expected to increase by 4% from the base period and account for just over half of total global food consumption in 2032, as measured in terms of daily per capita calorie availability (Figure 1.8). Since demand for staple foods is predominantly driven by population growth, the largest expansion in the consumption of staples is expected to take place in regions with the highest expected population growth. As such, the global consumption of staples will increase most importantly in Asia (lead by India), Sub-Saharan Africa, and the Near East and North Africa region.

However, globally, the growth of overall cereal demand, the most important staple, is expected to be slower over the next decade than it was in the past decade due to slowing growth in feed demand, biofuels, and other industrial uses. Moreover, in many countries direct human per capita food consumption of most cereals is approaching saturation levels, thus constraining gains in overall demand. Particularly in North America and Western Europe, per capita food use of cereals is expected to be stagnant, or even declining, due to low population growth and consumer preferences moving away from staple commodities.

Figure 1.8. Contribution of food groups to total daily per capita calorie food consumption by region



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 include 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 includes other crop and animal products.
Source: FAO (2023). FAOSTAT Food Balances Database, http://www.fao.org/faostat/en/#data/FBS; OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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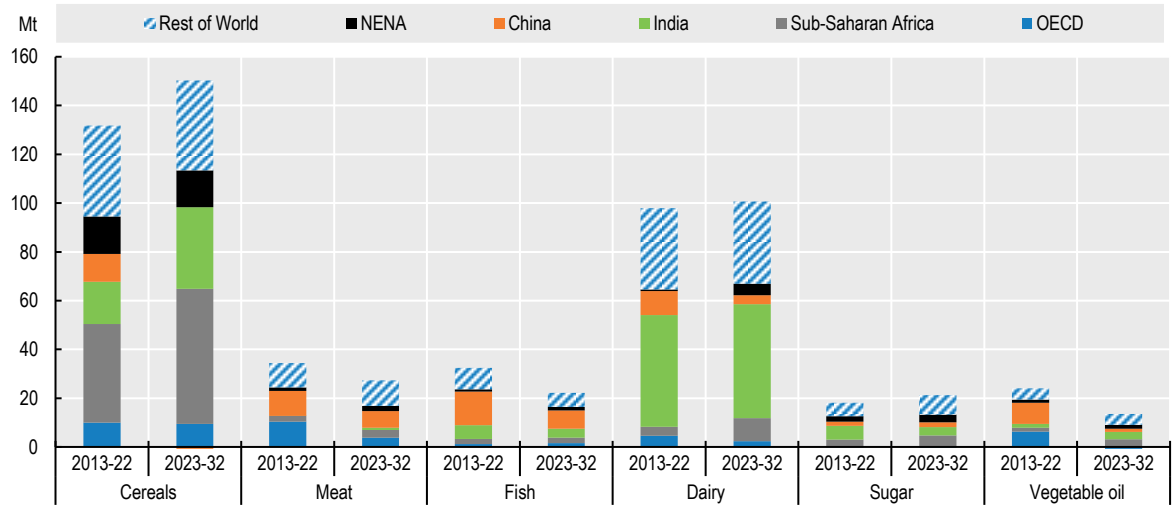
Global consumption of higher value food will primarily expand in response to rising incomes in emerging markets in Asia, where approximately half of the increase will come from higher demand for meat and fish in China (Figure 1.19). India will account for most of the consumption growth for fresh dairy products and an important share of additional consumption of vegetable oil and sugar. In North America and Europe, income growth will similarly reduce per capita demand for basic foodstuffs, in particular for cereals, and thus facilitate a shift in consumption towards foods of higher nutritional value, most importantly in items that are dense in micronutrients such as fruits, vegetables, seeds, and nuts.

Figure 1.9. Regional contributions to food demand growth by region, 2013-22 and 2023-32



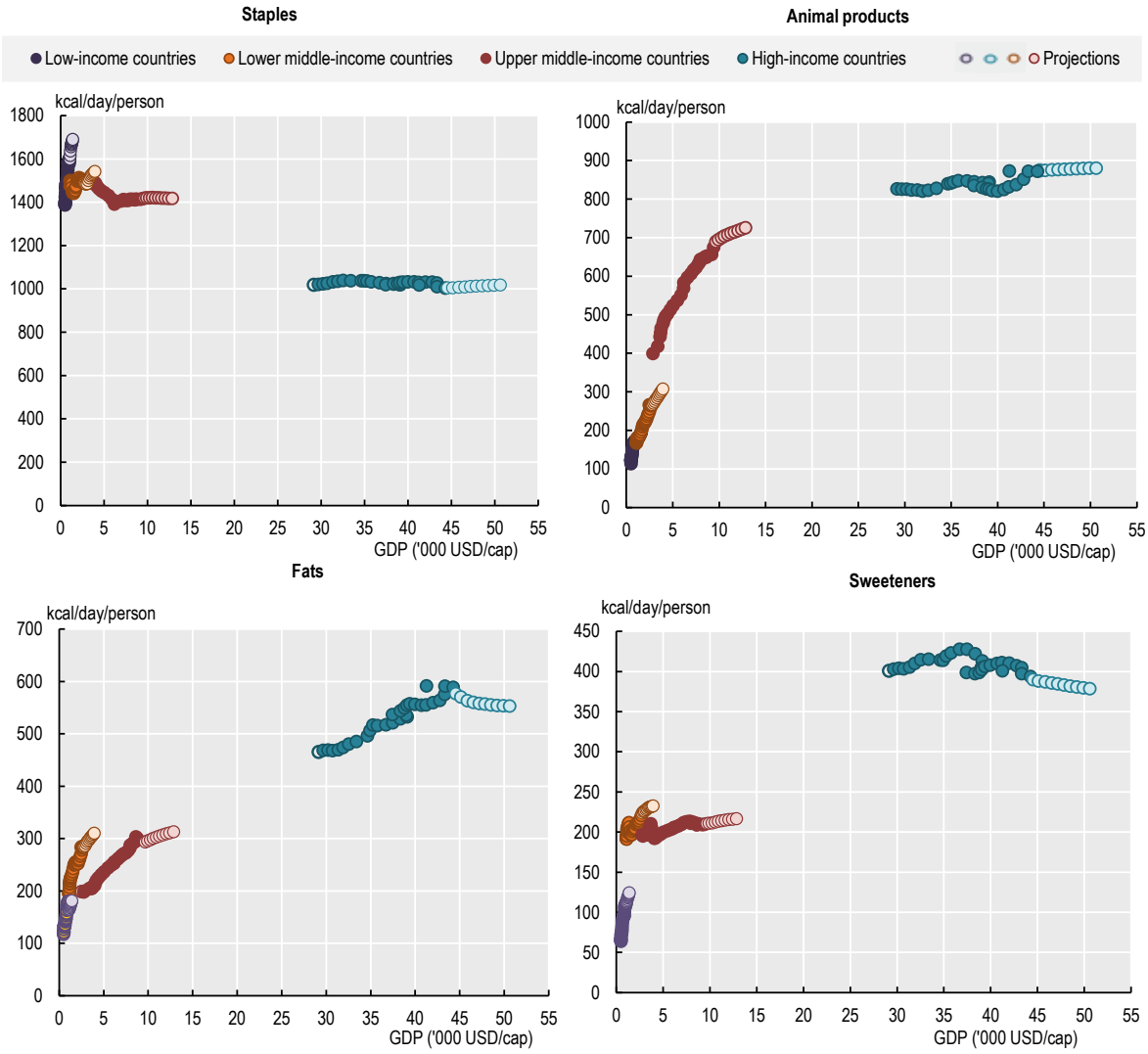
Note: Each column shows the increase in global demand over a ten-year period, split by region, for food uses only. NENA stands for Near East and North Africa, and is defined as in Chapter 2.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

The consumption projections reflect varying developments in per capita incomes and their respective impact on food consumption patterns (Figure 1.10). As income rises, food consumption of the various food groups tends to increase rapidly, leading to a higher consumption of calories overall. At a certain income level, however, growth in food consumption begins to slow down. The level of income at which this takes place as well as the pace of the slowdown vary by food group. For example, the responsiveness of consumer demand to changes in income remains higher for animal products and some other higher priced items than for staple products.

In line with this, in high-income countries, per capita consumption of most food commodities is expected to level off due to saturation. Per capita consumption of sweeteners and fats are projected to decline over the coming decade due to growing health concerns and policy measures that discourage their excessive consumption.

In middle-income countries, the evolution towards the dietary patterns of high-income countries away from staples is expected to continue, with the consumption of animal products projected to increase at fast pace. Low-income countries, meanwhile, will continue to obtain most of their calories from staples. Due to income constraints, low growth in the consumption of animal products and other higher-value foods (e.g. fruits and vegetables) is expected in low-income countries.

Figure 1.10. Evolution of daily per capita calorie consumption, by food groups and income level



Note: Per capita consumption beyond 2032 is extended based on trends. The 38 individual countries and 11 regional aggregates in the baseline are classified into 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.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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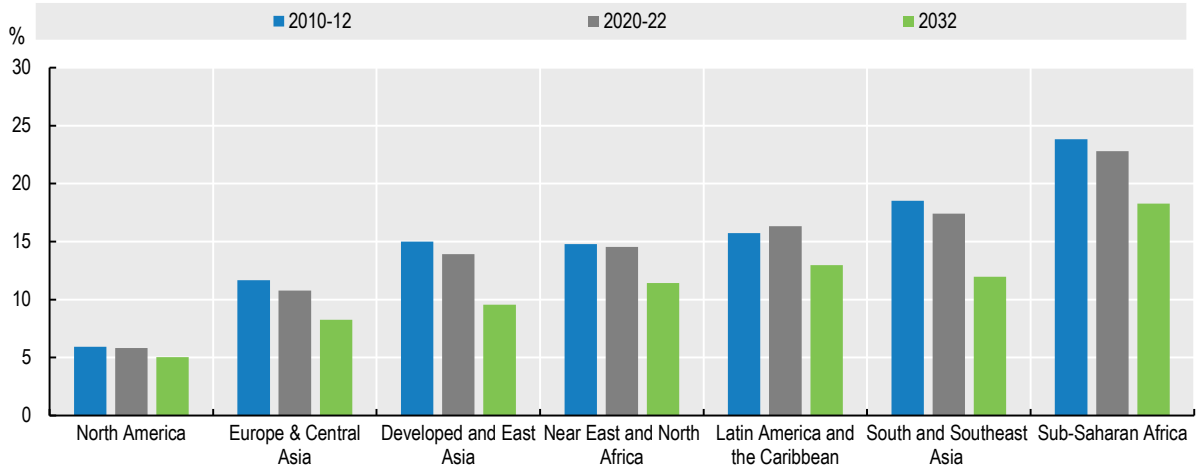
1.2.5. Share of income spent on food continues to fall in emerging economies, but remains high in Least Developed Countries

The share of disposable household income spent on food is expected to continue to fall in all regions (Figure 1.11), with the largest declines foreseen in the emerging economies in Asia. Average expenditures on food are projected to fall to 10% of total household expenditures in Developed and East Asia by 2032, from 14% in the base period 2020-2022, and from 17% in the base period to 12% in 2032 in South and Southeast Asia.

In Sub-Saharan Africa, a similar development is expected but the region remains with highest share of food in household expenditure at 18% in 2032 (Figure 1.11). Particularly in the least developed countries of the region, the share of food in household expenditures is set to remain high, reflecting a vulnerability of households to income and food price shocks in the most food insecure countries.

Figure 1.11. Food as a share of household expenditures by region



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.2.6. Accounting for loss and waste along the food value chain

Another issue of increasing concern to the efficiency of the global food system are food losses along the value chain including food wasted in households and retail establishments. Across the globe, approximately 14% of the world's food, valued at USD 400 billion is lost on an annual basis between harvest and the retail market. At the same time, an estimated further 17% of food is wasted at the retail and consumer levels. Reducing food loss and waste is a significant lever for broader improvements of food systems' outcomes, including improving food security and sustainability as well as increasing efficiency. Box 1.1 examines the current and projected state of food loss and waste along the value chain at the retail stage and by households.

Box 1.1. Food loss and waste: Definitions, global estimates and drivers

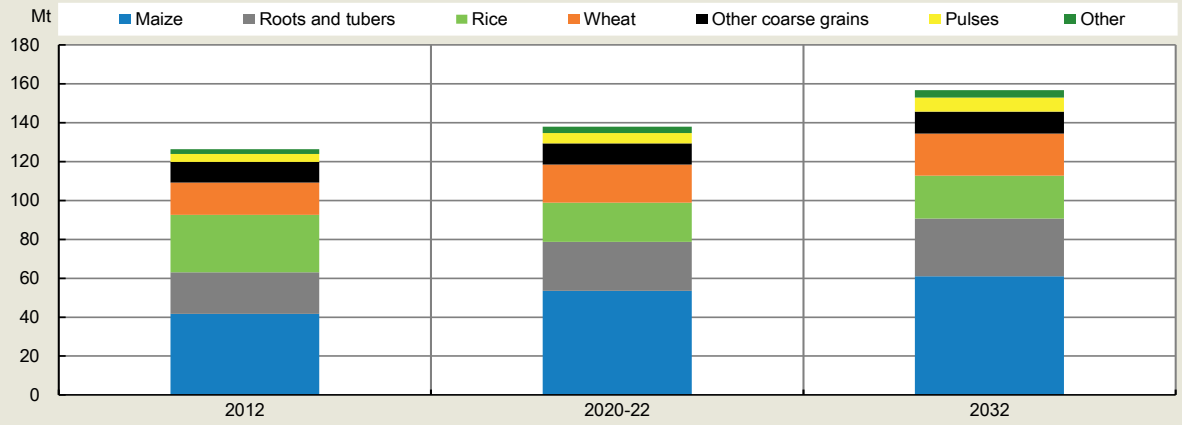
Literature provides several definitions of food loss and waste (FLW), which complicates the analysis thereof (FAO, 2019[1]). Food waste and losses include plants and animals produced or harvested for human consumption but not ultimately consumed by people (Lipinski et al., 2013[2]); this excludes materials for non-food purposes such as crops for biofuels (FAO, 2011[3]) (FAO, 2019[1]). Since agricultural produce is classified as food when it is ready to be harvested or slaughtered, yield losses resulting from weather events or diseases are excluded (Beausang, Hall and Toma, 2017[4]). Some studies have defined these terms relative to the stage at which the loss or waste occurs in the food value chain (Figure 1.14). Studies by the FAO (2011[3]); (Kummu et al., 2012[5])and (Parfitt, Barthel and Macnaughton, 2010[6])have highlighted that food is *lost* at the early stages of the value chain, specifically at primary production, post-harvest, and processing, while food is *wasted* at a later stage, in retail and consumption by end-consumers. Food that was intended for human consumption but is diverted to animal feed is excluded from the

definition (waste) where the animals remain part of the food value chain (Beausang, Hall and Toma, 2017[4]).

Although the definitions provided by the literature differentiate between food loss and waste, there is not one database that measures food loss or waste separately over time. Moreover, the available data does not explicitly distinguish between food loss and food waste. Food loss or waste data is mostly presented as a percentage loss or in quantity (tonnes). Most literature providing FLW estimates contains data from 2005 onwards, with the most publications only post-2015. According to The State of Food and Agriculture report by the (FAO, 2019[1]) only 39 countries have officially reported FLW data on an annual basis between 1990 and 2017. Case studies may cover losses at specific nodes in the value chain, but these differ from case to case. The UNEP Food Index Report (2021[7]) and the Sustainable Development Goals (SDG) Report (2022) prepared by the FAO are examples of sources that provide global estimates for FLW. According to the UNEP (2021[7]), global food waste amounts to 931 Mt per annum – generated from households (61%), and the distribution (26%) and food service industries (13%). According to the SDG Progress Report (2022), global food loss remained stable from 2016 to 2020, with substantial variations across regions and subregions. The percentage of food lost in 2020 was 13.3%, compared to 13% in 2016 (FAO, 2022[8]).

Figure 1.12 presents losses along the value chain for major crops. Total value chain losses of major crops are estimated at 137.9 Mt in the base period and are estimated to increase up to 157 Mt by 2032.

Figure 1.12. Global staples and other field crop losses along the value chain



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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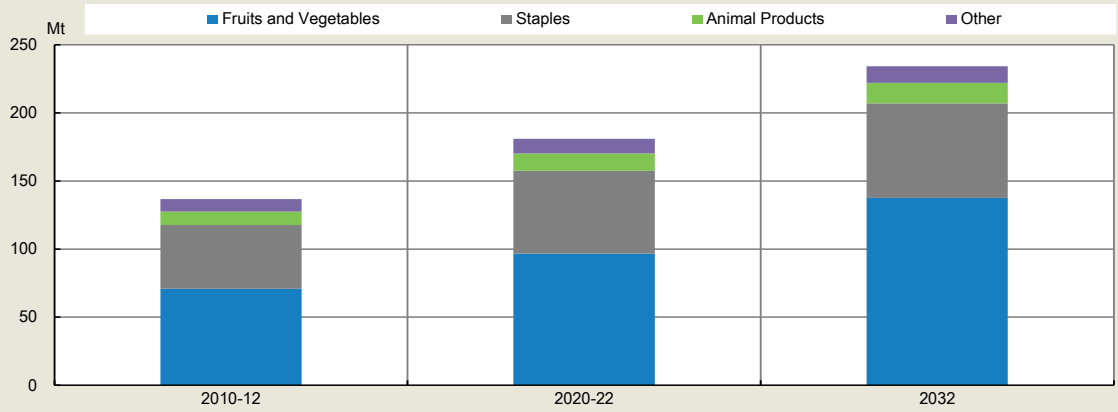
Figure 1.13 illustrates retail waste of major food commodities. Fruits and vegetables contribute more than half of total distribution waste. Rice and wheat as major staples contribute also substantially to total distribution waste (22% during the base period), which is estimated to increase from 180 Mt in the base period to 234 Mt by 2032.

Literature broadly accounts for six main factors that generate food loss and waste. These are: economic factors, e.g. globalisation, urbanisation, industrialisation, increasing incomes and consequently dietary transitions; post-harvest losses and value chain inefficiencies in the form of limited access to infrastructure, technology and markets; marketing specifications, including product quality and retailer standards; natural or environmental factors, e.g. climate change and perishability of products; legislation, e.g. agricultural and food safety policies; and technical inefficiencies, poor management, planning and handling.

Figure 1.13. Global distribution waste



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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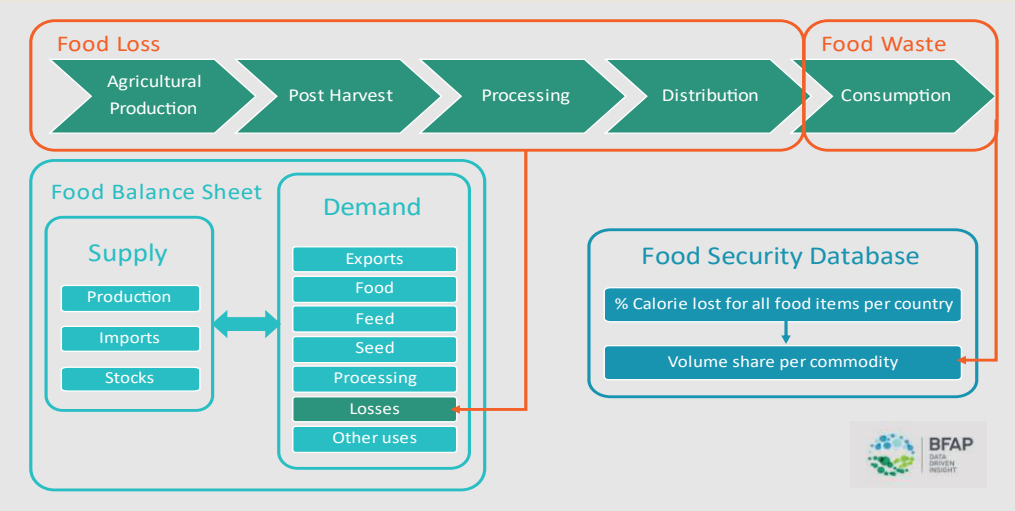
In order to account for food losses and waste, the first step was the compilation of a database trough that combined existing FLW data sources. Figure 1.14 illustrates how the losses quoted in the FAO food balance sheet database (FBS) relate to the definitions of food loss and waste throughout the food value chain as discussed above. The losses set out in the FBS are assumed to cover all food loss up to the retail point of the food value chain.

Figure 1.14. Food loss and waste along the food value chain



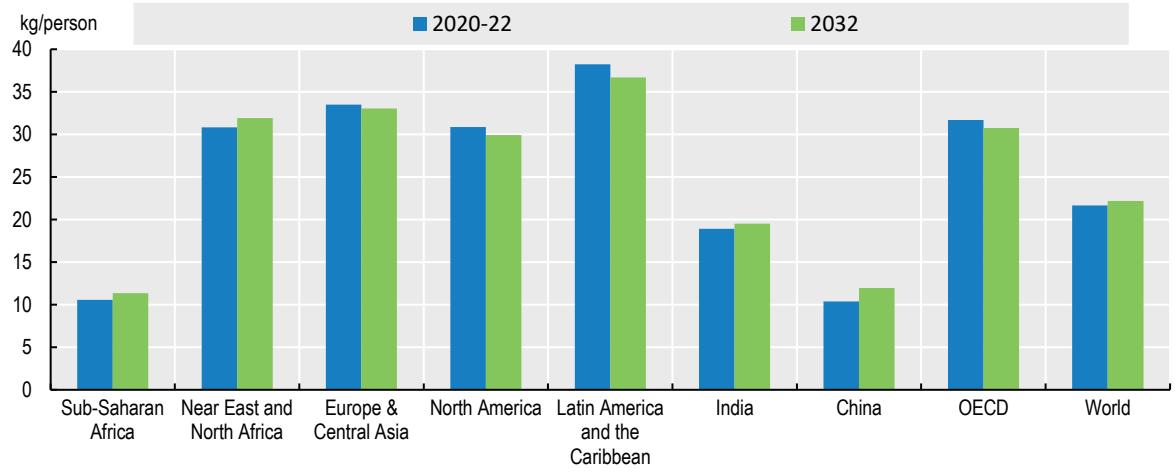
Different approaches were used to estimate the share of food losses and waste at the distribution level. For each food group, we derived an equation relating food loss share to relevant macroeconomic variables (selected to represent drivers of food loss identified in literature) to estimate a share of food loss for each country.

The FAO Food Security database includes a percentage of total calories lost of all food items per country. This was used to estimate the consumption waste share for each commodity using the study by Oelosfe et al. (2021[9]) *to "translate" the total calorie loss share per food item to a food waste volume share per food group.*

1.2.7. Developments in sugar consumption

World sugar consumption is expected to continue to rise primarily in regions with significant population growth, notably Sub-Saharan Africa, Asia and the Near East and North Africa region (Figure 1.15). In high-income countries a decline in per capita consumption is projected, reflecting rising health concerns among consumers and measures implemented by countries to discourage sugar consumption. The pace of growth in consumption is expected to slow down in nearly all regions compared to the previous decade.

Figure 1.15. Evolution in per capita food consumption of sugar, by world region, 2020-22 to 2032



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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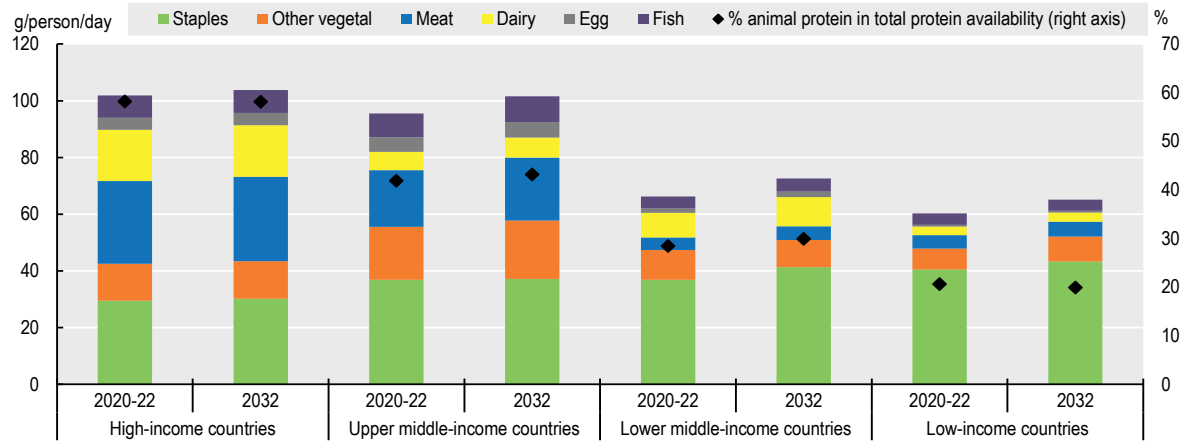
1.2.8. Developments in protein consumption

In response to changing dietary preferences among increasingly affluent and health-conscious consumers in high-income and emerging countries, total per capita availability of protein sources is expected to rise at the global level to 88.4g per day in 2032, from 83.9g per day in the base period. However, regional differences in the composition of protein sources will persist, with Sub-Saharan Africa and the Near East and North Africa region expected to remain heavily dependent on proteins from crop sources, given their substantially lower average household incomes (Figure 1.16). Protein from animal sources will continue to account for the bulk of protein consumption in the high-income regions of North America, Europe, and Central Asia.

About two-thirds of meat is expected to be consumed by one-third of the world's population in 2032, which is only a slight improvement from the base period. The high per capita use in high-income countries is the main reason for this. In some countries such as China, despite per capita consumption being comparatively low, total meat consumption will be substantial given their large population sizes (Figure 1.17).

Over the outlook period, animal proteins are expected to make further advances in their contribution to total daily per capita availability due to rising per capita incomes globally. Growth in animal protein consumption will be particularly pronounced in Asia and the Latin America and Caribbean region, where daily per capita meat and fish availability is expected to rise by 11-13% and 6-4%, respectively. Income-driven growth in consumption of meat and fish in China, which is respectively expected to see an 12% and 14% total increase in daily per capita availability by 2032, will be the main contributor. However, regarding the projected increase in meat consumption in China, it is important to note that this will be from a lower base following the recent shock caused by the outbreak of African Swine Fever.

Figure 1.16. Contribution of protein sources to total daily per capita food consumption



Note: Staples include cereals, pulses, and roots and tubers.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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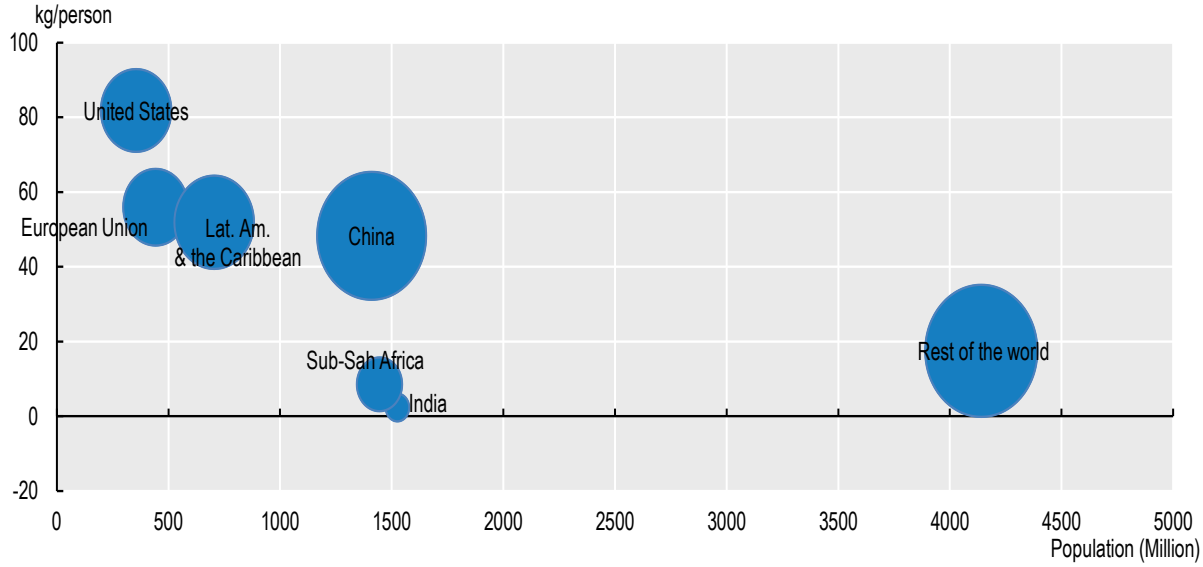
Figure 1.17. Meat consumption in the largest consuming countries, 2032



Note : The size of the bubbles represents total meat consumption (Mt).
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Overall, growth in global average consumption of meat is expected to increase by 2.5% over the outlook period, amounting to an increase of 0.7 kg/per capita/year in boneless retail weight equivalent, to reach 29.5 kg/year by 2032. Consumption growth in middle-income countries, as outlined above, will account for a significant share of this increase. However, against high and rising consumer expenses and weaker income growth, the *Outlook* expects growth in global meat demand to be slower than over the last decade. Expenditures on meat constitute a sizeable share of the food basket in middle- and high-income countries. In view of strong inflationary pressures and reduced purchasing power, consumers are expected to

increasingly shift their spending towards cheaper meats and meat cuts, as well as potentially reduce their overall consumption and out-of-home consumption of meat.

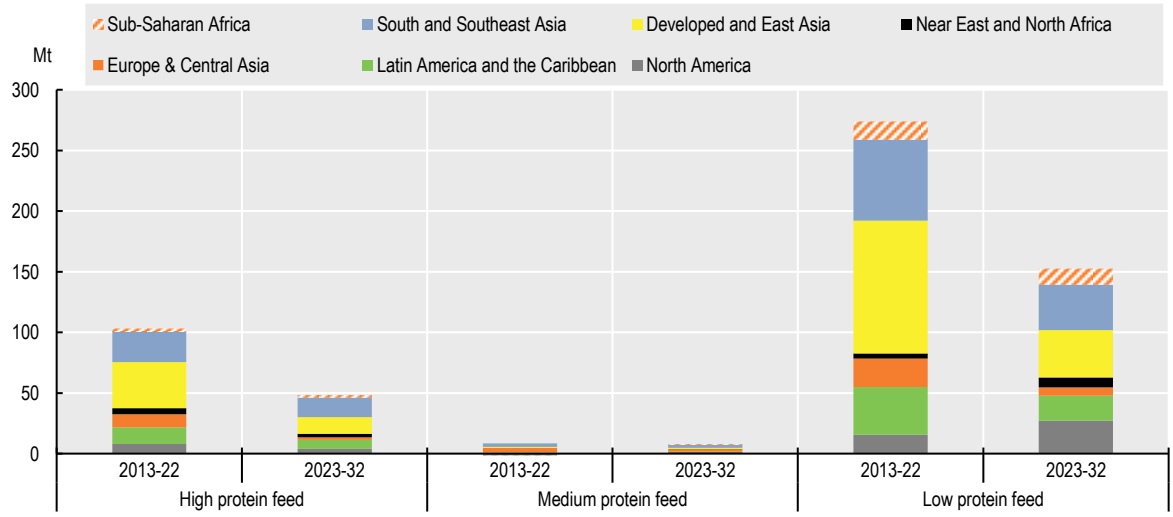
In terms of substitution between meat and aquatic foods, mounting environmental and health concerns are expected to continue to shift consumer preferences away from red and processed meat, notably beef, towards leaner and allegedly more environmentally friendly alternatives, notably poultry and fish. These shifts will be particularly pronounced in Europe and North America. Demand for poultry in Sub-Saharan Africa will be primarily driven by the higher affordability of poultry compared to beef.

1.2.9. Global outlook for feed use of agricultural commodities

Demand for feed is driven by two factors: the number of farm animals and the feed use per animal. Over the projection period, the expanding animal herds and the continuing intensification of the livestock sector will drive an increase in feed demand in most world regions (Figure 1.18). Low- and middle-income countries are expected to account for the bulk of the increase as moderate to strong growth in feed consumption is projected over the coming decade, in line with or exceeding the growth in animal production, as these countries move to more commercialised and feed-intensive production systems. Particularly in Southeast Asia, increasing animal production is projected to raise demand for mostly imported protein meal. By contrast, demand growth in China is expected to slow down considerably, driven by improved feed efficiency combined with efforts to achieve lower protein meal shares in livestock feed rations.

In high-income countries, higher production efficiency resulting in herd reductions, especially in dairy production, means feed consumption of both protein meal and cereals is expected to grow slowly as improvements in animal genetics, feed technology and herd management will continue to generate substantial efficiency gains in livestock and dairy production. Notably in the European Union, the second-largest user of protein meal, consumption is expected to decline as growth in animal production slows and other protein sources are increasingly used in feed (Figure 1.19).

Figure 1.18. Feed demand by component and by region, 2013-22 and 2023-32



Note: Low protein feed includes maize, wheat, other coarse grains, rice, cereal brans, beet pulp, molasses, roots and tubers. Medium protein feed includes dried distilled grains, pulses, whey powder. High protein feed includes protein meal, fish meal, and skim milk powder.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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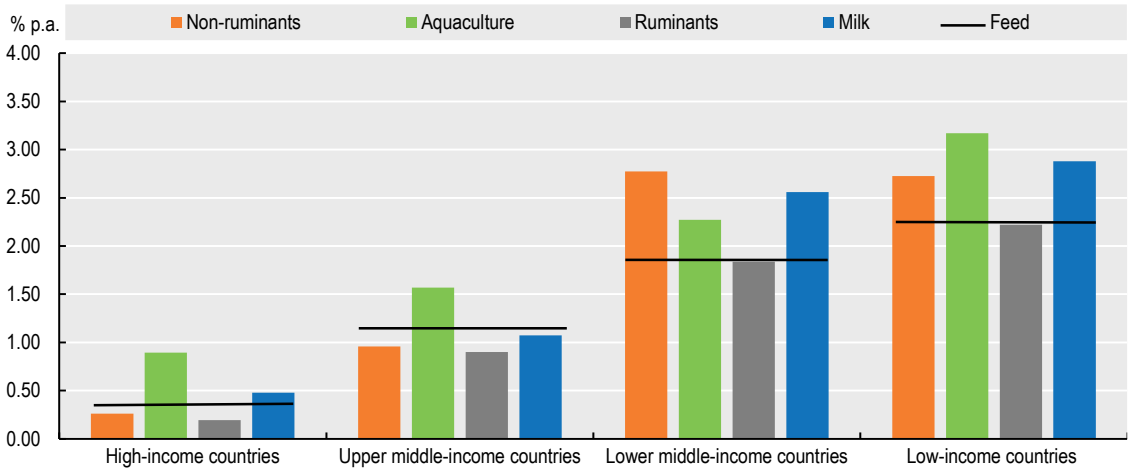
Figure 1.19. Annual change in feed use and in livestock production, 2023-2032



Note: Ruminants include beef and veal and sheepmeat. Non-ruminants include poultry and pigmeat. The bars show annual changes in production volumes for the different livestock products. The black line shows annual changes in feed use.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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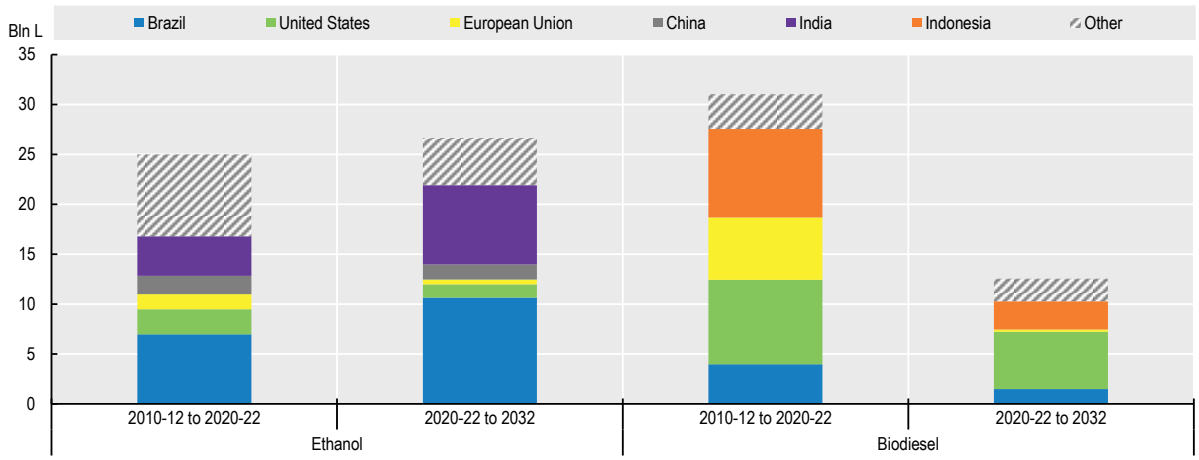
1.2.10. Global outlook for industrial use of agricultural commodities

Biofuels have become the dominant industrial use of agricultural commodities in recent years. Their production uses cereals and sugar crops, but also processed products such as molasses and various vegetable oils. Demand for biofuels is largely determined by transport fuel demand and domestic support policies. Over the next decade, global biofuel use is projected to continue to expand substantially, driven mainly by additional demand for biofuels in middle-income countries, where higher blending rates are being implemented, supported by subsidies for domestic production and blended fuel use (Figure 1.20). A substantial increase in biodiesel production in the United States due to increasing targets and the increased application of state and federal renewable fuel programmes and biomass-based diesel tax credits (under the IRA of 2022) will further generate additional demand. By contrast, in other high-income countries, notably in the European Union, demand growth will be constrained by declining transport fuel demand and reduced policy incentives. In the European Union, the RED II (Renewable Energy Directive) has classified palm oil-based biodiesel in the high ILUC (Indirect Land Use Change) risk category. As a result, the use of palm oil-based biodiesel is expected to decrease, thereby slightly reducing total biodiesel use in the European Union. Nevertheless, the share of biodiesel in total diesel use is expected to grow over the coming decade.

Transport fuel consumption is expected to expand in Brazil, Argentina, Colombia, and Paraguay over the coming years, with ethanol and biodiesel usage projected to increase accordingly. Indonesia's diesel use is set to rise and the blending rate is assumed to stay above 30% (B30). In South and Southeast Asia, biodiesel is expected to become more popular due to the growth in transport fuel demand and for industrial use. In India, sugarcane-based ethanol is projected to contribute significantly towards the goal of achieving an ethanol blend rate of 16% by 2025, whereas the E20 target should be met by 2032.

Agricultural commodities are also used as feedstock for other industrial applications, including in the material (plastic, clothing, paint), bio-chemical, and bio-pharmaceutical industries. “Other” uses, mostly industrial applications of agricultural commodities for commercial production such as grains for industrial starch production, have become increasingly important in recent years and are expected to gain importance in absolute terms.

Figure 1.20. Changes in biofuel consumption in key consuming countries



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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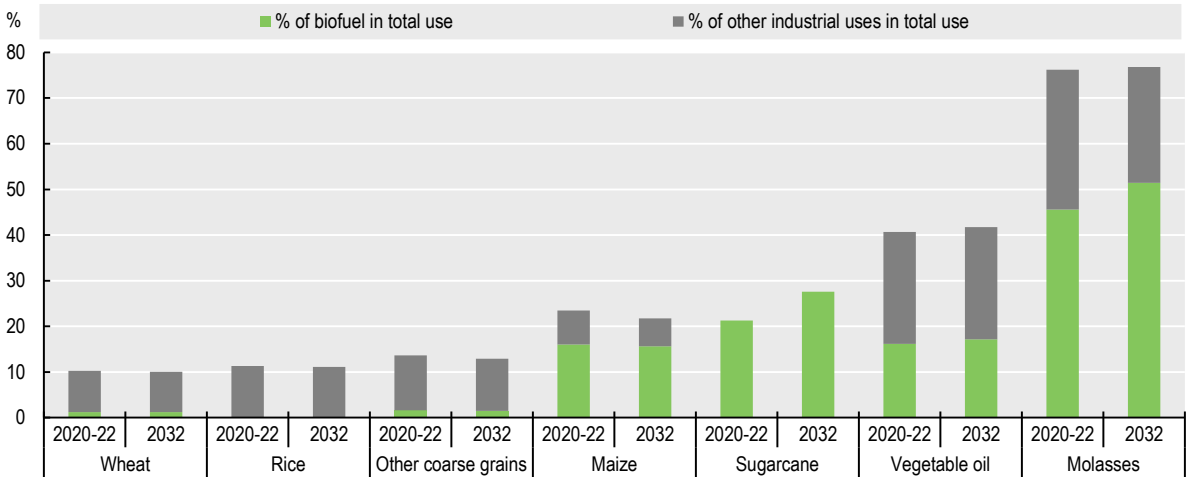
Figure 1.21. Share of biofuel and other industrial uses in total use of agricultural commodities



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.2.11. Uncertainties affecting global demand for agricultural commodities

The medium-term projections presented in the *Outlook* assume a fast recovery from inflationary pressures, no change to policies in place, and an on-trend evolution in consumer preferences over the coming decade. These assumptions introduce some uncertainty into the projections of agricultural commodity demand.

Aside from conflict and geopolitical tensions, at present the most severe threat to the consumption of agricultural commodities – and the consumption of food in particular – is posed by the adverse economic repercussions of persistently high inflation rates and a potential global recession. At the time of writing, global reference prices in real terms were expected to decline slightly over the coming decade; however, consumer prices may spike in response to severe economic, political or environmental events, as further

described in the prices section. Uncertainty further arises from the fact that many additional factors along the food value chain may contribute to food price inflation, including market power in the processing and retailing sectors. The war in Ukraine has demonstrated its global economic implication and potentially threatens the proper functioning of local and global food systems. Coupled with other uncertainties such as climate change, the negative ramifications of all these factors for global economic growth may result in a global recession, suggesting that the income growth projections underlying the *Outlook* may not materialise. In this regard, the reduced prospects would likely result in a downward adjustment in global food demand, with different adjustment for different commodities. Furthermore, the last revision of the UN's population projection resulted in a downward revision of population growth in some countries (e.g. China), and while not significant, does point to the possibility of lower-than-expected population growth in the future, with direct implications for lower growth in global demand for food. Income and food price shocks, especially in countries where the share of food in expenditures is high, pose an additional threat, as does the risk of further disease outbreaks that may disrupt human health or the production of agricultural commodities.

Mounting environmental and health concerns, as well as animal welfare concerns, are expected to increasingly influence consumer choices and to drive growing demand for higher value items, such as poultry, fish, fruits, vegetables, nuts and seeds, as well as for alternative food stuffs, such as dairy alternatives, gluten free foods, and vegan meat substitutes. These ongoing developments could have a significant impact on agricultural commodity demand in the future, especially regarding the consumption of products with large environmental footprints or purportedly adverse health effects, such as palm oil, cotton, beef, and sugar. In contrast, demand for certified food as well as vegetarian and vegan alternatives, often touted as more nutritious and environmentally friendly, may increase. However, the potential trade-offs between healthier and more sustainable diets based on Life Cycle Analysis need to be considered. For example, while an increase in the consumption of fruits and vegetables may be desirable from a health point of view, the typically intensive use of agro-chemicals and water in their cultivation as well as the high emissions from cold chains and transport may not be desirable from an environmental perspective. On the other hand, a reduction in meat and dairy consumption in populations where it is very high may provide net benefits.

1.3. Production

Projections for the production of crops, livestock and fish products covered by the *Outlook* are presented. This section also examines the underlying drivers of production, namely crop yields, cropping intensity, and agricultural land use in the crop sector, and the number of farm animals and output per animal in the livestock sector.

Over the coming decade, the global production (measured in constant prices) of crops, livestock and fish commodities covered by the *Outlook* is expected to increase by 1.1% p.a., a slower rate than in previous decades. The reduced growth incentives are driven by a weakening of expected gross returns for producers from both sales and due to costs developments. The proceeds of production sales are not expected to follow a sustained growth because of projected flat or slightly declining trends of world prices in real terms and slower population growth. Input costs are expected to increase, notably because of the nexus between energy and fertiliser prices and tightening of environmental regulations.

Middle- and low-income countries, including China, India and other Asian countries, will continue to drive growth (Figure 1.22). By 2032, the whole Asian region is expected to account for more than half of global crop production, almost half of livestock production, and almost three-quarters of fish production. Production growth will be driven almost entirely by productivity in this resource-constrained region.

Production in Sub-Saharan Africa and Near East and North Africa is expected to grow significantly, although from a low base. In these regions, the bulk of agricultural output comes from crops production,

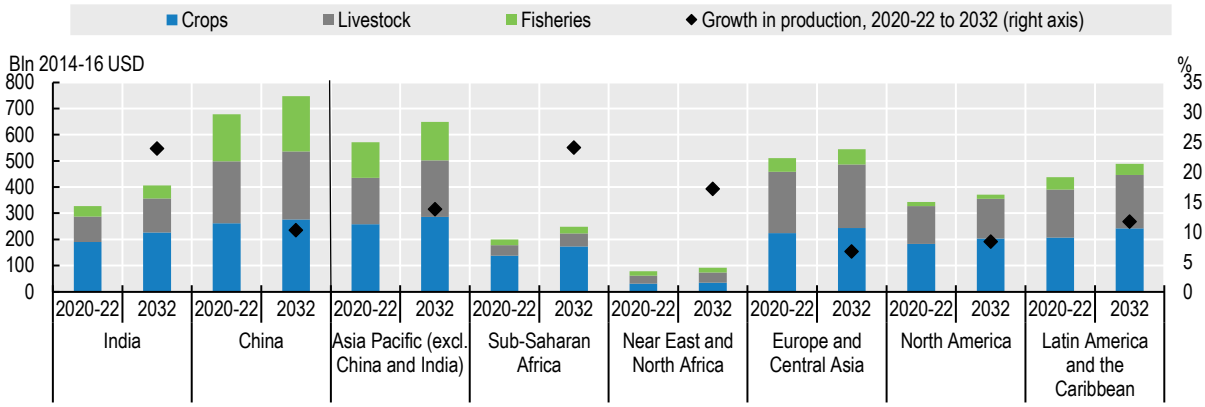
but higher value livestock production is expected to grow faster over the coming decade in response to a rapid population increase and urbanisation. In Sub-Saharan Africa, growth in crop production will be underpinned by a combination of area expansion, changing crop mix, and productivity gains; dairy will drive much of the growth of livestock production. In Near East and North Africa, growth in crop production will be derived mainly from productivity gains as the region is faced with severe constraints in the availability of arable land and water. Poultry will drive most of the increase in livestock production.

Europe and Central Asia is expected to be the region with the slowest production growth, mostly driven by Central Asia and Eastern Europe. Growth will mainly be derived from productivity gains as the long-term decline in agricultural land-use is expected to persist, but tighter regulations related to environmental sustainability and animal welfare will place downward pressure on yield improvements.

Production growth in North America is expected to be limited. Crop production is expected to grow faster than livestock production, reversing the trend of the past decade. Production growth will be driven by productivity gains.

In Latin America and the Caribbean, production growth is projected to slow down compared to the last decade. Growth is expected to come predominantly from crop production. The region's land abundance contributes to strong crop production growth, which is derived from a combination of expansion and intensification, but yield gains are expected to play a bigger role because of an expected rapid increase in fertiliser application. Despite slower growth in livestock production, the region will continue to be a large contributor to global production.

Figure 1.22. 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 at constant USD of the period 2014-2016.
Source: FAO (2023). FAOSTAT Value of Agricultural Production Database, http://www.fao.org/faostat/en/#data/QV; OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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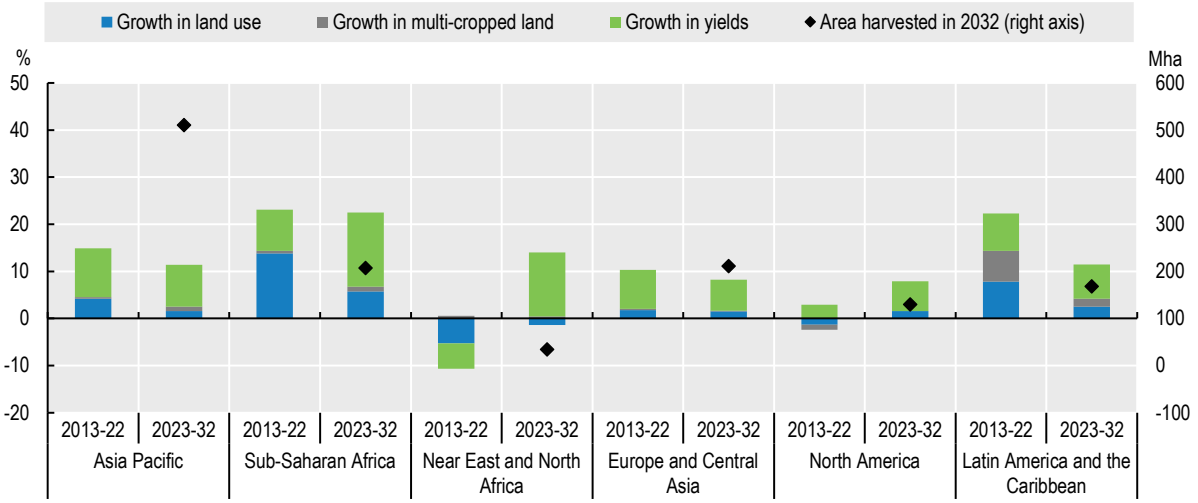
1.3.1. Productivity improvements drive crop production growth

Overall, crop production is projected to expand slightly faster (1.2% p.a.) than livestock or fish production (each at 1.1% p.a.). This result is driven by productivity, mostly from yield developments and to a lesser extent crop intensification rather than from land use, but with important regional and sectoral variations (Figure 1.23).

Figure 1.23. Sources of growth in crop production



Note: Figure shows the decomposition of total production growth (2013-22 and 2023-32) 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, sugar beet, sugarcane, wheat and palm oil.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook OECD Agriculture statistics (database)", http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink https://stat.link/rowqum

In Sub-Saharan Africa, yield growth is expected to almost double to 16% over the next decade compared to 8% over the previous one. Investments in locally adapted and improved crop varieties, increased access to fertilisers, and consolidation of land holdings that has allowed for more large-scale and mechanised farming will spur growth in crop production. Sub-Saharan Africa is the region with the largest untapped agricultural land and the expansion of the area harvested has been an important driver of production growth over the last decade. However, the role of land expansion in production growth is projected to decrease because it is increasingly difficult to convert land for agriculture in what remains largely unreachable areas, conflict zones, or conservation areas. Growth in the Near East and North Africa region is entirely based on yield growth because of the decline in the harvested area.

In Western Europe, yield growth is projected to slow down due to stricter environmental regulations, whereas in North America it will be underpinned by investment in innovations and wider biotechnological options.

Crop yield variations

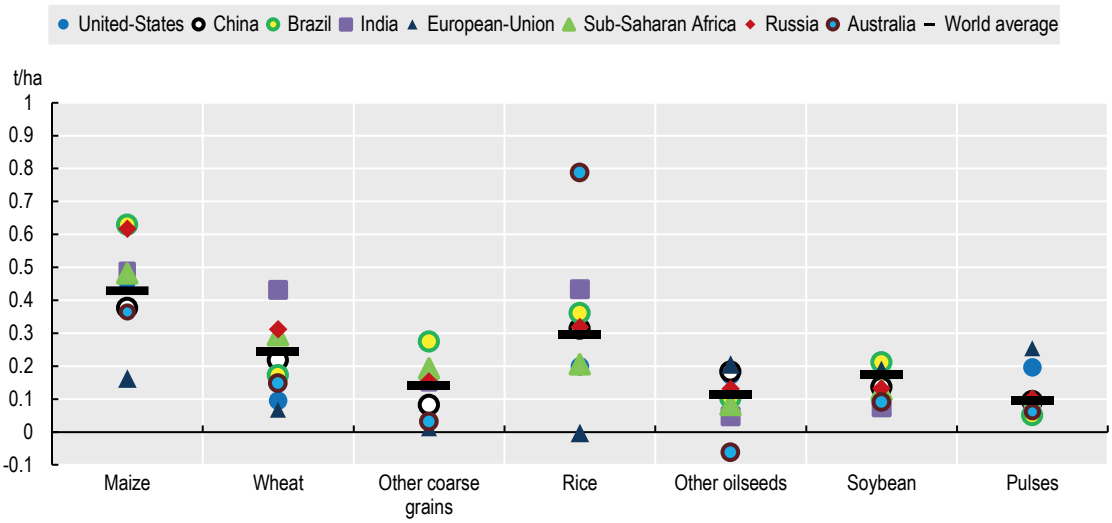
Over the coming decade, yield growth is projected to contribute 79% on average to global production growth of the main crops covered by the *Outlook*. Projected rates differ across regions and countries due to differences in production technologies, management practices, natural resource endowment, and local climatic conditions (Figure 1.24).

Farmers in low- and middle-income countries, notably Brazil and India, are projected to achieve growth rates above the world average for maize, wheat and rice through better adapted seeds and improved crop management. Notable yield increases in Sub-Saharan Africa are also projected, but average cereal yields in 2032 are expected to remain at less than a third of high-income countries.

In high-income countries, the growth in yields is projected to be smaller than the world average for the main crops, except for pulses. Yields in these countries are already close to the production frontier and further increases are constrained by stricter environmental regulations. However, production and

investment in nitrogen-fixing crops known for their productivity-increasing properties are expected to expand to meet sustainable food production objectives.

Figure 1.24. Change in projected yields for selected crops and countries, 2023 to 2032



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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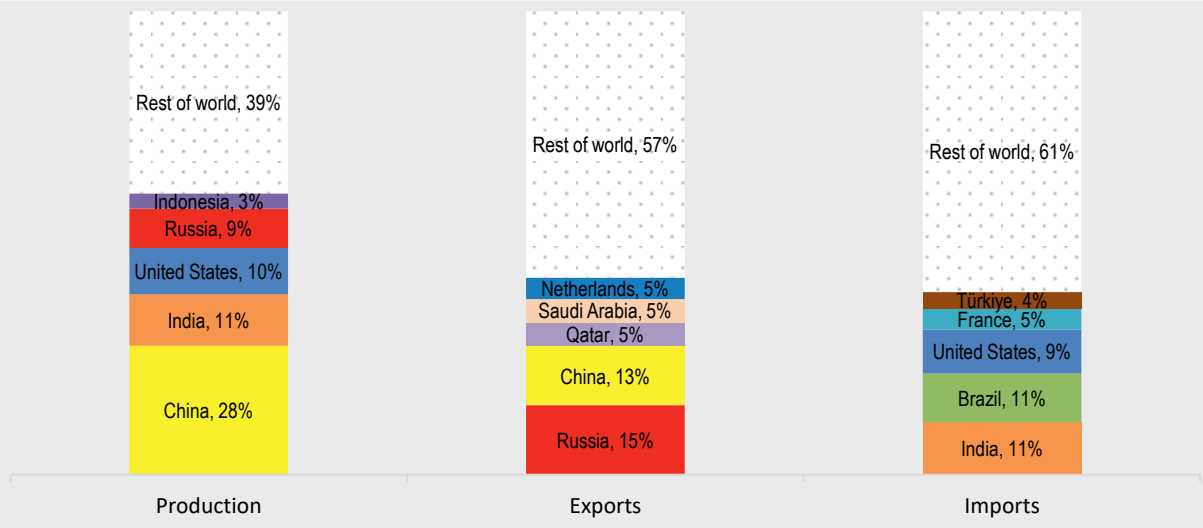
1.3.2. The role of fertiliser prices in driving food prices

Fertilisers provide essential nutrients for maintaining agricultural crop yields and quality, and for growth in production. The three most important nutrients are nitrogen (N), phosphorus (P), and potassium (K). Nitrogen is the most fundamental nutrient for crop yields because it ensures that plants remain healthy as they develop and are nutritious once they are harvested. Phosphorus supports a plant's ability to use and store energy, and helps with normal development. Potassium strengthens a plant's resistance to disease and its overall quality. The application of N-based fertilisers is critical for crop yields in the short run and the effectiveness depends on the timing of its application. Application of N-based fertilisers cannot be delayed in response to price changes, in contrast to the application of P and K fertilisers which can be in order to optimise variations in overall input costs since P and K nutrients remain in the soil for a longer period of time.

The production of N-based mineral fertilisers is dependent on the availability of natural gas both as a raw material and to power the synthesis process. Given this link, the production of nitrogen fertilisers is concentrated in countries that have access to natural gas: China, India, the United States, and Russia (Figure 1.25). Over the period 2016-2020, Russia was the main exporter of N-based fertilisers, responsible for 15% of global exports, followed by China (13%). Key importers of nitrogen fertilisers over the same period were India and Brazil, both accounting for 11% of global imports.

Figure 1.25. Main producers and traders of nitrogen-based fertilisers (average 2016-2020)



Source: FAOSTAT.

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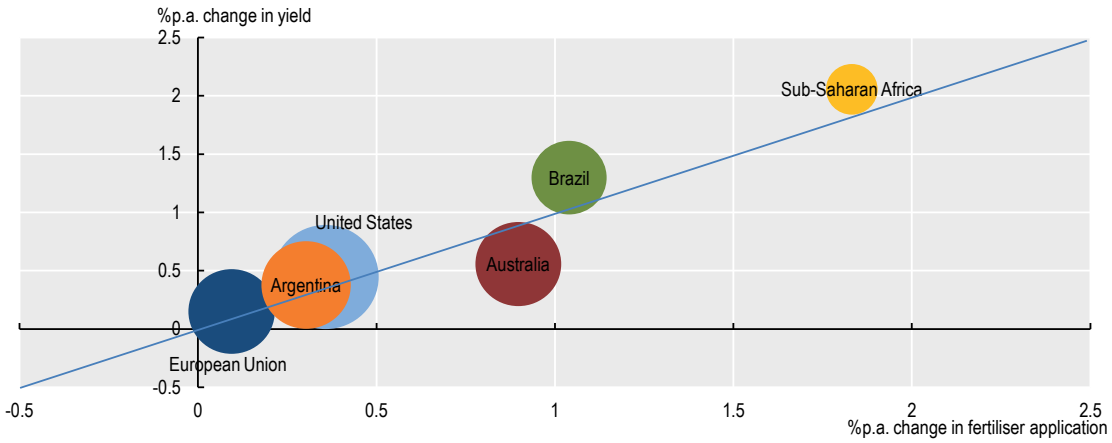
In this context, focusing on the application of N-fertilisers per hectare of planted crop in relation to output per hectare can provide elements to qualitatively explain the observed variation in production efficiency across regions. Figure 1.26 shows how the projected per annum changes in N-fertiliser application compare to the corresponding per annum changes in yield in selected countries or regions for maize.

Figure 1.26. Change in N-fertiliser application per hectare and yields for maize, 2023 to 2032



Note: The size of each bubble reflects yield in 2032
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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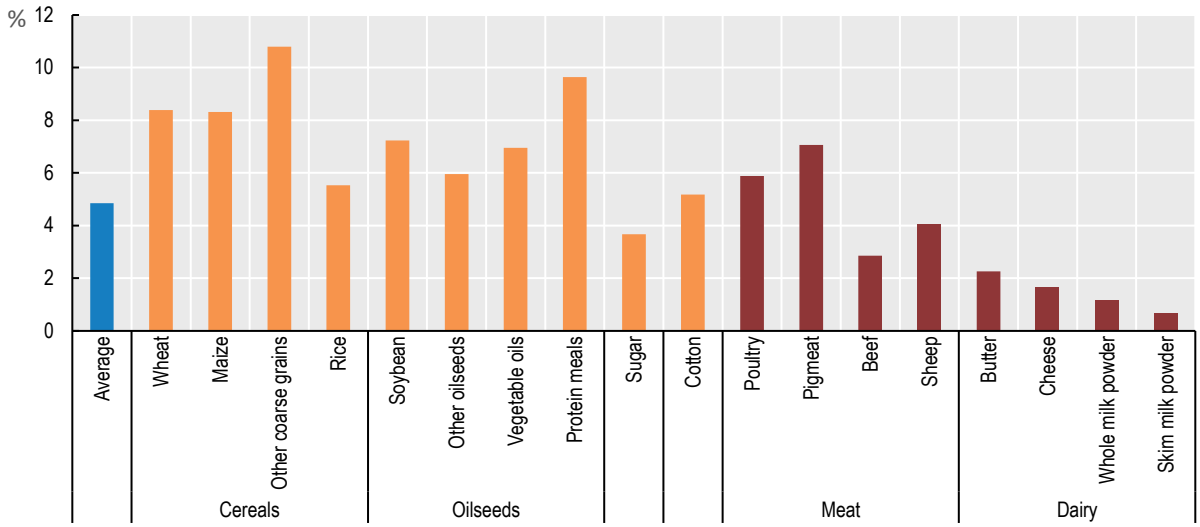
In the European Union and the United States, where yields are high, future development in production practices will be limited compared to other countries but changes in yields are expected to be greater than changes in fertiliser application. High-income countries are rolling out various incentives to curb the use of synthetic fertilisers, notably by increasing their efficiency through better management practices or expanding the use of nutrient alternatives such as biofertilisers. In Australia, the relatively limited increase in yields can be explained by physical and climatic constraints.

In Brazil, the use of N-fertilisers is expected to grow significantly due to the increase in production, and yield increase should outpace N-fertiliser application over the projected period. While several factors such as progress in breeding can play a role in future yield developments, improvements in crop management, use of nitrogen-fixing crops or biofertilisers will play a critical role in the increase of maize production yields. Sub-Saharan Africa is also expected to experience significant increases in both N-fertiliser application and yields, but from a low base.

A scenario analysis was undertaken to examine the impact of a 25% increase of N-, P- and K-fertiliser prices on fertiliser application, resulting crop production and commodity prices, while keeping oil price constant. Factors underpinning such fertiliser price increases other than an oil shock would include, for example, market access restrictions, tighter environment regulations, or increases in other manufacturing costs such as labour or minerals.

Figure 1.27 shows the percentage change of selected commodity prices from the baseline projections in 2032 to those of the scenario projections in 2032. On average, agricultural commodity prices would increase by 5%. The impact would be greater on crops that use fertilisers as direct inputs than on livestock products that use them indirectly through feed. Among livestock products, the increase in prices is greater for poultry and pigmeat than it is for ruminants because the former relies more on compound feed.

Figure 1.27. Change in agricultural commodity prices due to 25% increase in fertiliser prices



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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This scenario illustrates how changes in fertiliser prices readily translate into changes of product prices and hence food prices. Consumers who spend a high share of their household budget on food and fuel would be particularly impacted. The impact on producers is mixed, as only the most efficient users of fertilisers would benefit from higher product prices and increase their margins. Rising costs for agricultural

inputs will inevitably translate into higher food prices unless new models of production can be found to make agriculture less dependent on conventional fertilisers.

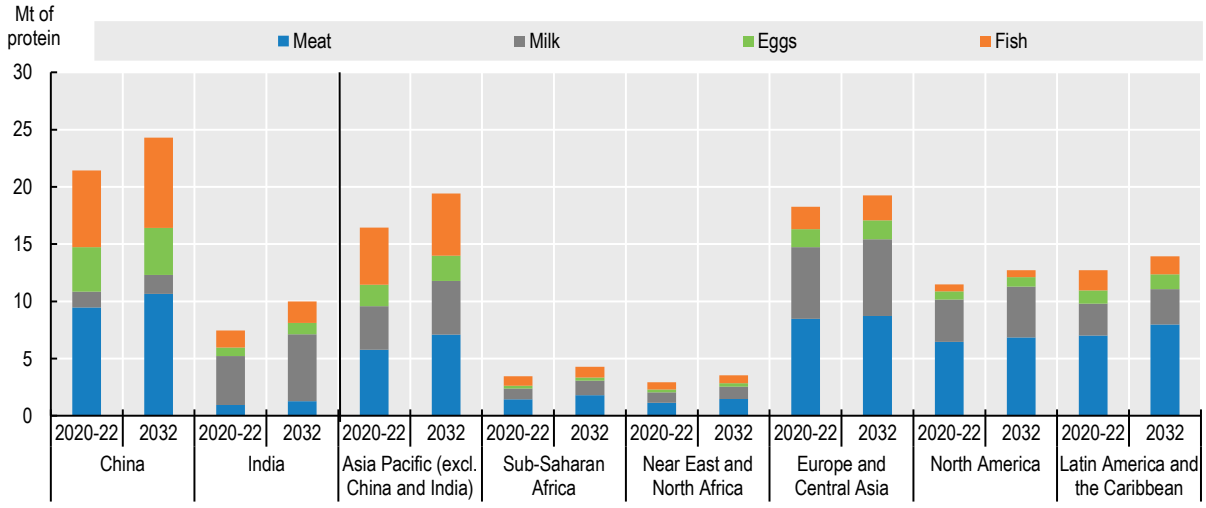
1.3.3. Growth in livestock and fish production varies in intensity across region

Global production of livestock and fish is projected to expand by 10% over the next decade, almost half the rate of the previous decade. A significant share of this growth will be driven by production in China (13%), India (34%), and other middle- and low-income countries (Figure 1.28). In China, the expansion will be largely underpinned by the recovery from African Swine Fever (ASF) and in India by sustained growth in diary production.

In Sub-Saharan Africa and Near East and North Africa, livestock and fish production is expected to increase by more than 20%, mostly because of the expansion of the dairy and poultry meat sectors. The rising demand for high value food spurred by the ongoing urbanisation of these regions is expected to be mainly met by local production rather than by imports. Insufficient infrastructures and associated elevated transport and logistic costs will remain major impediments to trade in these regions.

In high-income countries, overall growth will be limited. In Europe, factors such as the current African Swine Fever outbreaks, stricter environmental laws, and animal welfare regulations in some EU countries will exert pressure on production growth. In North America, the intensive production system is expected to recover slowly from recent high feed prices and labour costs. Almost all production of animal proteins will experience single-digit growth over the coming decade, except for the dairy sector in North America which will grow by 20% by 2032. Improvements in dairy cow milk yields will be the main contributor to milk production in the region.

Figure 1.28. Global livestock and fish production on a protein basis



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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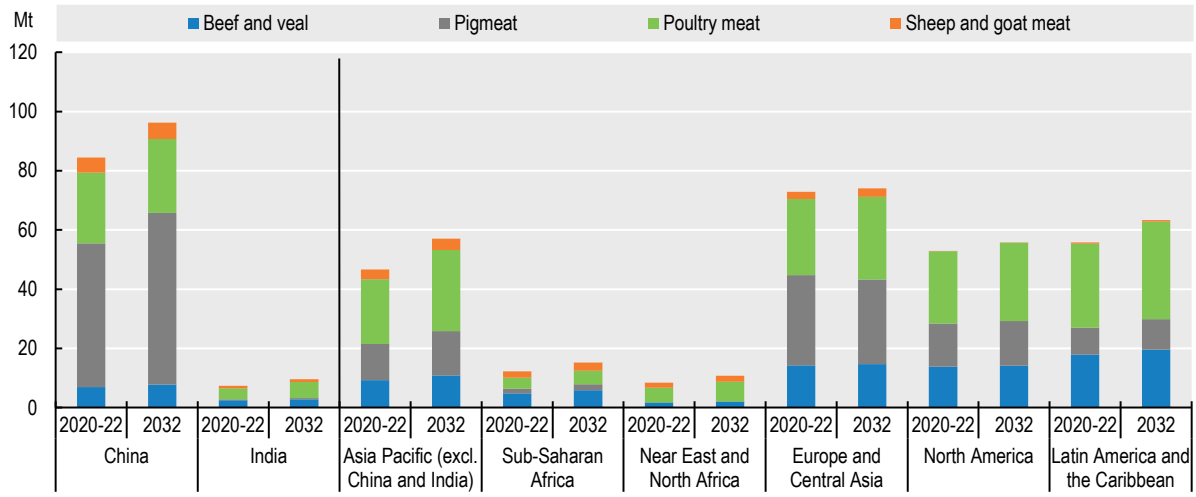
Meat production

Over the coming decade, increased global meat production is expected to originate mainly in middle-income countries (Figure 1.29), supported by global herd and flock expansion and improved per-animal performance through higher feed intensity, and continuous improvement in animal breeding, management, and technology.

Poultry meat will be the fastest growing segment of animal protein production (14%) and is projected to account for 48% of the increase in total meat production over the coming decade. The greatest increase in production will occur in Asia Pacific, notably in India, largely as a result of increased feed intensity and breeding improvements. Poultry meat will significantly expand in Sub-Saharan Africa and Near East and North Africa, albeit from a low base. In North America and Europe and Central Asia, poultry meat will be driven by its greater attractivity for consumers compared to bovine meat and its improved profitability in the medium term due to shorter production cycles.

Figure 1.29. Global meat production in carcass weight equivalent



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Pigmeat production is expected to recover in Asian ASF-affected countries, growing by 19% in China, the largest producing country, and 23% in other Asian countries over the coming decade. In Europe, pigmeat production will decline over the next decade mainly because of stricter environmental regulations and animal welfare standards.

Beef production is expected to expand by 9% and contribute to 16% of the total increase in global meat production. Overall, beef production will increase with higher carcass weights as feed costs decline and animal genetics improve, although in the fastest growing African regions the increase will be driven by higher herd numbers. In Europe and North America, beef production will adjust to stricter environmental sustainability standards for the former and severe pressure on the profitability of the intensive model of production for the latter.

Sheepmeat production will contribute only 6% to the overall growth in meat production and is expected to expand by 15% over the coming decade. Increased availability in the global sheepmeat market will be due to flock rebuilding and increased lambing rates in Asia and Sub-Saharan Africa. Production in the European Union is projected to increase slightly due to income support and favourable producer prices. Sheep and goat meat production in Sub-Saharan Africa will grow by almost 30% despite pressure on pasture land due to desertification.

Dairy production

Dairy will remain the fastest expanding livestock sector over the next decade, with global milk production projected to increase by 17%. In low- and middle-income countries, milk production will be driven by an

increase in inventory and yields, while in high-income countries it will be almost entirely supported by improvements in yields due to optimisation, improved animal health, and better genetics.

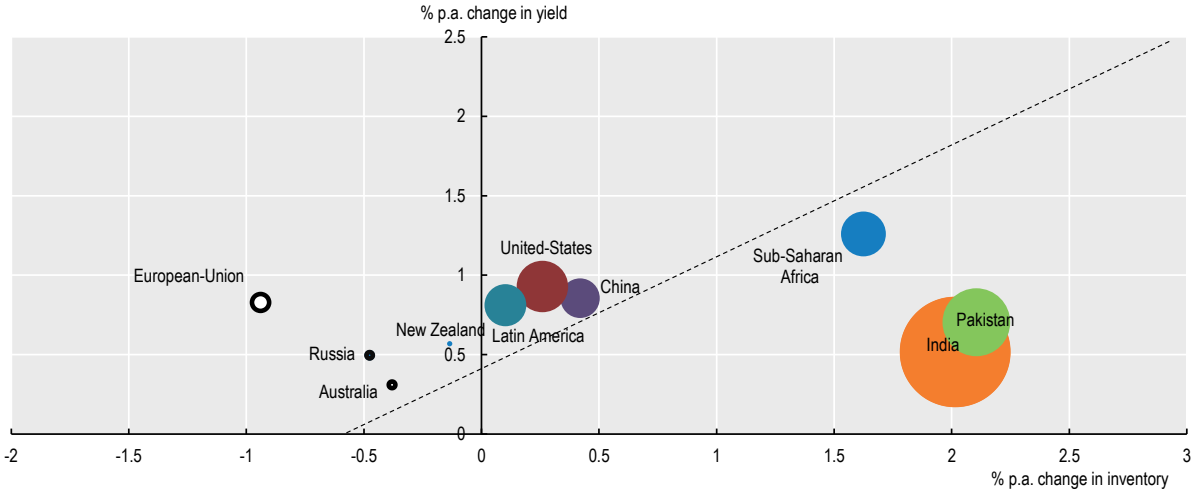
Population growth in the main consuming middle- and low-income regions, as well as per capita consumption growth for fresh and processed dairy products will incentivise investments in dairy production.

India and Pakistan are projected to rank first and second, respectively, in terms of absolute growth of milk production and to generate over half of the increase in global milk production; they will jointly account for 30% of production by 2032. In these countries, the increase in milk production will be due primarily to herd expansion (Figure 1.30).

In Sub-Saharan Africa, the 33% growth in milk production is projected to originate from an increase in the number of milk-producing animals. The region will also experience some yield improvement, albeit from the lower levels produced by ovine animals that are mainly used to provide milk.

Production in the European Union, the second largest global milk producer after India, is expected to decline slightly in response to the ongoing transition towards environmentally sustainable production, the expansion of organic production, and the shift from intensive to pasture-based production systems.

Figure 1.30. Changes in inventories of dairy herds and yields, 2020-2022 to 2032



Note: The size of the bubble reflects absolute growth in dairy production between 2020-22 and 2032.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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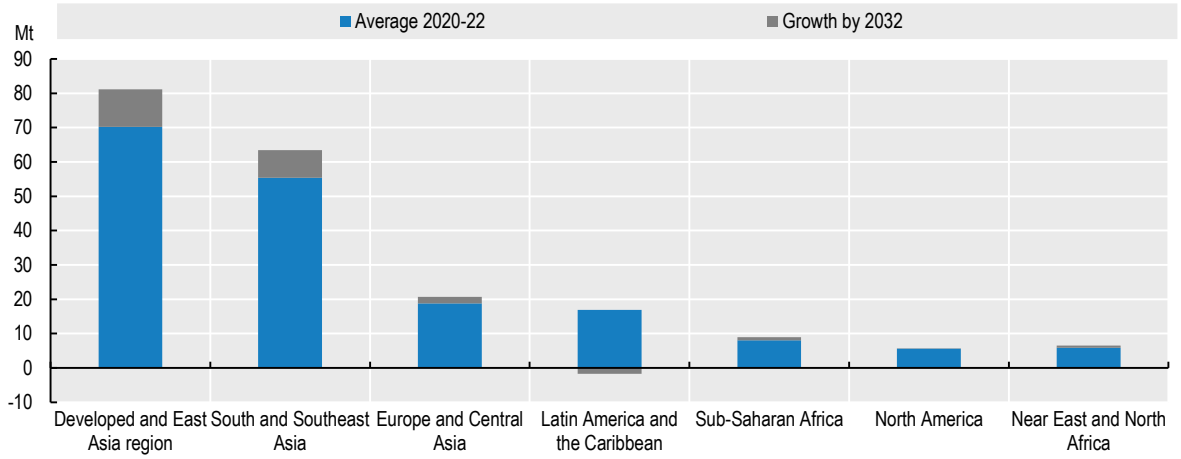
Fish production

Global fish production is projected to grow by 12% over the coming decade, albeit at a slower rate compared to the previous decade. This slowdown in growth reflects the impact of policy changes in China toward more sustainable fisheries, the higher costs for fuel inputs, and the assumption that 2024, 2028 and 2032 will be *El Nino* years that will result in lower production, mainly in Latin America and the Caribbean (Figure 1.31). Most of the increase in fish production is expected to come from Asia, which will account for more than 70% of global production by 2032. The largest contributors to output growth are expected to be China, India, Indonesia, and Viet Nam.

Production will be driven by continuing but slower progression in aquaculture production and broadly stable capture fisheries production, except during the years of *El Nino*. By 2032, aquaculture production is projected to account for more than half of total fish production.

The increase in aquaculture production is expected to be largely achieved by productivity gains and technological improvements related to spatial planning, breeding, feed, and disease management.

Figure 1.31. Regional fish production



Note: The regions Developed and East Asia, and South and Southeast Asia are defined as in Chapter 2.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.3.4. Investments and human capital are vital for productivity gains

Investments in agricultural infrastructure, research and development, wider access to more productive agricultural inputs, improved farm management practices, including the adoption of digital automation technologies are important factors that enhance productivity.

The availability of human capital employed in the agricultural sector is a key determinant of production growth. Nevertheless, there remain important barriers for human capital to thrive within the current food systems. For instance, the lack of access to finance for youth or smallholders, or the insufficient attention to the constraints faced by women in food systems (Box 1.2) are impediments to productivity gains. A recent FAO report on the status of women in agrifood systems (FAO, 2023[10]) shows that inequalities related to land tenure, credit, training, and technology create a 24% gender gap in productivity between women and men farmers on farms of equal size. In September 2021, the United Nations Food Systems Summit urged for the greater integration of women in food systems, notably calling for solutions that narrow the gender gap and support women entrepreneurship. Subsequently, in adopting the Ministerial Declaration on Transformative Solutions for Sustainable Agriculture and Food Systems in November 2022, Ministers of Agriculture of OECD countries and partner economies worldwide committed to promoting and measuring progress towards inclusive food systems and to reinforce measures that foster greater opportunity for women in the agricultural sector.

Box 1.2. Gender and food systems

Understanding the role of women in food systems

The livelihoods of men and women in food-related activities differ. The contribution of women to food systems remains overlooked, irrespective of their role as entrepreneurs, workers, or consumers. A recent OECD report (Giner, Hobeika and Fischetti, 2022[11]) explores the extent of women's participation to food systems and identifies the following key insights.

- *Women as entrepreneurs*: Women are less likely than men to lead businesses in *the* agri-food industry.
- *Women as workers*: Women represent one-third of the workforce in agriculture, but earn disproportionately less than men and are more involved *in* lower-skilled or informal jobs.
- *Women as consumers*: Given their overrepresentation among low-income and single parent households, women tend to spend a larger share of their disposable income on food and are more at risk of food insecurity.

Barriers to enhanced women's entrepreneurship in agri-food systems are threefold.

- *Inequality of endowments* with unequal access to land and assets, education, entrepreneurial and digital skills, and professional networks,
- *Formal and informal external barriers* including longstanding sociocultural and institutional gender norms and land inheritance systems,
- *Internal barriers*, such as internalised discriminatory practices, that lead to reduced self-confidence and undervaluation of competencies of women with consequences on the tasks undertaken by female farm owners and managers.

Fostering gender inclusion can have positive impacts on the triple challenge faced by food systems, which is to ensure food security and nutrition for a growing population, support the livelihoods of millions of people working in the food supply chain, and to do so in an environmentally sustainable way. Greater gender diversity at the decision-making level can translate into firms taking more environmentally conscious decisions.

Evidence gaps on women in food systems

A move towards greater gender equality requires applying a gender lens when developing and implementing policies related to food systems, as well as collecting better evidence on gender and food systems.

The contributions of women as entrepreneurs, workers, and consumers across food systems are difficult to recognise because of the lack of sex-disaggregated data. This prevents policy makers from considering the interests and concerns of both women and men at all stages of policy processes.

Digital technologies and government-wide commitments can facilitate the information collection process. Regular reporting on the situation of women across food systems can raise awareness on their roles, on the barriers they face, and on progress achieved.

Gender in food systems policies

The main strategy to reach gender equality is to apply *gender mainstreaming* to agricultural and food policies. This is the process of assessing the implications for women and men of any planned action, including legislation, regulations, policies, or programmes, in all areas and at all levels.

Furthermore, countries use a combination of instruments to support women as workers and entrepreneurs in food systems, with the aim of supporting: the rights and needs of women on family farms, and access to land, equipment, finance and markets. However, not much is known about the effectiveness and impact of these policy instruments; robust *ex ante* and *ex post* gender impact assessments could evaluate the cost-effectiveness of measures introduced and revaluate resource allocations.

A roadmap for addressing evidence gaps

Many countries are committed to achieving gender equality. Giner, Hobeika and Fischetti (2022[11]) provide a five-step roadmap to identify and overcome evidence gaps on gender aspects and policies that address gender inequality in food systems.

- Apply a gender lens when developing policies related to food systems.
- Identify and close evidence gaps on gender and food systems by collecting sex-disaggregated data.
- Develop and implement a mix of policy instruments that address gender inequality and support women in food systems.
- Monitor and evaluate policy impacts and their effectiveness.
- Adjust policy responses.

Notes: Gender is defined as Socially constructed and socially learned behaviours and expectations associated with females and males. All cultures interpret and elaborate the biological differences between women and men into a set of social expectations about what behaviours and activities are appropriate and what rights, resources, and power women and men possess. Like race, ethnicity, and class, gender is a social category that largely establishes one's life chances and participation in society and in the economy (OECD, 2018[12]).

1.3.5. Environmental impacts of agricultural production

Direct GHG emissions

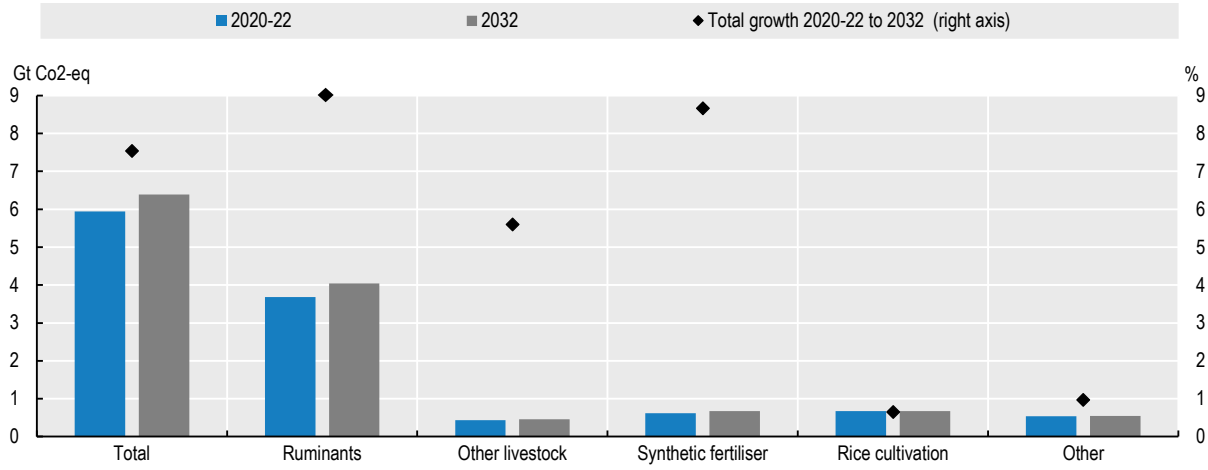
The *Outlook* estimates direct GHG emissions using the FAOSTAT Emissions-Agriculture database and following the IPCC's Tier 1 approach (i.e. basic method relying on direct emission factors such as herd size). The projections assume no change in current policies and on-trend technological progress. Higher-tier methods (that account for management practices or land use change for instance) would provide greater certainty of the estimates but are not undertaken given the scope of the *Outlook*.

Subject to the above caveat, global direct agricultural emissions are set to increase by 7.5% over the coming decade, while the projected increase in agricultural production is 13% (Figure 1.32). Livestock production will account for 80% of this increase. Geographically, most of the increase in emissions is projected to occur in middle and low-income regions due to the higher growth in ruminant production in systems that are emission intensive.

Synthetic fertilisers are an important source of direct GHG emissions. High energy prices, domestic policies, and developments in market access will shift the use of fertilisers at the global level (Section 1.3.2). Country-level efficiencies in applying fertilisers to agricultural soils by, for example, applying a new generation "special fertiliser products", such as stabilised nitrogen fertilisers, slow and controlled-release fertilisers, and water-soluble fertilisers, can increase nutrient use efficiency and reduce the need for application; thus lowering GHG emissions. In some countries, governments strongly encourage the use of special fertiliser products or organic fertilisers. In others, farmers have adopted these products without government intervention because of the economic and environmental benefits.

Rice cultivation is another major source of GHG emissions because irrigated paddy fields emit a lot of methane. The projected increase in rice production, however, will be largely the result of yield improvements with unchanged paddy areas, thereby largely limiting any increase in GHG emissions.

Figure 1.32. 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.CO2 equivalents are calculated using the global warming potential of each gas as reported in the IPCC Sixth Assessment Report (AR6). 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: FAOSTAT Emissions-Agriculture Database, http://www.fao.org/faostat/en/#data/GT, accessed January 2022; OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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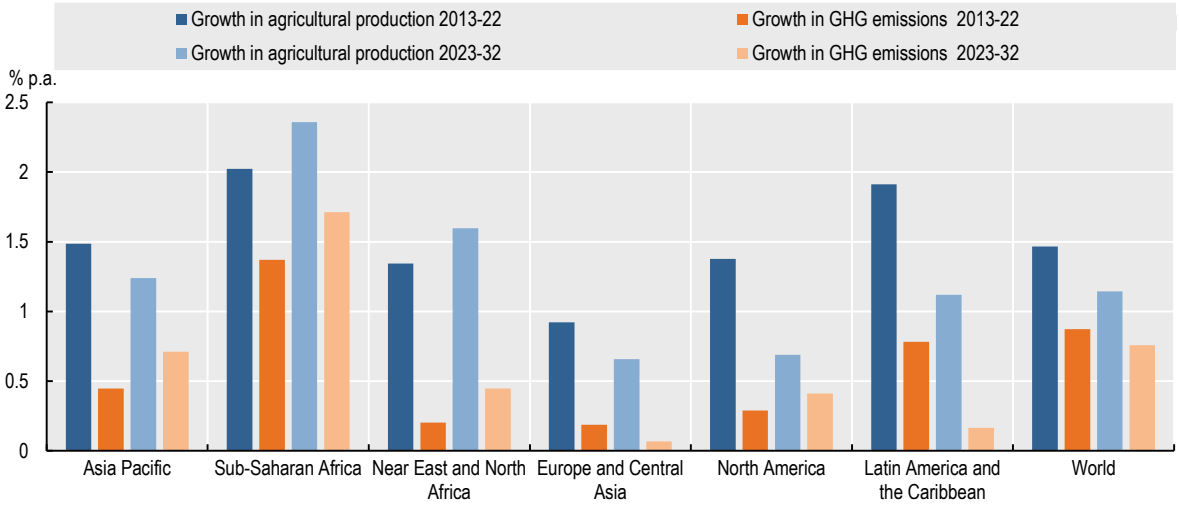
At the global level, growth in direct GHG emissions from agriculture will be lower than in the previous decade and lower than the projected growth in agricultural output, indicating a faster decline in the carbon intensity of agricultural production (Figure 1.33). This will be the case in Europe, Central Asia, Latin America and the Caribbean due to yield improvements and a declining share of ruminant production.

In other regions, the growth of GHG emissions is projected to be greater than in the previous decade. In low- and middle-income countries in Asia Pacific and Sub-Saharan Africa, increased GHG emissions are due to the projected higher output growth in these regions. While important efforts are undertaken in these regions to make production systems more sustainable, on average those tend to be more emission-intensive than in high-income countries. By 2032, Sub-Saharan Africa will experience the highest growth in direct GHG emission per year (1.7%), accounting for 16% of global direct GHG emissions from agriculture but only 7% of crop and livestock production.

In Europe and Central Asia, annual direct GHG emissions from agriculture are projected to be divided by three, while agricultural output is expected to increase by 7%. Further reductions in the carbon intensity of agricultural production could be achieved by the large-scale adoption of emission-reducing technologies and agricultural practices.

Figure 1.33. Annual change in agricultural production and direct GHG emissions, 2023 to 2032



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. CO2 equivalents are calculated using the global warming potential of each gas as reported in the IPCC Sixth Assessment Report (AR6). 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: FAOSTAT Emissions-Agriculture and Value of Agricultural Production databases, http://www.fao.org/faostat/en/#data, accessed January 2022; OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Land use

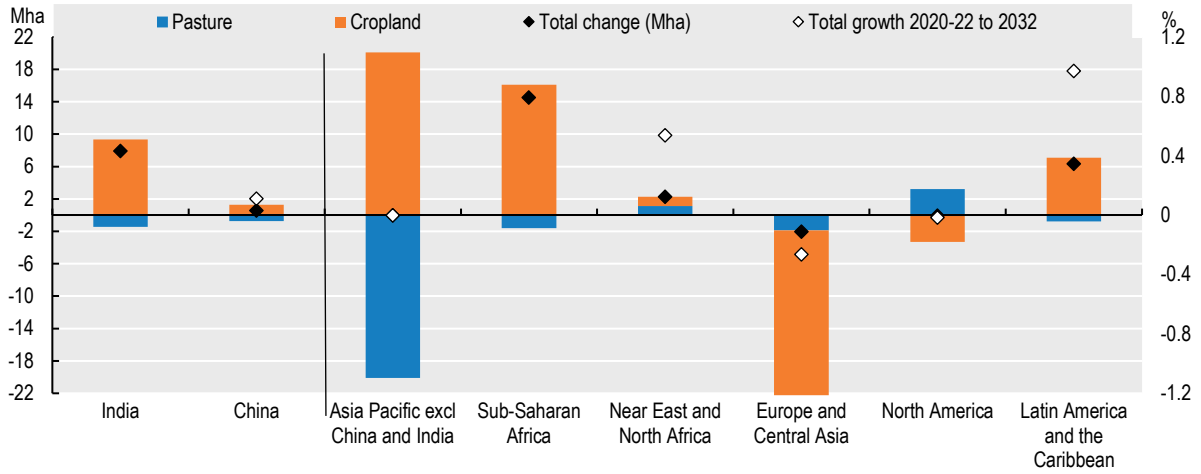
Agriculture uses 38% of the global land area, with one-third of this area dedicated to the cultivation of crops and the rest to livestock grazing. Land conversion from natural ecosystems to agriculture has been historically the largest cause of GHG emissions. The expansion of cropland is projected to account for 15% of crop production growth. Over the coming decade, total agricultural land use is not expected to increase as overall cropland increases will be offset by overall pasture decreases. There will be regional variations in the locations where there are increases in cropland and decreases in pastureland.

Figure 1.34 shows the changes in total crop land over the coming decade. Projected trends in land use will vary across regions and commodities, with the largest reduction in pastureland use and the largest increase in cropland use occurring in the Asia and Pacific region. In this region, pasture is expected to be converted into cropland, whereas in Latin America mainly non-agricultural land will be brought into use.

In the Near East and North Africa, the expansion of cropland will be constrained by natural conditions. Low rainfall is a barrier to rain fed agriculture and the cost of irrigation is prohibitive in most places. In North America and Western Europe, cropland is projected to decrease, since any increase in crop production is tightly regulated by policies on environmental sustainability, and as land used for fruits, vegetables and other crops is expected to decline.

Pastureland is expected to decrease in Asia and Pacific, excluding China and India, due to the expected transition from pasture-based beef, sheep and goat production to more intensive production systems for pigs and poultry. Ruminant production is assumed to shift to more feed-intensive production systems which require less pastureland. Pastureland is projected to increase slightly in North America due to the expansion of the cattle herd.

Figure 1.34. Change in agricultural land use 2020-22 to 2032



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.3.6. Uncertainties affecting agricultural production

Russia's war against Ukraine, and policy responses introduced in many countries, have triggered further rise in energy and fertiliser prices, and increased the price volatility of those inputs. Despite recent easing, the risk of continued uncertainties could alter production decisions, limit input use and subsequently depress yield growth, eventually threatening global food security.

The production of agricultural commodities remains vulnerable to plant and animal diseases. The recent ASF outbreak led to significant losses in pigmeat production in East Asia and a desert locust infestation caused significant production losses in East Africa in 2020. The *Outlook* does not assume a recurrence of these or similar events, but the success of measures to combat diseases and pests remains a concern.

Historically, private sector investment has been the principal driver of productivity growth and productivity enhancement was expected to come from tangible inputs. Private companies usually invested more into technological innovations and research and development related to the development of new plant varieties, equipment, machinery and chemicals inputs for which they could expect return on investment from intellectual property rights and direct sales to farmers.

It is currently unknown how the strengthening of environmental policies to foster sustainability of the agricultural sector might reshape global patterns of production. Future policies will likely impose stricter standards on the use of chemicals in production and promote new production practices, including the use of organic alternatives. However, this risks placing downward pressure on yields, which could lead to higher food prices if other innovations are not developed or adopted fast enough. There is at present a gap in research and programmes that aim to transmit better management practices to farmers given that such activities neither bring in royalties nor have public institutions endorsed them (OECD, 2022[13]).

As climate change is expected to increase, the magnitude and frequencies of extreme weather events, sanitary and phytosanitary conditions will change, and the natural endowment of agriculture and food producing regions could be irreversibly changed (IPCC, 2022[14]); this could encourage producers to adjust their production methods.

1.4. Trade

International agricultural trade links the food systems of countries. By efficiently moving agricultural products globally from surplus to deficit regions, trade continues to play a critical role in providing consumers worldwide with sufficient, safe, and nutritious food, while generating income for farmers, workers and traders in agriculture and food industry.

The COVID-19 pandemic led to trade disruptions worldwide, but trade in the agricultural commodities covered by the *Outlook* proved to be more resilient than other sectors of the economy. In the short run, the *Outlook* assumes the continuation of the Black Sea Grain Initiative, which is crucial for global food security as grain and fertiliser prices remain high.

The importance of trade in ensuring food security will likely increase in the future in view of changing demand and supply forces. First, the ongoing major demographic changes combined with developments in income, dietary preferences, and urbanisation are expected to have an increasing impact on global consumption patterns. In this respect, trade can help improve availability and access to food and agriculture products. Second, as the significant adverse effects of climate change on agriculture and food supply are expected to worsen, trade can also contribute to the stability of food security.

Well-functioning domestic and international markets are essential to supporting the transformation towards the greater sustainability and resilience that is needed to address the triple challenge facing agriculture and food systems.

1.4.1. Agricultural and fish trade continues to grow but at a slower pace

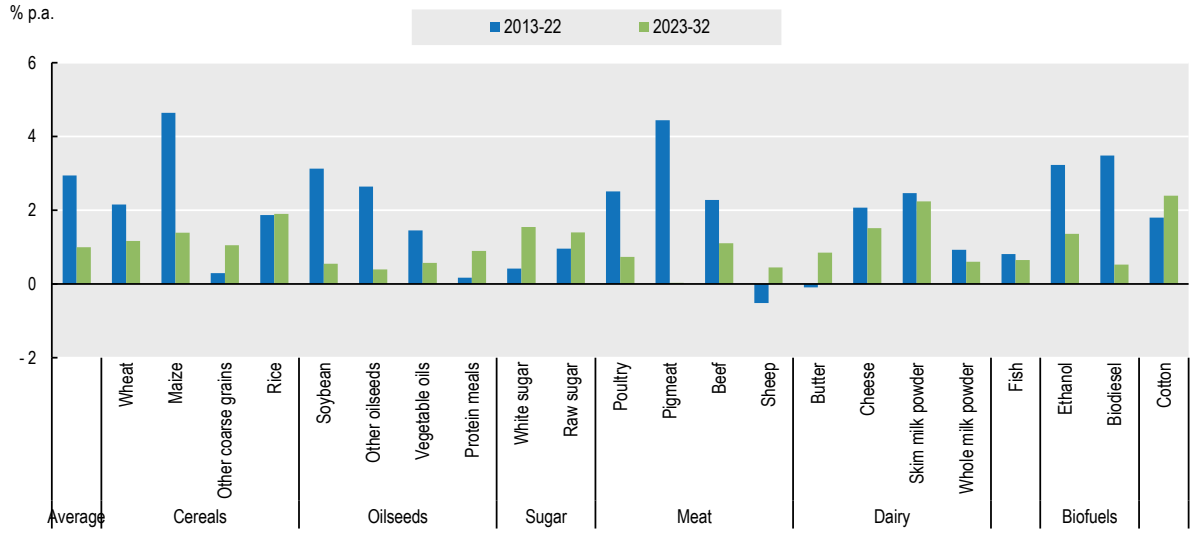
Over the coming decade, trade in agricultural commodities covered in the *Outlook* is projected to expand by 1% p.a., which about a third of the rate of the last ten years. This slowdown is due to the expected weakening of the main historical drivers of global demand for traded commodities, namely the slower growth in demand for agricultural products by China and other middle-income countries.

Agricultural commodities products were traded more intensively in the early 2000s, reflecting the implementation of the WTO Agreement on Agriculture and China's accession to the rules-based trading system in December 2001. Growth in both agricultural and industrial trade entered a downward trend in the aftermath of the financial crisis of 2008. The *Outlook* assumes a diminishing impact of previous trade liberalisation efforts that boosted agricultural trade, as progress to reduce multilateral tariffs and reforms to trade-distorting producer support have largely stalled in recent years.

Figure 1.35 shows the average annual growth in trade volumes for selected commodities covered in the *Outlook*. Given their share in overall volumes traded, maize, soybeans and wheat contributed the most to overall agrifood trade growth of the last decade. These commodities are projected to experience the biggest drop in trade growth over the coming decade. Because of their importance in feed use, the drop in the global export of maize can be explained by the projected increase in maize production in China that will reduce its need for imported feed over the medium term.

Trade growth in poultry and beef are expected to drop sharply due to the slowdown of the convergence in diets and the reduction in Chinese imports from Europe and Latin America and Caribbean regions. The exceptionally high growth of trade in pigmeat over the previous decade was due to the African Swine Fever outbreak in China, which forced the country to import massively in 2019 and 2020.

Figure 1.35. Growth in trade volumes, by commodity



Note: Annual growth rate of trade volumes as calculated from 2014-16 reference prices.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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The increase in the growth of cotton traded will reflect 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 from the top exporters (the United States, Brazil, and Sub-Saharan Africa). International trade in sugar will continue to grow, mainly reflecting expanding demand from deficit regions in low- and middle-income economies. Trade in rice is projected to increase, supported by India's production surplus mainly directed to Sub-Saharan Africa.

1.4.2. The share of production traded is stabilising, with sustained dominance of top exporting countries

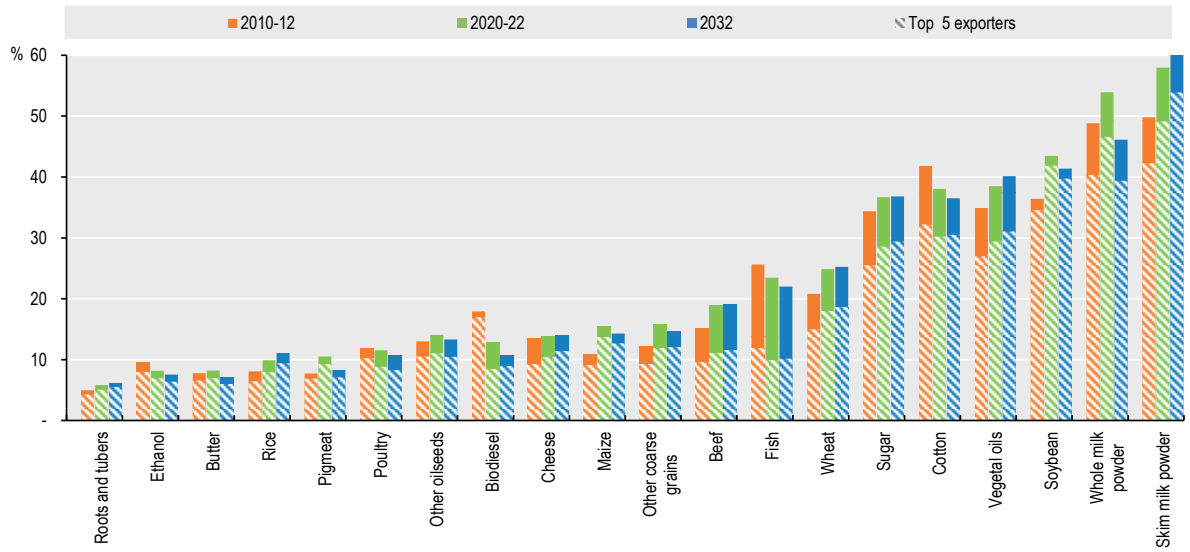
The share of production traded for the commodities covered in the *Outlook* has been gradually increasing over time, rising from an average of 15% in 2000, to 23% in the baseline period 2020-22, and reflects a trade sector that has been growing at a faster pace than agricultural production. Assuming a diminishing impact of previous trade liberalisation efforts that boosted global agricultural trade and no major changes in policies, trade relative to production is projected to stabilise over the next decade, with growth in trade and production being more closely aligned.

However, there are significant variations in the importance of trade across commodities (Figure 1.36). For many agricultural commodities, most of the production is used domestically. For a few commodities trade represents at least one-third of global production. This is the case for sugar, cotton, vegetable oils, soybean, and milk powders, which are either demanded for further processing or produced in highly concentrated markets.

Over the coming decade, the share of production that is traded will not change significantly for most commodities covered in the *Outlook* and few will experience some shifts in trading patterns. The export ratio of cotton and fish is projected to decline marginally, reflecting either weakness in import demand or increasing domestic use, or in the case of biodiesel, both tendencies. For skim milk powder (SMP),

vegetable oils, wheat, and rice, trade is expected to expand at a higher pace than global output, resulting in an increase in the share of production traded for these commodities.

Figure 1.36. Share of production traded, by commodity



Note: The solid bar in the graph is computed as global exports over global production (in volume). The hatched bar is computed as exports of the top five exporters over global exports (in volume).
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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For commodities covered in the *Outlook*, the five largest exporting countries generally account for 70% or more of global export volume, a trend that is expected to continue over the coming decade. Figure 1.34 shows the export share of the top five exporters for each commodity. For soybeans, this share exceeded 96% in 2020-22. Even for commodities with relatively less concentrated exports, such as fish and beef, the five leading exporters accounted for 42% and 58% of global exports in 2020-22, respectively.

For almost all commodities (except pigmeat, ethanol, and whole milk powder), exports from the top five exporters are expected to increase over the coming decade. The biggest increase in export dominance of the top five exporting countries is projected for trade in biodiesel. The top five exporters of biodiesel are expected to increase their share from 65% to 79% over the next ten years, supported by growing exports of biodiesel from recycled cooking oil from Singapore and of soybean-oil based biodiesel from the United-States. The biodiesel export share of China, however, is projected to drop over the next ten years due to limited growth in its production of biodiesel from recycled cooking oil.

The dominance of the top five exporting countries of cereal is projected to increase over the next ten years. The share of the top five exporting countries of rice is projected to rise from 80% in 2020-22 to 85% in 2032, mainly due to strong export growth in India and Thailand. The export share of the five leading exporters is projected to increase from 75% in 2020-22 to 78% in 2032 for other coarse grains. This share is expected to slightly increase by 2 percentage points over the same period reaching 74% in 2032 for wheat, while it will remain unchanged for maize.

Dairy exports are expected to become more dominated by the top five exporting countries, with growing dominance from key suppliers in high-income countries. For cheese, for instance, the export share of the top five exporters is projected to increase from 75% to 80%, mainly driven by strong export growth in the leading exporter, the European Union. The share of the top five exporting countries of SMP is also

projected to increase, mainly due to strong growth in exports from the United-States. The latter is projected to account for 35% of global SMP exports in 2032, up from 30% in 2020-22.

This high dominance of leading exporting countries risks having significant impacts on global markets if exports are interrupted due to adverse production shocks (e.g. poor harvests), policy changes in the major exporting countries, or conflict. Such interruptions could affect prices and availability of agricultural commodities, with implications for global food security. Risks to global markets are particularly high for highly traded commodities.

1.4.3. Growing differentiation between net exporting and net importing regions

Over the coming decade, the net exporting position of the Americas and Eastern Europe Central Asia and net importing position of Asia, the Middle East and Africa are expected to deepen. The evolution of agri-food surpluses and deficits of the main regions of the world (Figure 1.37, panel a) and important trading countries (Figure 1.37, panel b) sheds light on the direction of trade that differentiates net exporters from net importers.

Increasing trade surpluses from traditional exporters

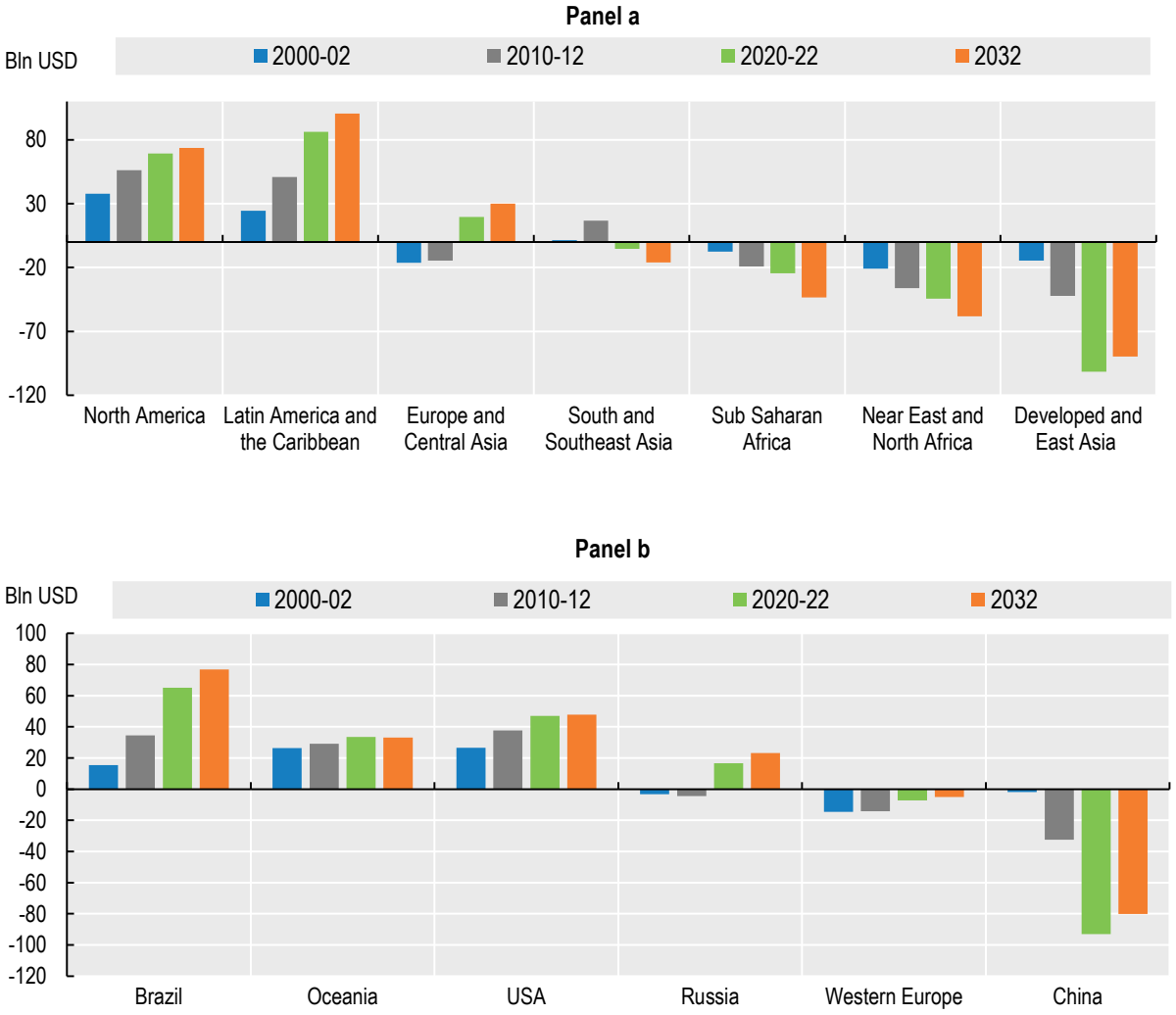
The Latin America and Caribbean region has experienced a vast expansion of its exports, notably from Brazil, and is projected to reinforce its position as the world's prime exporter of basic agricultural commodities. The dramatic surge in South America owes much to the spread of farming into the drylands of the *cerrado* in Brazil, which was not cultivated until the 1990s. The continued growth in production of soybeans, maize, protein meals, meat and raw sugar are expected to increase the net export position of the region by 17% between the baseline period 2020-22 and 2032.

Eastern Europe and Central Asia became a net exporting region in 2008. The collapse of the Soviet Union and the subsequent privatisation of state and collectively owned enterprises including farms led to significant productivity gains that boosted agricultural production. The limited domestic demand, due to stagnating population and per capita consumption, combined with a strong economic relationship with booming Asia contributed to the export expansion of the region. However, while Europe and Central Asia are projected to maintain a strong net exporting position, their past increase in trade surpluses of is expected to slow down in the short run because Russia's war against Ukraine is hampering growth in agricultural production and exports from these countries, with more profound impacts on the Ukrainian agricultural sector related to limited marketing opportunities, low farm gate prices and high input costs. In the medium term, the *Outlook* assumes that production and exports of these two countries will return to their pre-war trends. Western Europe (Figure 1.37, panel b) is a net importing region for the agricultural commodities covered in the *Outlook*, but a net exporter of processed food products. Western Europe's net trade deficit will decrease due to slower demand growth.

North America is expected to remain the second largest exporter of agricultural commodities to world markets over the next ten years, but its continued strong domestic consumption growth is expected to slightly slow down the progression of its net exporting position.

In Oceania, Australia and New Zealand are traditional net exporters of agricultural commodities. Over the coming decade, the region is expected to continue maintaining their net trade position, due to continued efforts to increase its access to other market through the negotiation of preferential trade agreements.

Figure 1.37. 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. Net trade figures include intra-regional trade but exclude intra-EU trade. The regions Developed and East Asia, and South and Southeast Asia are defined as in Chapter 2.

Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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Deepening net importing positions from regions with fastest population growth

Import patterns have changed significantly due to the substantial and continuous growth in demand for food and agriculture products from population booms and resource-constrained regions. Asia, with about 60% of the current world population, has seen its import demand more than quadruple in 30 years; this demand has been largely driven by rapid developments in China. China's net import position more than doubled over the last ten years and peaked in 2020 to represent 48% of the overall Asian trade deficit as the ASF outbreak caused a surge in its import demand; the country's exports remained broadly stable. The projected decrease in Chinese population growth will result in a stabilisation of its food consumption and feed use over the coming decade, implying that Asia's net trade deficit will increase by 11% only, in contrast to when it doubled between 2010 and 2020.

With the fastest growing population, Sub-Saharan Africa is the third largest net importing region of agricultural commodities, notably of cereals that support food security both directly and through their use as animal feed. In Sub-Saharan Africa, imports (mainly of maize, rice, wheat, and soybeans) are projected to grow strongly over the coming decade, as population growth is expected to outpace output growth. As a result, the region's trade deficit is projected to further increase by 77% between 2022 and 2032.

In the Near East and North Africa region, imports are projected to continue expanding over the next ten years, while exports are expected to decline, increasing the net trade deficit of the region by a further 32% until 2032. Strong population growth and limited growth in domestic production due to natural resource constraints underpin these trends.

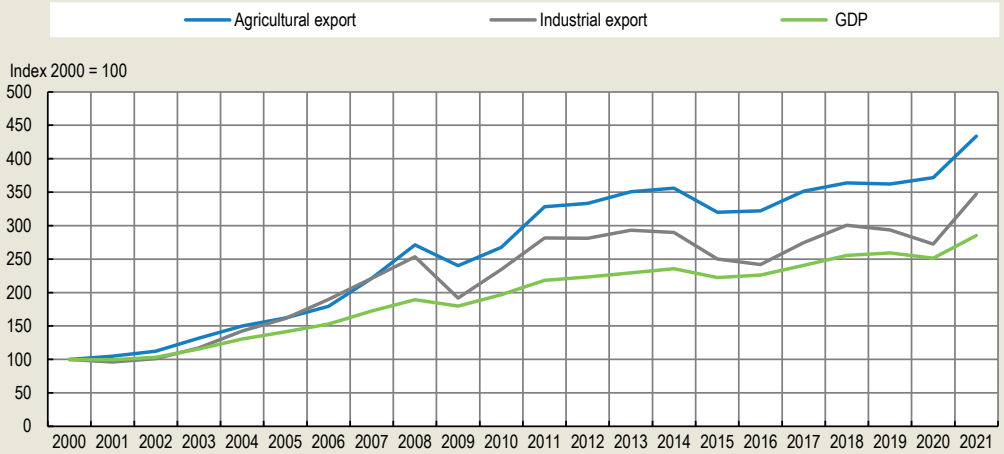
Trade liberalisation at the multilateral and regional levels has fostered greater participation in international markets. Box 1.3 looks at the evidence of globalisation and regionalisation of agricultural trade and highlights the role of trade policies in shaping the geography of trade. The global food and agricultural market has become more resilient, but many countries remain vulnerable to the impact of trade shocks on food security.

Box 1.3. From globalisation to regionalisation

Agricultural trade has been more resilient than industrial trade but is nevertheless affected by the transformation of global supply chains

After booming in the 1990s and the 2000s, the pace of globalisation stalled due to the global financial crisis, the deadlock in multilateral liberalisation negotiations, and diminishing civil society support for mega regional trade agreements. Trade in food and agricultural products showed more resilience than industrial trade during the COVID-19 pandemic. While sustained global cooperation and supportive trade policies maintained a well-functioning global agricultural market (unlike during the 2008 food crisis) (Figure 1.38), agricultural global supply chains are evolving towards greater regionalisation.

Figure 1.38. Growth in agricultural and industrial trade



Source: COMTRADE and World Bank World Development Indicators.

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At present, more countries are trading and the global agrifood market is less concentrated and more decentralised than in 1995 because of the greater participation of low- and middle-income countries. Before the creation of the WTO, a few large trading hubs dominated the trade network. Their dominance over time weakened as more countries participated in agricultural global value chains, resulting in more

South-North trade and more hubs than two decades ago. This trade integration has been an important driver of the diffusion of technology and knowledge necessary to promote productivity and overall growth.

The regionalisation of food and agricultural trade – the tendency of countries to trade more within a region than with countries outside the region – increased between 1995 and 2019. Within the global food and agricultural trade network, countries tend to form particular trade clusters and to trade more within them. These clusters may be regional, or they may expand to include countries across regions. They are often shaped by geographic proximity and economic integration fostered by trade agreements.

The global network of food and agricultural trade has become more balanced. Today, more countries are connected to more trade partners, which can strengthen the buffer capacity and resilience of the network. Several network indicators show that the connectivity of countries to the global network of food and agricultural trade has increased (Figure 1.39, Panel a). The higher the connectivity, the more countries are connected directly with each other (direct connectivity) and with countries that are themselves connected to many others (indirect connectivity). Connectivity can be measured by the number of links or by the value of products that are traded via these links.

Figure 1.39. Average connectivity between countries in the global food and agricultural trade network, 1995-2019

Note: Connectivity is measured by the number of trade links, i.e. import or export flows between countries. The higher the connectivity, the more countries are connected directly with each other (direct connectivity) and with countries that are themselves connected to many others (eigenvector or "indirect" connectivity). The closeness index indicates how "close" a country is to all other countries in the network. It is measured by counting the shortest paths, where each short path is defined as the strongest link, that is the link with the highest trade intensity (value of import or export flows of a country), between two countries. The higher the closeness index, the more central a country is located in the network and the "closer" it is to all other countries.
Source: Jafari, Engemann and Zimmermann (2022[15]).

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Countries are closely connected with each other and, overall, are better integrated in the trade network, as indicated by the connectivity indices (Figure 1.39, Panel a). The direct connectivity index counts the number of trade links that a country has within the global network of food and agricultural trade and is normalised by the total number of possible links in the network. The eigenvector connectivity further counts the trade links of all direct trade partners. The closeness connectivity index counts the shortest paths, where each short path represents the link with the highest trade intensity, between two countries. The higher the closeness index, the more central a country is located in the network and the "closer" it is to all other countries.

Historically, countries with similar income per capita tended to trade more amongst each other, reflecting similar tastes and preferences. However, with the increasing participation of low- and middle-income countries in global food and agricultural markets, high trade intensity was more likely to take place between countries of a different income group in 2019 than in 1995 (Figure 1.39, Panel b). The assortativity index by regions suggests that countries within a region tend to trade more with each other than with countries in other regions. The more pronounced regionalisation of agrifood trade is often shaped by geographic proximity and economic integration forged by regional trade agreements (RTAs).

Only a few countries continue to account for most of the value traded and only a few source a large variety of food and agricultural products from many different exporters. The fact that imports of most countries are concentrated on a few products from a limited number of trade partners makes them vulnerable to shocks in exporter markets. To improve their resilience and to ensure food security and healthy diets, countries should aim to diversify products imported and to increase the number of trading partners.

Source: FAO (2022[16]).

1.4.4. Trade plays a key role in ensuring food security and farmer livelihoods

International trade forms the backbone of the global food system. When the terms of trade are determined by comparative advantage and economies of scale, mutually beneficial trade can improve the availability and affordability of different foods and offer a wider choice for consumers. Trade is particularly important for resource-constrained countries, which are highly dependent on the import of basic and high-value commodities. Trade is also a driver of economic growth as it creates opportunities for producers, including smallholders, to access additional markets. Exports of agricultural commodities that account for a large share of domestic production in some countries are therefore an important source of income.

Figure 1.40 illustrates the share of exports in total production (panel a) and the share of imports in total consumption (panel b) for selected regions, measured in calorie equivalent. These shares should be put in perspective with the historical and projected developments of the net trade positions presented in Figure 1.37. At the global level, while net exporting and net importing positions are projected to deepen, the share of trade in production and consumption is expected to remain stable over the coming decade, suggesting they are proportional to production.

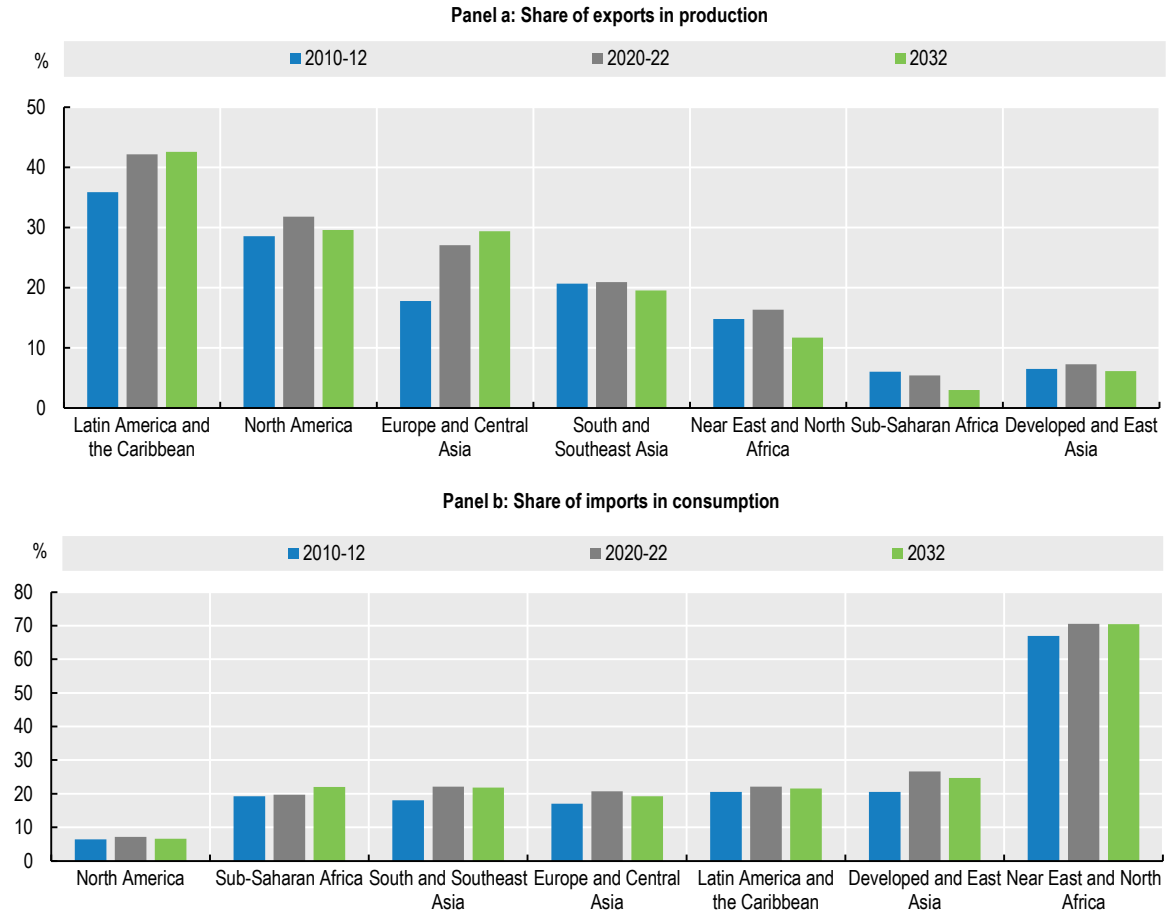
Large producing regions such as Latin America and the Caribbean and North America tend to export (including via intra-regional trade) a large share of their domestic production, at 42% and 32%, respectively in the baseline period 2020-22, and are expected to maintain these shares for the former or slightly reduce it for the latter in 2032. The Europe and Central Asia region is expected to increase its share of exports in domestic production from 27% in 2020-22 to 29% in 2032 (Figure 1.40, panel a).

The role of trade in providing a wider range of food is confirmed by the fact that even large net exporting regions rely on imports for their domestic consumption. In Latin America and the Caribbean, for instance, imports account for about 22% of total demand for commodities covered in the *Outlook* (Figure 1.40, panel b).

In the Near East and North Africa region, where the population is growing strongly and water resource constraints limit production response, imports play a significant role in complementing domestic food and feed production. Imports accounted for 71% of total demand of agricultural commodities in the region in 2020-22, a share that is expected to remain stable over the coming decade.

In Sub-Saharan Africa, the share of imports in total demand was lower, at 20% in 2020-22. However, this share is expected to reach 22% by 2032 as growth in domestic production will not keep up with high population growth (Figure 1.40, panel b). Insufficient infrastructure supporting the development of trade, but also the prominence of informal cross-border trade in the region, can explain the relatively low level of imports in consumption goods.

Figure 1.40. Trade as a share of total production and consumption by region, in calorie equivalents



Note: Calculations using average calorie content of commodities included in the *Outlook*. Note that exports/imports include feed, and availability includes processing of commodities which may be re-exported. The regions Developed and East Asia, and South and Southeast Asia are defined as in Chapter 2.

Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.4.5. Uncertainties affecting international trade in agricultural commodities

The disruptions in global supply chains caused by the COVID-19 pandemic due to the increased demand for durable goods and the logistical bottlenecks created by movement restrictions in locked-down countries, have faded. While freight and shipping container rates are decreasing, infrastructure challenges

continue to be a problem for some supply chains. Moreover, energy price hikes and the sustained price volatility resulting from Russia's war against Ukraine have had a big impact on transportation costs and their evolution remains subject to high uncertainty.

The recent price surge and volatility have revived the risk of countries imposing export restricting measures to keep domestic food inflation in check. According to the International Food Policy Research Institute (IFPRI) presentation given during the Agricultural Market Information System (AMIS) initiative webinar "Ukraine One Year Later – The Impact of the War on Agricultural Markets and Food Security" (AMIS, 2023[17]), at least 20 countries have imposed a limit on exports since the war began. Yet export bans are only aggravating the adverse effect of price uncertainties and can only push prices further up. They have a negative impact on global food security (and livelihoods) in the short term, and undermine supply capacity in the long term.

Increasing concerns on the role of globalisation in global warming, the depletion of natural resources, deforestation, and biodiversity loss support growing demands for more sustainable food and agricultural trade. However, the agricultural support policies and unilateral trade policy approaches adopted to pursue climate change mitigation objectives can create important distortions on production and trade.

Developments in trade policies that will be negotiated and implemented over the coming decade could have significant impacts. The *Outlook* includes only policies that are currently in place and holds them constant over the medium term; this constitutes a source of uncertainty as any change in policies over the coming decade will affect the projections. New trade agreements (e.g. Regional Comprehensive Economic Partnership, EU-Mercosur), for instance, will potentially increase intra-regional and inter-regional trade over the next ten years.

1.5. Prices

The *Outlook* uses prices recorded in the main international markets for each commodity as international reference prices. In addition to market fundamentals, current prices are influenced by the effects of short-term demand and supply shocks, such as economic and political shocks (e.g. the COVID-19 pandemic and conflicts), and annual weather fluctuations. In addition, speculation within the context of portfolio investment decisions can influence prices at certain points in time. As the effects of these shocks are largely unpredictable and cannot be incorporated into the projections, prices in the *Outlook* are assumed to return to their long-term trends, which are determined by demand and supply fundamentals.

1.5.1. Agricultural price trends and main drivers

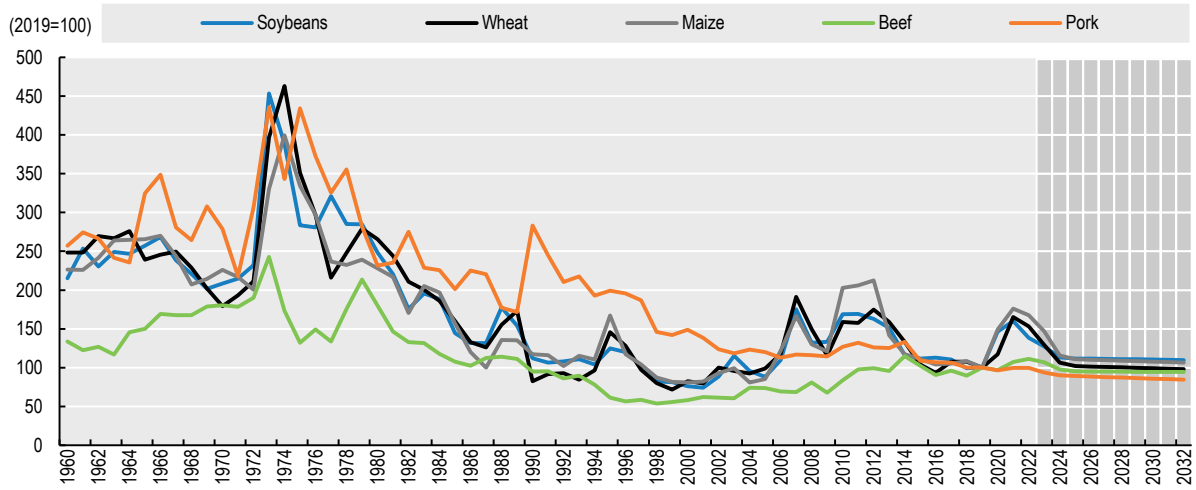
Productivity gains the key to production increases

Current real prices (i.e. adjusted for inflation) for most agricultural commodities covered in the *Outlook* are high by historical comparison, but have started to fall in 2022 and are expected to continue downward over the coming decade returning to their projected longer-term trend level (Figure 1.41).

Real prices of agricultural commodities have been on a declining trend since the 1960s due to rising productivity, which lowers the marginal cost of production of food commodities. Prior to 1990, most output growth at the global level was driven by intensifying land use and increasing the area under cultivation, as well as extending irrigation. After 1990, growth in total factor productivity (TFP, i.e. output expressed relative to total inputs used in production) accounted for most of the growth in world output. The emergence of new technologies in the 1990s contributed to improved yields and led to falling marginal production costs, resulting in lower food prices despite rising food demand, especially in high-, upper and lower middle-income countries.[3] Looking forward, yield increases will continue to be the main driver of production increases as the availability of new land is limited. However, sustained agricultural productivity growth may

be threatened in the longer-term as average temperatures exceed the biological thresholds of many crop and livestock species.

Figure 1.41. 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 (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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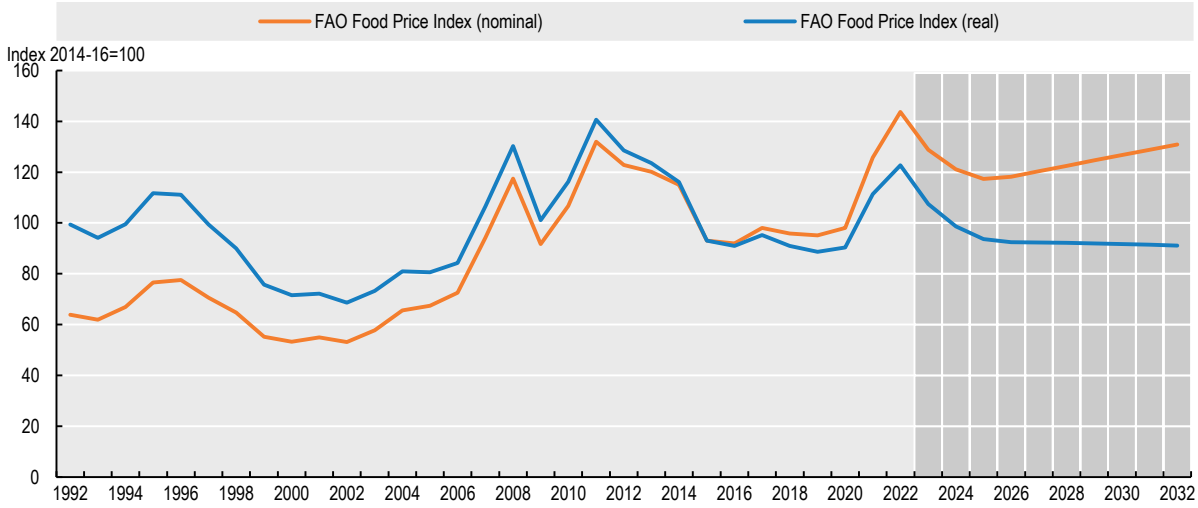
Many real prices of agricultural commodities rose substantially in 2020 and 2021, and rose or remained high in 2022. This was due to the recovery following the COVID-19 pandemic, tight global supplies because of higher production costs (mainly energy and fertiliser) due mainly to supply chain disruptions. Poor weather affected harvests in several important producing countries. In addition, Russia's war against Ukraine reduced harvests of key crops in 2022 in Ukraine.

The *Outlook* projects that real prices of agricultural commodities will fall more rapidly in the early years of the projection period as the factors that underpinned the price increases subside; real prices will then resume their projected long-term declining trend, consistent with supply and demand fundamentals expected over the next decade. These projections take into account income and population growth, combined with prevailing consumer trends that influence demand, and continued productivity growth increasing supply.

The FAO Food Price Index (FPI) shows the development of international reference prices of major traded food commodities in a single indicator, and it is aligned with the projections for the commodities covered in the report (Figure 1.42).

Figure 1.42. 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 (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.5.2. Commodity price trends

The grain price spike was due to the COVID-19 pandemic restrictions, and the high input, energy and transport costs. Prices of wheat and maize peaked in 2022, and they are expected to remain higher than their pre-COVID-19 levels in 2023. However, assuming average yields and a broad geopolitical stability grain prices will return towards their long-term trends. Falling wheat prices and recovering rice prices indicate the rice-to-wheat price ratio approach long-term, pre-COVID-19 levels. As cereal prices revert to their projected long-term trend, the co-movement of wheat and rice prices will maintain or return to their historic ratio.

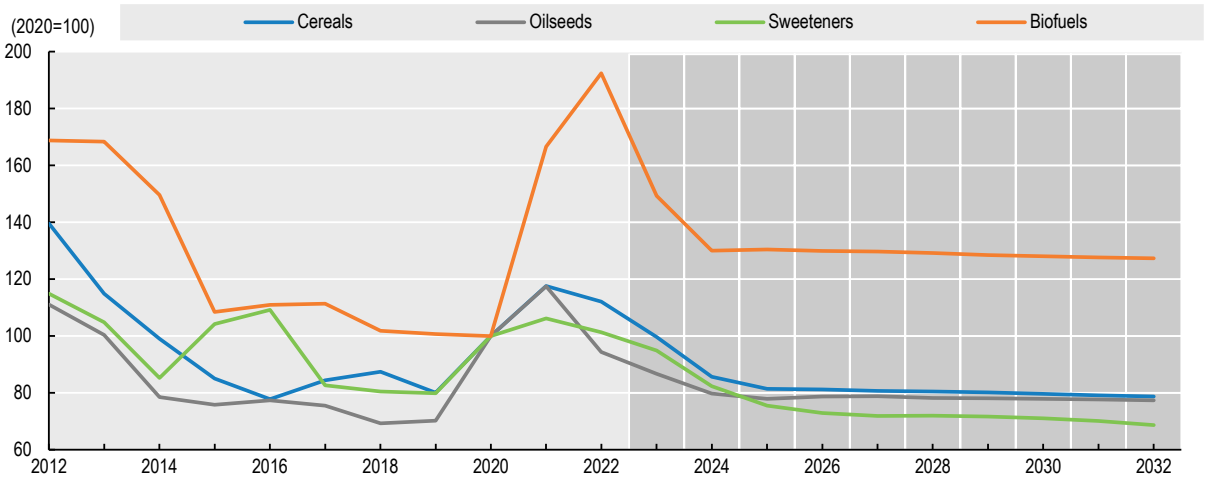
Oilseed prices increased rapidly since 2021 largely due to strong demand, especially for soybeans from China, where hog herds were being rebuilt following the African swine fever (ASF) outbreak necessitating higher feed use. In addition, lower production of soybeans in South America and rapeseed in Canada, combined with Indonesia's export restrictions on palm oil and reduced sunflower oil exportable availabilities following the outbreak of the Russia's war against Ukraine pushed up prices further. After reaching all-time highs in early 2022, international prices for oilseeds and derived products started to fall, mainly on account of prospects of a record soybean harvest in Brazil and ample vegetable oil supplies following the relaxation of restrictive export measures in Indonesia. In the longer-run, oilseed and protein meal prices are expected to decline in real terms while vegetable oil prices could increase in nominal and real terms due to strong demand and constrained production growth as palm oil plantations in Indonesia and Malaysia are maturing and arable land available for oilseeds cultivation in the European Union and China is limited.

Real sugar prices also peaked in 2021 as exports from Brazil were reduced at a time of strong global demand. Higher global production in 2022/23, mainly due to better harvests in Brazil and Thailand, is reflected in higher availability, causing sugar prices to further fall in the near term, although this decline is dampened by still high input prices. The downward trend in sugar prices will continue over the longer-term, due to rising productivity and slowing demand growth. However, stable international crude oil prices are expected to partially offset downward pressure on sugar prices.

Real biofuel prices rose dramatically in 2020 and 2022, driven by high feedstock prices and higher labour costs. Real feedstock prices (i.e. sugarcane, molasses, maize, and vegetable oil) are expected to return to their projected long-term trend over the projection period and biofuel prices are expected to decline and stabilise, although at a higher level than in 2014-2020. However, biofuel production and consumption, and hence prices, will remain heavily influenced by policies, such as blending mandates and domestic support measures.

The higher biofuel to fossil fuel price ratios in 2020 and 2021 reflected high feedstock prices combined with relatively low oil prices. As feedstock prices decline over the projection period, this ratio is expected to revert to historic levels (Figure 1.45). In this regard, the assumption in the *Outlook* of mandates that bind the demand for biofuels with fossil fuel, will contribute to the stability of their relative price.

Figure 1.43. Medium-term evolution of crop-based commodity prices, in real terms



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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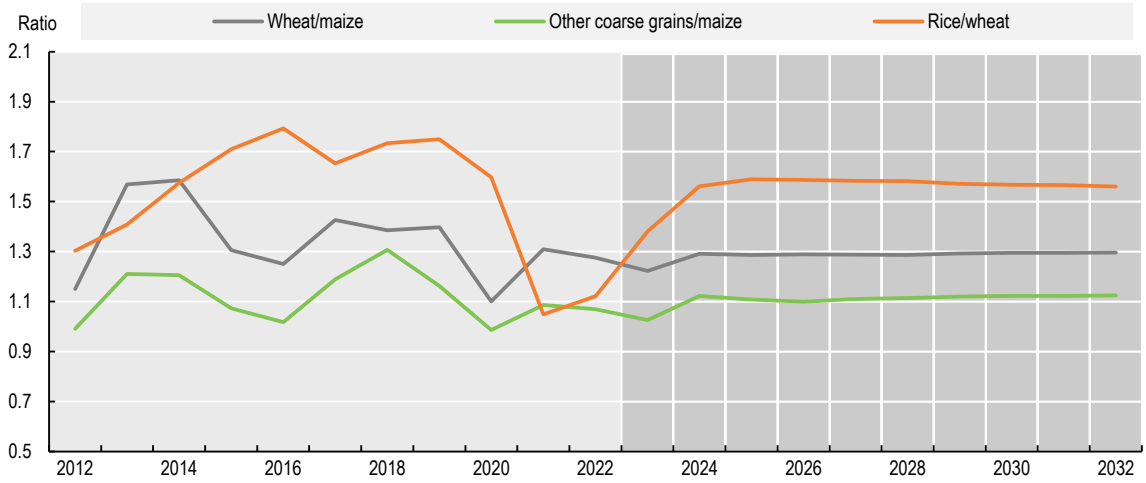
Figure 1.44. Cereals' price ratios



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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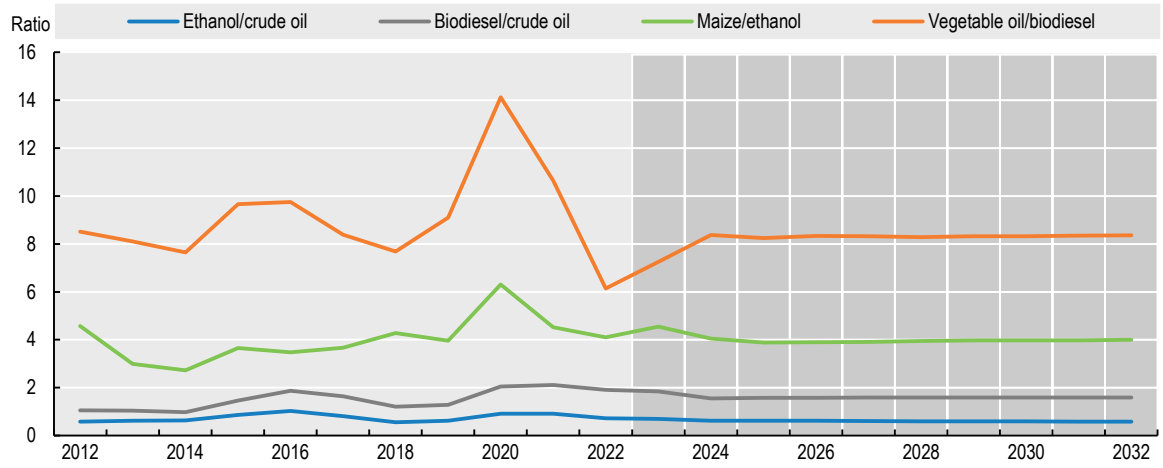
Figure 1.45. Biofuel price ratios



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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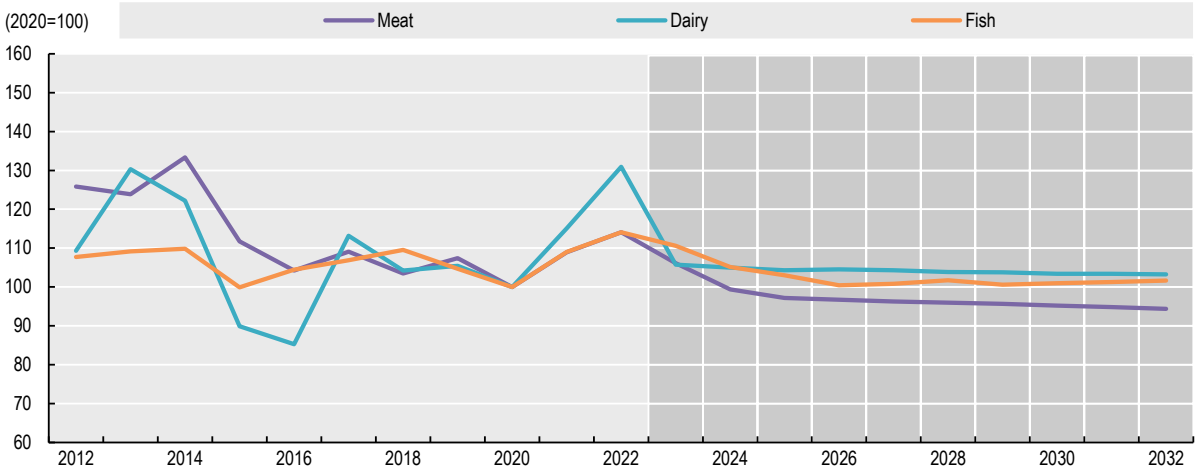
Real meat prices rebounded in 2021 and 2022, reflecting higher demand following the economic recovery from the COVID-19 pandemic as well as increased transportation and marketing costs. Meat prices are projected to decline in 2023 and continue to gradually fall in real terms over the next decade as demand weakens, supply chains stabilise, productivity continues to grow and feed costs decrease (Figure 1.46). Pigmeat prices are expected to decline more than prices for other meats due to the recovery of production following the ASF outbreak, especially in China, Viet Nam, and the Philippines.

Figure 1.46. Medium-term evolution of animal-based commodity prices, in real terms



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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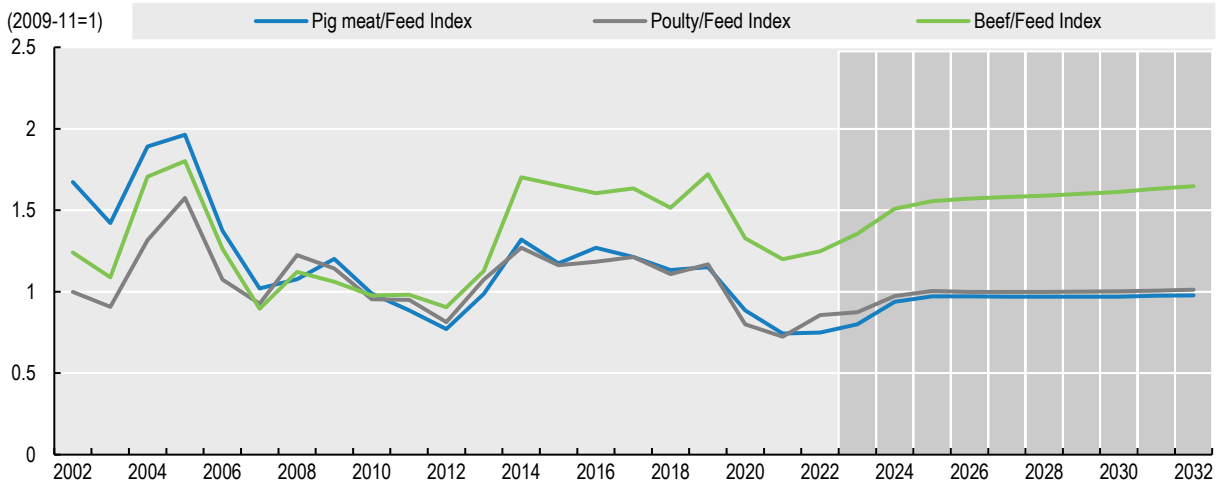
The ratio of meat prices to a feed price index is expected to rise in the short term and then stabilise (Figure 1.47). Beef prices, however, are less affected by cereal and protein meal prices, since most global beef production is pasture-based. Pigmeat and poultry prices show a strong link to feed costs as their

production uses more grain and protein meal-based feed. The tendency is for the ratio of meat to feed prices to remain within a relatively narrow band.

Figure 1.47. Meat to feed price ratios



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

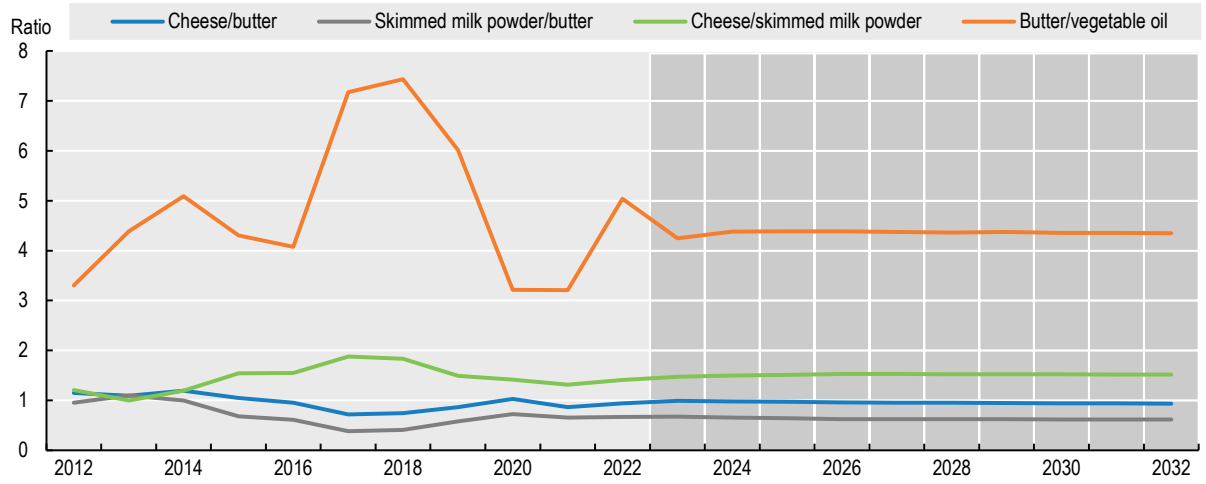
StatLink https://stat.link/e1cdyp

About 93% of global milk production is consumed domestically in the form of fresh, unprocessed, or lightly processed (e.g. pasteurised or fermented) dairy products. Marginal productivity is assumed to improve in dairy sectors across the world leading to a gradual decline in real prices for these fresh dairy products. Higher international prices in 2021 and 2022 were driven by high demand, high inputs costs and tight supply from the main exporters. International dairy prices are expected to fall in the short-term and return to the longer-term pre-COVID-19 trend as supply chain disruptions ease and marginal costs decline.

Global price developments in the dairy sector are mainly determined by trends in the international prices of butter and skim milk powder (SMP), which set the value of milk fat and non-fat milk solids, respectively. Both SMP and butter prices were expected to remain high in 2022 mainly due to high production costs and strong demand: the latter also affected by high vegetable oil prices, with the price of butter increasing more than vegetable oils through 2022 (Figure 1.48). SMP and butter prices are expected to start decreasing thereafter and to resume their long-term declining trends as supplies respond to current price signals. Real prices of cheese and whole milk powder (WMP) also track developments of butter and SMP prices, respectively.

Real fish prices rose in 2021 and 2022 due to high demand at both household and food service levels, following the recovery from the COVID-19 pandemic, and the modest supply response to growing demand. After 2023, real prices for capture fish are projected to decline while for aquaculture and fish oil there is a modest upward trend. Real prices for aquatic food are projected to remain flat while fishmeal prices fluctuate around a flat trend. Although over the longer-term real prices of fish are projected to decline or remain largely flat, fluctuations over the next decade are expected because of recurring *El Niño* conditions that limit capture in the Pacific.

Figure 1.48. Dairy price ratios



Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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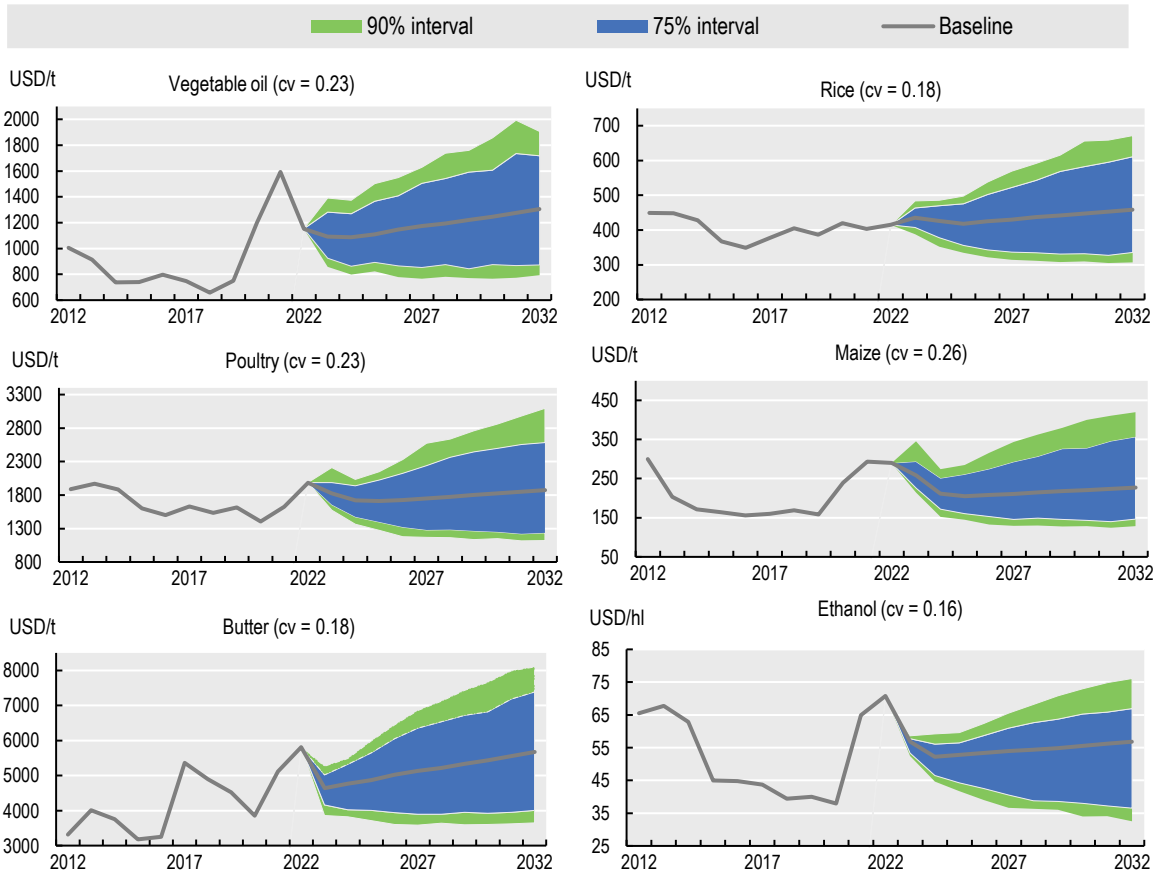
1.5.3. Transmission of price signals within the global food system

While the international reference prices used in the *Outlook* characterise global markets, their actual impact on the decisions of producers and consumers is thought to be indirect. In domestic markets, individual producers and consumers are mainly price takers and their aggregate behaviour determines 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 small share in global markets, a well-developed trade infrastructure and/or high substitutability of trade for domestic products, domestic market shocks are absorbed quickly through trade, and domestic prices are not affected. Major producer and consumer countries transmit their domestic market trends and variability more directly into the global market. By contrast, countries having only very limited interaction with the global market, i.e. those with high self-sufficiency, are mostly, but not always, shielded from shocks transmitted by global price movements, yet they are more exposed to domestic shocks.

Price transmissions are also affected by trade policies, where restrictive policies can effectively dampen the transmission of price volatility to domestic markets. However, when restrictive policies are implemented by countries that account for a large share of the market, or when such policies are implemented collectively, they are likely to exacerbate price volatility.

Figure 1.49. Baseline and stochastic intervals for selected international reference prices



Note: Expected evolution of nominal prices under the baseline scenario of the Outlook (solid line) in relation to the stochastic outcomes shown in the blue 75% and green 90% confidence intervals.
Source: OECD/FAO (2023), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

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1.5.4. Many uncertainties in the next decade mean price projections need to be interpreted with care

Price projections presented in this *Outlook* result from the interplay of fundamental supply and demand factors under normal weather, macroeconomic and policy assumptions. The *Outlook* is based on the best information available, but there is an unavoidable degree of uncertainty attached to the projections and to the underlying assumptions. Until a mutually agreeable solution is identified, Russia's war against Ukraine will continue to add uncertainties to energy, input, and agricultural commodities prices. At the onset of the war, reduced availability of grains, oilseeds and fertilisers was of major concern for global markets. More than one year after the start of the war in February 2022, market access issues have somewhat improved thanks to the enforcement and subsequent extension of the Black Sea Grain Initiative, as well as expanding capacity of rail, road and river based export channels from Ukraine via the European Union-Ukraine Solidarity Lanes. However, high and volatile energy prices remain an important factor in food price inflation. In addition, the possible use of trade restrictions and subsidies by some countries to manage domestic inflation is a further source of uncertainty. And in the longer-term, climate change and environmental policies may cause market disruptions.

The assumption of normality in this *Outlook* results in a smooth trajectory for most projected variables, deviations from the assumed trends causing 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 drives and specific agricultural crop yields. Variability related to animal disease or policy changes is not considered. The aggregated results of multiple PSA simulations indicate the sensitivity of the baseline price paths (Figure 1.49). With likelihood of 75%, prices will remain within the blue range in any given year while they are expected to remain with a probability of 90% 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 is considerably larger than that estimated for last year's *Outlook*. This is most pronounced for vegetable oil, rice, poultry and maize. Notably, the variability is generally much larger above the baseline.

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Notes

[1] Meat includes beef and veal, poultry, pigmeat and sheepmeat. Dairy products include butter, cheese, fresh dairy products, skimmed and whole milk powder, whey powder, and, for few cases, casein. Fish includes both fish from capture fisheries and aquaculture.

[2] By-products of crop production include cereal bran, beet pulp, dried distilled grains, and molasses. By-products of livestock production mainly include meat and bone meals.

[3] Fuglie, K., J. Jelliffe, and S. Morgan, “International Agricultural Productivity”, https://www.ers.usda.gov/data-products/international-agricultural-productivity/. Last updated: Friday, 7 October 2022.