Challenges and opportunities for food and agriculture in the 21st Century

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Challenges and opportunities for food and agriculture in the 21st Century

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Abstract. The food and agricultural sector will have to respond to growing and changing demand, while facing increasing constraints on natural resource use. It will also have to adapt to climate change, and is expected to contribute to its mitigation. At the same time, the whole supply chain is undergoing significant structural changes and agricultural markets are evolving, notably with the emergence of new players. Innovation will be key for the sector to achieve sustainably the productivity growth needed to meet future demand and ease price tensions on world markets. Agricultural policy reform has an important role to play in facilitating innovation and adjustment, by providing targeted incentives, removing market and trade distortions, providing efficient tools for risk management, and promoting sustainable practices and technologies. But attention should also be paid to other policy areas that contribute to the longer-term competitiveness of the sector, such as the provision of rural infrastructure and services and an efficient regulatory framework. Improving the efficiency and the relevance of agricultural innovation systems is also essential. Developments in agricultural higher education need to be considered in this context.

Keywords. Agricultural markets – Food – Productivity – Sustainability – Agricultural policy.

Défis et opportunités pour l'avenir du secteur agricole et alimentaire

Résumé. *Le secteur agricole et alimentaire devra répondre à une demande croissante et en mutation tout en faisant face à l'augmentation des contraintes sur l'utilisation des ressources naturelles. Il devra également s'adapter au changement climatique et contribuer à sa réduction. Ceci dans un contexte caractérisé par les changements structurels dans l'ensemble de la filière et la transformation des marchés agricoles avec, notamment, l'émergence de nouveaux acteurs. L'innovation sera essentielle pour permettre au secteur d'accroître sa productivité de façon durable et répondre ainsi à la demande future et atténuer les tensions sur les prix des marchés mondiaux. Les politiques agricoles ont un rôle important à jouer pour faciliter l'innovation et l'ajustement par le biais d'incitations ciblées, de l'élimination des mesures qui faussent la production et les échanges, d'e la mise en place d'outils de gestion des risques efficaces, et par des mesures encourageant les pratiques et technologies durables. Il convient cependant de considérer également les autres domaines d'action qui contribuent à la compétitivité du secteur à long terme, tels que les infrastructures et services dans les zones rurales, et la mise en place d'un cadre réglementaire efficace. Il est également essentiel d'améliorer l'efficacité et l'adéquation des systèmes d'innovation agricoles. L'évolution de l'éducation supérieure agricole doit être considérée dans ce contexte.*

Mots-clés. *Marchés agricoles – Alimentation – Productivité – Durabilité – Politiques agricoles.*

I – Global challenges for food and agriculture

The agriculture and agri-food sector is expected to provide healthy, safe and nutritious food for a growing and wealthier world population, feed for increasing farm animal populations, and fibre and fuel for a growing range of industrial uses – all without depleting available land, water and biodiversity resources. At the same time, climate change will affect production conditions, and in particular it

is expected to increase uncertainties. Current productivity and sustainability trends raise concerns over the capacity of the sector to meet these global food security and climate change challenges.

Public and private actors will need to work together to improve productivity growth sustainably along the supply chain. This means improving total and partial factor productivity growth and reducing food waste in primary agriculture and at the processing and distribution levels. Natural resources will need to be used more efficiency and sustainability, while negative external effects are minimised. Agriculture will also need to adapt to climate change and is expected, along with other sectors, to contribute to the mitigation of its impacts. Responding to market opportunities will also require the adoption of technologies and practices that are better adapted to changing demands.

II – Productivity and sustainability performance

Since the 1990s, total factor productivity (TFP) growth has been the main driver of agricultural output growth, with land expansion and higher application of inputs per hectare, which used to be the main drivers of output growth, now playing a limited role. TFP growth varies by country and region. Major transition and emerging economies achieved significant TFP growth of over 3% in the 2000s, representing generally a large increase compared to the previous decade, with the exception of India and China (Fig. 1). TFP growth has been more modest and lower than in the previous decade in main OECD agricultural exporters such as Australia, Canada and the United States, as well as in some EU member states like the United Kingdom, and to a lesser extent France. Decreasing TFP growth in high population countries like China and India, and in major exporting countries, has raised concerns over global food security in the future and prompted investigations into the potential causes of these developments, which may include lack of innovation and the impacts of climate change (e.g. Gray *et al*., 2014), It has also led to consideration of government action to foster productivity growth, sustainably (IO, 2012; OECD, 2015a, b, c, d).

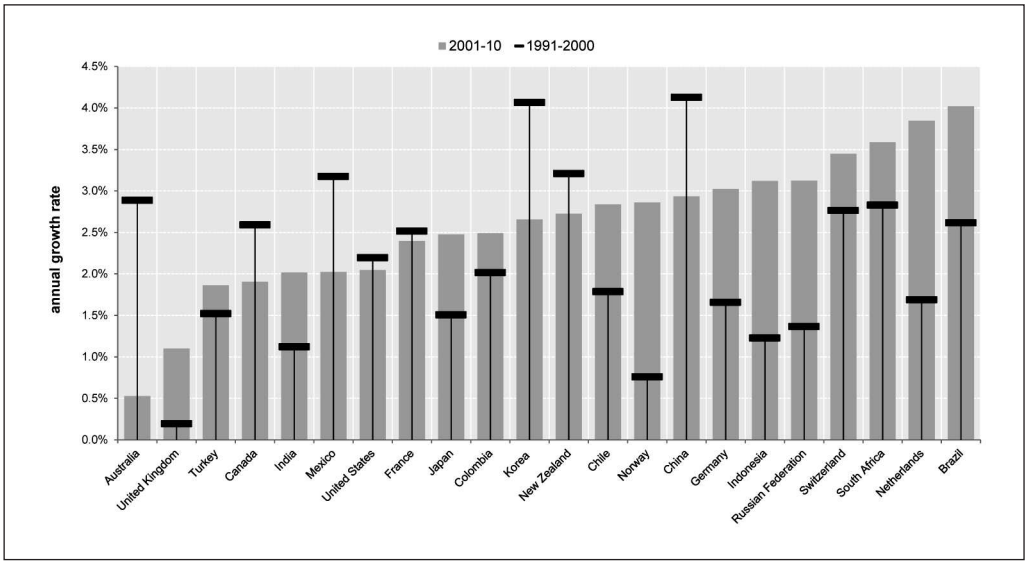

Fig. 1. Total Factor Productivity growth by country.

Source: United States Department of Agriculture, Economic Research Service, Agricultural Productivity Database, 2014. *www.ers.usda.gov/data-products/international-agricultural-productivity/documentation-and-methods.aspx#excel*

Another concern is whether current trends in TFP growth are sustainable in the longer terms. Primary agriculture is a major user of natural resources, in particular in the developing world (Table 1). In many parts of the world, agriculture faces constraints on natural resources. Agricultural land increases at a reduced rate. Two-third of land expansion is in Latin America and Africa, but 70% suffers from soil and terrain constraints (IO, 2012). According to OECD projections, 40% of the world population will live near river basins with severe water stress by 2050 (OECD, 2012). In addition, land use changes are the cause of losses in biodiversity, and agriculture is a major source of pollution from nutrients and greenhouse gas (GHG) emissions (Table 1). Finally, climate change is expected affect natural resource availability and quality, increase weather variability and the occurrence of extreme weather events. This could pose additional sustainability challenges, in particular in countries already under resource stress.

Table 1. Share of agriculture in GDP, natural resource use and emissions

	OECD countries	Non-OECD countries
Gross Domestic Product	2.6%	> 25% in less-developed countries
Land	36%	30-55%
Water	44%	> 70%
GHG emissions	8%	> 17%
Ammonia emissions	91%	> 94%

Source: *OECD, 2013a. OECD Compendium of Agri-environmental Indicators*, OECD Publishing, Paris. *http://dx.doi.org/10.1787/9789264181151-en.* FAO agri-environmental indicators, FAOstat: *http://faostat.fao.org/site/674/default.aspx*

In OECD countries, aggregate trends in agri-environmental indicators show encouraging developments (Fig. 2). In the 2000s, agricultural production has increased using less land, water and inputs, and severe erosion risk is limited to some countries. But more needs to be done as problems of water quality remain, biodiversity losses continue and despite average improvements, problems can remain severe at the local level.

Societal demand is also changing in developed countries. The value of agricultural ecosystem services is increasingly recognised, while concerns for environmental impact of farming are rising.

III – Market developments

Following the price spikes of recent years, food markets are now calmer, with strong harvests and abundant stocks for cereals and oilseeds. Meat and dairy markets follow diverse trends: World markets in 2014 saw record high prices for meat linked to disease outbreaks and herd rebuilding in several countries, but sharp drop in dairy prices resulting from strong production in the European Union and New Zealand, and reduced demand from China and Russia. These developments took place in a context of low oil prices, which make biofuel production not profitable without mandates or support policies, and weak economic growth globally (OECD/FAO, 2015).

According to the most recent OECD-FAO outlook for agricultural markets 2015-2024 (OECD/FAO, 2015), real food prices expected to decline slightly, but remain above levels before 2007-08 food price crisis. As shown in Fig. 3, projected real prices continue a trend of long-term decline. Periods of high and volatile prices may occur, but there is no long term evidence that demand will consistently outstrip supply and reverse this pattern.

The composition of demand is projected to change with consumption of staples reaching saturation in many countries, and demand for protein increasing with income growth. As a result, meat

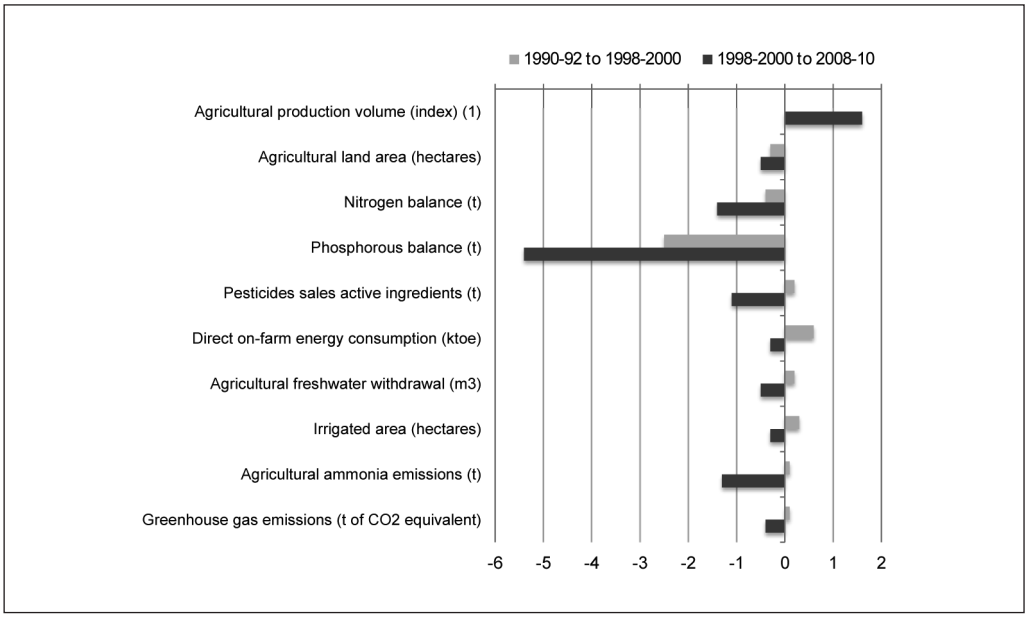

Fig. 2. Key agri-environmental indicators, OECD average, 1990-2010.

Notes: t: tonnes; toe: tonnes oil equivalent; m3: cubic meters; CO2: carbon dioxide.

The OECD total average for the indicators listed here is the average for 34 member countries, except (figure in brackets show the number of OECD countries included in the average calculation): nitrogen and phosphorus balance (31); pesticide sales (29); on-farm energy consumption (32); freshwater withdrawals (24); irrigated area (21); and ammonia emissions (26).

1. For technical reasons, the OECD agricultural production volume annual average growth rate is not calculated for the period 1990-92 to 1998-2000.
2. The annual growth rate for irrigated area between 1990-92 to 1998-2000 was less than 0.1% per annum.

Source: OECD, 2013a. OECD Compendium of Agri-environmental Indicators, OECD Publishing, Paris.
http://dx.doi.org/10.1787/9789264181151-en

and dairy prices increase relative to crops, and coarse grain and oilseed prices increase relative to food staples, driven by feed demand. Growth in livestock production is expected to outpace crop production in the next decade.

Regional patterns of production and trade are also expected to change. The importance of emerging economies in both production and demand is projected to rise. Imports spread across a large number of countries, while exports are concentrated among a few key suppliers. Asia is expected to account for nearly half of all additional consumption and production in the world. Significant production expansion in Africa is mitigated by population growth. The meat and grain sectors in Latin America are increasingly export oriented as domestic consumption growth slows.

The outlook assumes constant policies and “normal” market conditions but there are risks related to economic growth, energy prices, and agricultural and trade policy changes, as well as long-term structural uncertainties regarding productivity growth rates, natural resource constraints and climate change. In order to prepare for uncertainties, and anticipate unknowns, long-term scenarios can be developed to sketch different futures. This exercise requires collaboration between various stakeholders and experts from different countries. Scenario analysis can serve as a framework for strategic conversations aiming to search for “robust policies” taking uncertainties

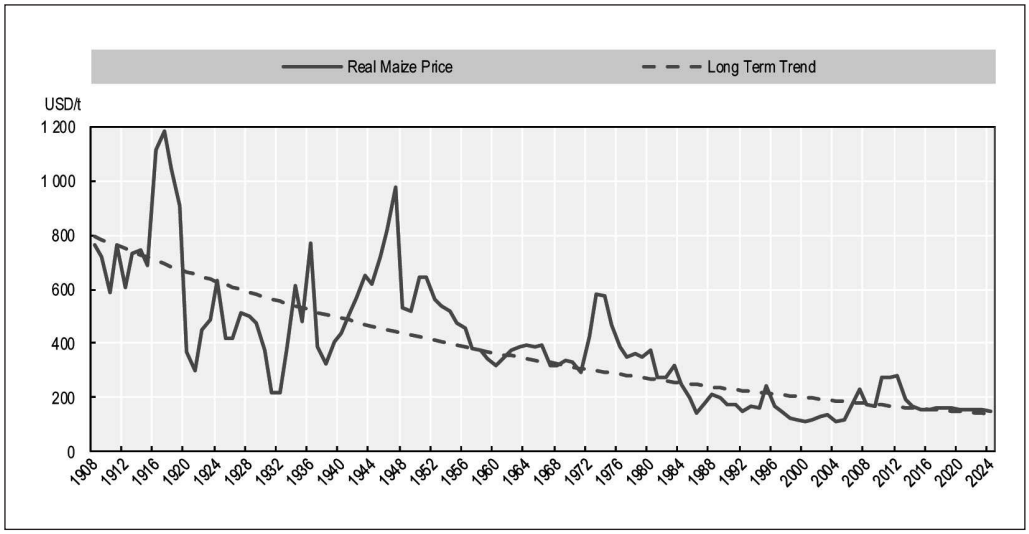

Fig. 3. Long-term price of maize in real terms, 1908-2024.

Note: The US yellow #2 Gulf maize price is used as a benchmark for the coarse grain world market price. This price is recorded back to 1960 in World Bank datasets as monthly data. Monthly prices were converted to annual averages using the maize marketing year September-August. For the years 1908-59 the series is extended using the relative changes in "corn price received" from the USDA quickstats. Nominal prices are deflated using the consumer price as reported by the Federal Bank (*www.minneapolisfed.org/community_education/teacher/calc/hist1800.cfm*).

Source: OECD/FAO, 2015. OECD-FAO Agricultural Outlook 2015, OECD Publishing, Paris.

DOI: *http://dx.doi.org/10.1787/agr_outlook-2015-en*

into account; and guide long-term investment decisions, e.g. in research and development (R&D) and education. The need for foresight exercises is increasingly recognised at national and international level. For example, the OECD recently developed and analysed alternative scenarios for global food and agriculture to help develop robust strategies (OECD, 2015e).

IV – Policy and sector's responses

1. Policy developments

Following a series of reforms and trade agreements since the 1980s, agricultural policies in OECD countries affect agricultural markets to a much lower extent than they used to.

Average support to producers from agricultural policies in OECD countries and emerging economies covers in OECD estimations has been decreasing since the mid-1990s. It represented 17% of gross farm receipts in 2012-14 compared to 21% in 1995-97 (OECD, 2015f). But this hides important differences in support levels between individual countries ranging from taxes to agriculture in Ukraine to support representing over half of farm receipts in Norway, Switzerland, Japan and Korea (Fig. 4). Moreover, while support has decreased in all OECD countries, it has increased significantly in some emerging economies (Indonesia, China and Kazakhstan, and on average support to agricultural producers in OECD countries and emerging economies is converging (Fig. 5).

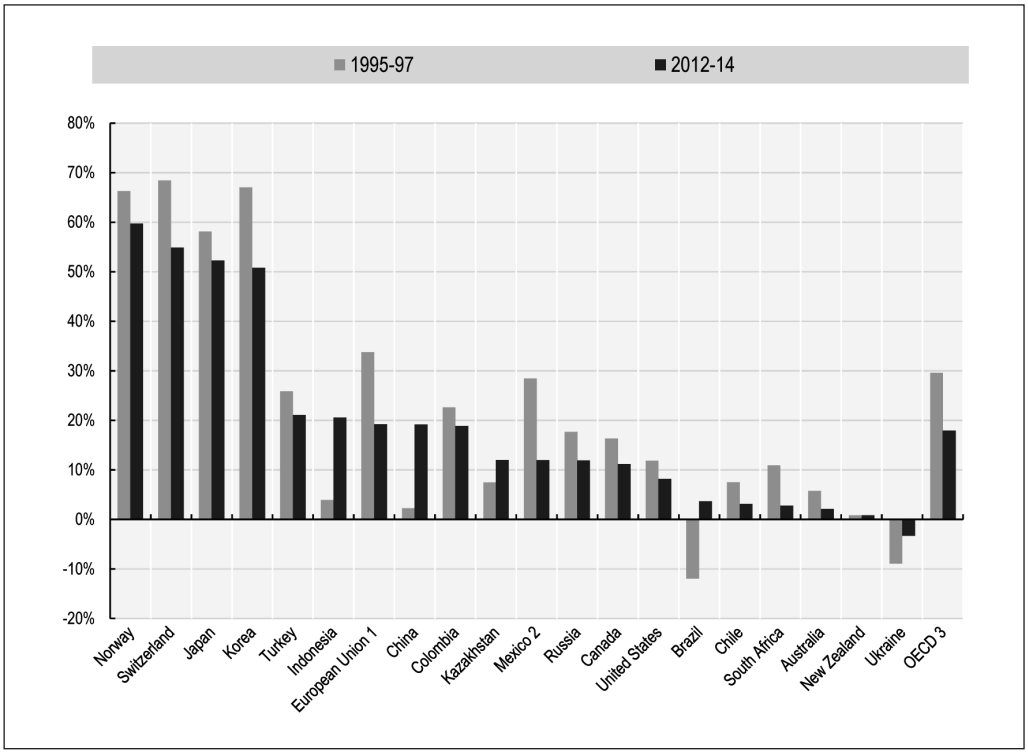

Fig. 4. Producer Support Estimate by country, 1995-97 and 2012-14. Percentage of gross farm receipts.

Notes: Countries are ranked according to 2012-14 levels. EU15 for 1995-97; EU27 for 2012-2013; and EU28 from 2014 when available.

2. For Mexico, 1995-97 is replaced by 1991-93.
3. The OECD total does not include the non-OECD EU Member States. The Czech Republic, Estonia, Hungary, Poland, the Slovak Republic and Slovenia are included in the OECD total for all years and in the EU from 2004.

Source: OECD (2015a), "Producer and Consumer Support Estimates", OECD Agriculture statistics (database). *http://www.oecd.org/tad/agricultural-policies/producerandconsumersupportestimatesdatabase.htm*

In addition to reducing support levels to producers, agricultural policies in OECD countries have also reduced distortions to trade, market and the environment, by delinking the granting of support from current production levels, imposing conditions on production practices, facilitating the adoption of innovations, promoting more sustainable and climate-friendly technologies and practices, and remunerating services. Better targeting towards specific objectives has helped improve the efficiency with which public resources are spent, but in many countries, broad-based income support is still important and domestic prices continue to be maintained above world market levels.

Countries also finance all or part of general services to the sector. These include agricultural R&D, education and advisory services, inspection, rural infrastructure, marketing and promotion actions. These expenditures contribute to improve the long-term competitiveness of the sector, although they do not necessarily benefit individual producers directly. Some countries have focused their efforts in providing an economic environment that enables the sector to invest and innovate in order to become more productive and sustainable.

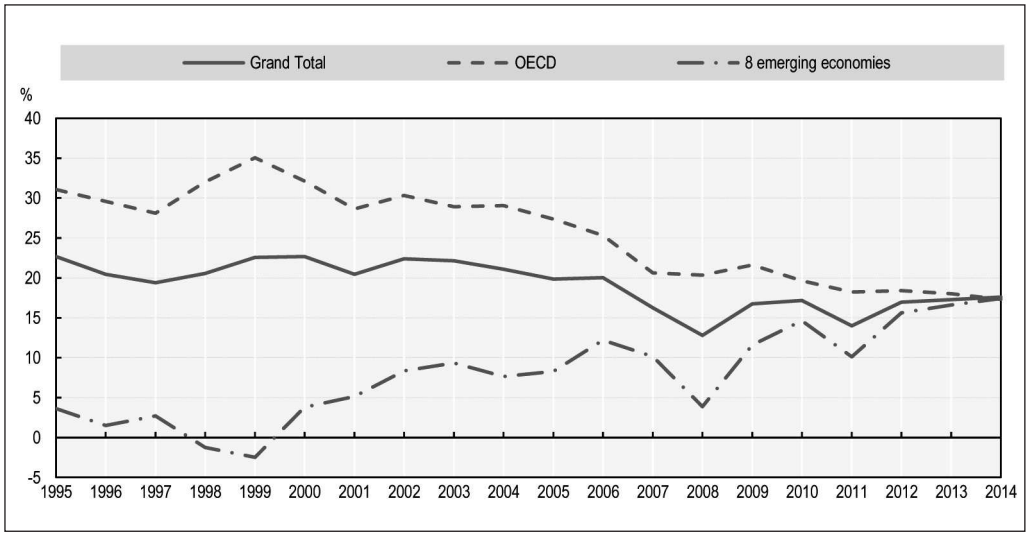

Fig. 5. Evolution of Producer Support Estimate, 1995 to 2014. Percentage of gross farm receipts.

Note: % PSE: Producer Support Estimate in percentage of gross farm receipts.

The OECD total does not include the non-OECD EU Member States. The Czech Republic, Estonia, Hungary, Poland, the Slovak Republic and Slovenia are included in the OECD total for all years and in the EU from 2004. The emerging economies are Brazil, China, Colombia, Indonesia, Kazakhstan, Russia, South Africa and Ukraine.

Source: OECD (2015a), "Producer and Consumer Support Estimates", OECD Agriculture statistics (database). *http://www.oecd.org/tad/agricultural-policies/producerandconsumersupportestimatesdatabase.htm*

2. Sector's response to market and policy changes

Responding to market and policy incentives, actors in the food chain have invested in new technologies and adopted practices to improve economic and environmental performance.

At the farm-level, strategies to adapt are diverse and involve various technological, structural, management and marketing changes, such as investment in equipment for precision agriculture, including Information and Communication Technology (ICT); expansion of farm operations; pluriactivity; diversification of products and marketing strategies; the adoption of risk management strategies at the farm and household levels to deal with uncertainties; changes in legal organisation to isolate business risk; contracting; and greater demand for upgrading skills, leading to the emergence of new actors in the agricultural innovation system (knowledge brokers).

All along the supply chain, companies have also invested to remain competitive. They have invested in R&D, alone or in partnership with public and private research organisations, to develop the innovations needed to meet market demand. These innovations can be technological, but also organisational. Consolidation has taken place, in particular for some segments (e.g. input industries, retail level). Strategies to secure reliable and quality inputs from supplies include vertical coordination, including contracting and technology transfer, which ensures raw material has the required specifications for processing (e.g. high rate of proteins in milk or cereals). Internationalisation of operations, including investments in high growth regions, has been a strategy to increase economies of scale and productivity, diversify risks and enter emerging markets. Market diversification in response to consumer demand, with the development of specific food attributes, but also greening, is a competitive strategy. Efforts have also been made to reduce food waste. These developments are associated with more detailed information to consumers, including the development of various private standards and labels.

V – Conclusions

The food and agricultural sector has a proven capacity to adapt to market and policy changes and take advantage of new opportunities at local, national and global levels. Innovation and structural change are crucial to facilitate adjustment along the supply chain. There is a wide range of areas in which governments could facilitate innovation, structural change and efficient use of natural resources to improve productivity growth, sustainability and resilience along the value chain.

OECD work has traditionally focused on agricultural policy (OECD, 2015f). Main recommendations in this area are to focus public efforts on improving long-term competitiveness and resilience of the sector. This involves moving away from policies that distort markets and restrict competition; reducing impediments to structural adjustment to improve the functioning of input markets, including land and labour; ensuring a clearer, more efficient regulatory environment; facilitating the provision of innovation enhancing services (R&D, advisory services, inspection and control, infrastructure); providing efficient tools for risk management; providing targeted incentives for the adoption of innovative technologies and practices that help increasing productivity, sustainability, while adapting to and mitigating climate change, responding to societal demands such as animal welfare; and facilitating the development of information systems to improve decision-making.

The broader policy environment also affects the food and agricultural sector. Recent OECD work has developed a framework to analyse the role of the government in fostering innovation and productivity growth sustainably (OECD, 2013b, 2015a,b,c,d). It outlines the role of a wide range of incentive areas in: (1) facilitating investment, by ensuring macroeconomic stability, trust in institutions, clear regulations, competition, well-functioning trade and markets to guide industry decisions, access to credit, and taxation; (2) ensuring capacity building, including adequate rural infrastructure and services, flexible labour markets, and an education and skills system responsive to demand; (3) improving agricultural policy efficiency; and (4) ensuring a well-functioning agricultural innovation system, which generates innovations adapted to demand, and thus more widely adopted, and ensures more efficient use of public funds. In this context, education policy is expected to supply the skills needed for the development of the sector.

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