Chapter 2

Policy and market drivers impacting on the recent and future environmental performance of agriculture

This chapter provides an overview of the role of agriculture in the economy and the environment, underlying the significant position of agriculture with respect to the environment. It also examines policy and market drivers affecting recent trends in the environmental performance of agriculture, such as the changes in the overall level and composition of support to farmers, developments in agri-environmental policies and trends in agricultural commodity prices. Finally, the chapter presents an outlook for the environmental performances of agriculture in relation to projected changes in agricultural commodity prices and production, and identifies developments that may help lower the pressure of agriculture on the environment and encourage the development of environmental benefits associated with agriculture.

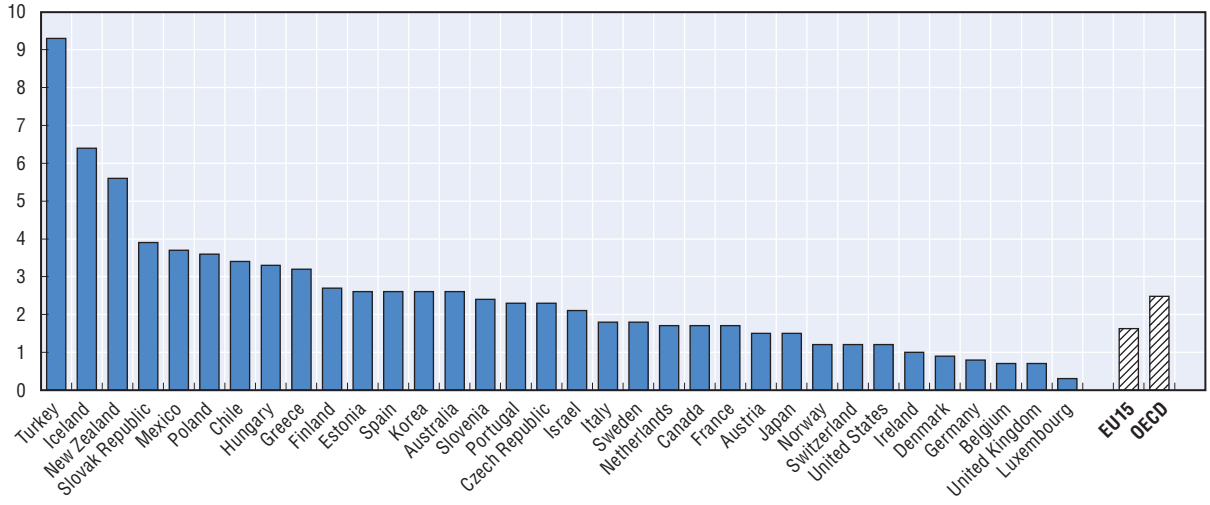
The environmental performance of agriculture is shaped by a number of key drivers including policies, markets, technologies, farm management practices, as well as environmental conditions (e.g. soils, weather) (Figure 1.1). The use of inputs by farmers, such as fertilisers, pesticides, land and water, ultimately depend on the relative prices of agricultural outputs, inputs and farm management skills. The incentives to adopt environmentally beneficial farming practices also depend on the level and composition of agricultural producer support, overall market forces and available technologies.

2.1. Context: The role of agriculture in the economy and the environment

The role of the primary agricultural sector in the Gross Domestic Product (GDP) of OECD countries remains relatively small in most cases, although is more significant when considering the whole agro-food chain (Figure 2.1). OECD countries, however, still contribute a significant share of world agricultural production and exports for a set of commodities, such as wheat, milk, and meat. However, these shares are projected to decline over the coming decade, with the continued expansion of the industrial and service sectors in some emerging countries (OECD, 2012a).

Figure 2.1. **Gross Domestic Product structure for agriculture, OECD countries, 2009**

Share of GDP (%)



Notes: Countries are ranked from highest to lowest share of agriculture in GDP.
The OECD includes 34 OECD countries. GDP structure: agriculture includes also hunting, forestry and fishing.
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.
Source: OECD (2011), *Towards Green Growth: Monitoring Progress: OECD Indicators*, *www.oecd.org/greengrowth*.

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New patterns of agricultural commodity trade are thus expected to emerge; which could affect the extent and distribution of environmental pressures across the world, for both agricultural exporting and importing countries. This tendency could be reinforced in a context where markets become major drivers of farmers' production and investment decisions, especially if the level of support continues its recent downward trend and the composition of agricultural producer support is increasingly decoupled from production and input use (OECD, 2012b).

OECD primary agriculture has a significant position with respect to the environment, in contrast to its much smaller role in terms of its contribution to the overall economy. Agriculture produces a broad set of both positive (e.g. biodiversity conservation) and negative environmental externalities (e.g. air pollution) that are not reflected by its contribution to GDP, as usually there are no markets for these externalities. The relative importance of OECD agriculture in its use of natural resources and contribution to environmental pressures, drawing from Chapters 3 to 12 of this report, are summarised in Table 2.1.

Table 2.1. **The role of primary agriculture in the economy and the environment, OECD countries, 2008-10**

Percentage of OECD primary agriculture in total	OECD average	Range of values (minimum to maximum)
● GDP	2.6%	0.3 to 9.2%
● Land area	36%	3 to 72%
● Certified organic farm area as a share of total agricultural area	1.9%	0.01 to 15.6%
● Nutrient balances (surpluses and deficits):		
Nitrogen, kg per hectare of agricultural land	63 kg/ha	1 to 228 kg/ha
Phosphorus, kg per hectare of agricultural land	6 kg/ha	-10 to 49 kg/ha
● Pesticide sales	70%	65 to 80%
● Energy consumption	1.6%	0.4 to 6.3%
● Water withdrawals	44%	0.2 to 89%
● Irrigated land area share in total agricultural area	4%	0.4 to 54%
❖ Water pollutants, *of which:*		
Nitrates in surface water	..	33 to 82%
Nitrates in groundwater[1]	..	1 to 34%
Nitrates in coastal water	..	35 to 78%
Phosphorus in surface water	..	17 to 70%
Phosphorus in coastal water	..	23 to 50%
Pesticides in surface water[1]	..	0 to 75%
Pesticides in groundwater[1]	..	0 to 25%
● Ammonia emissions	91%	82 to 98%
● Greenhouse gas emissions	8%	2 to 46%
Of which: Nitrous oxide emissions	75%	..
Methane emissions	38%	..
● Share of OECD methyl bromide use in world total:		
Ozone depleting products	5%	..
Methyl bromide use	46%	..

..: not available.

Notes: The data in this table should be interpreted as approximate values rather than precise values, and for some indicators include forestry and fisheries. For full notes and sources, consult the website below.

1. Share of monitoring sites exceeding recommended drinking water threshold limits.

Source: OECD Agri-environmental Indicator Database, www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm.

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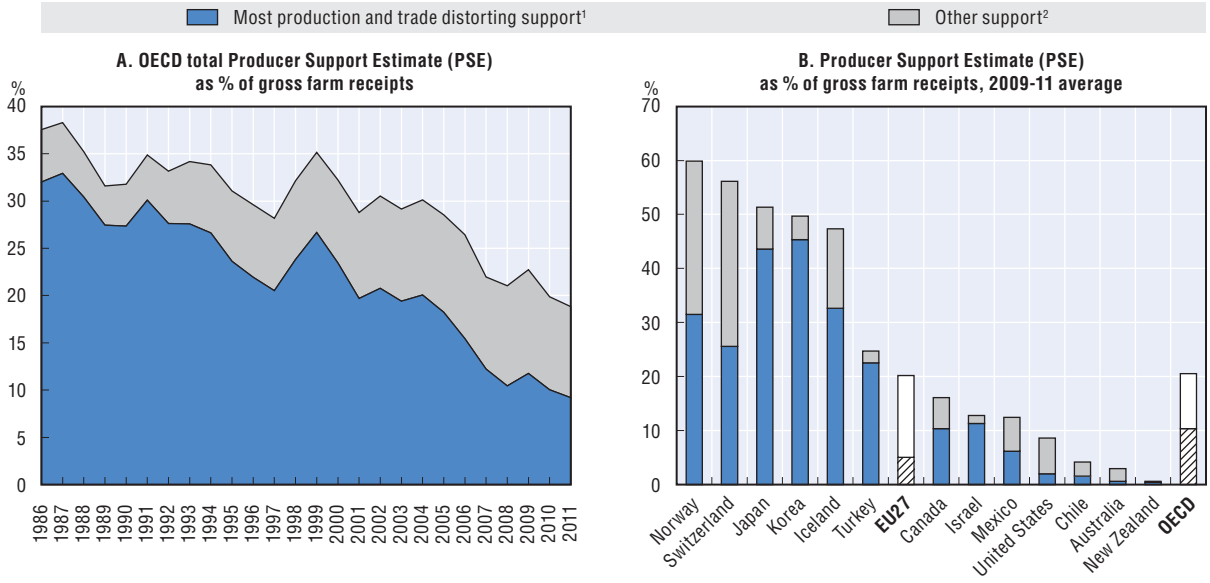
The main policy challenge is to progressively decrease the negative impacts and increase the positive environmental benefits associated with agricultural production so that ecosystem functions can be maintained and food security ensured for the world's growing population. This implies improving the productivity and sustainability of agro-food systems, for example, by: enhancing land management practices; minimising water and air pollution discharges from agriculture; curtailing the rate of biodiversity loss on farmland; and addressing agricultural support policies linked to production and use of inputs, that can encourage the intensity of production beyond that which would occur in the absence of these policies.

2.2. Policy and market drivers affecting recent trends in the environmental performance of agriculture

Reform in agricultural support policies across most OECD countries since 1990 have had an influence in lowering the overall pressure on the environment and encouraging environmental benefits, than would otherwise have been the case in the absence of these policy reforms, including (OECD, 2012c):

1. ***Reduction in the overall level and composition of support to farmers***. In 2009-11, support to producers in OECD countries was estimated at almost USD 250 billion (around EUR 180 billion), as measured by the Producer Support Estimate (PSE) (OECD, 2012b). The PSE fell from 37% of farmers' total receipts in 1986-88 on average to 20% in 2009-11, to a large extent due to lowering border protection and budgetary support to agriculture (Figure 2.2).

Figure 2.2. **Agricultural support and the composition of support, OECD countries, 1986-2011**



Notes: Producer Support Estimate (PSE): The annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policy measures that support agriculture, regardless of their nature, objectives or impacts on farm production or income.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Most production and trade most distorting support is defined to include market price support, payments based on output and variable input use without input constraints.
2. Other support is the difference between total producer support and the potentially most distorting support.

Source: OECD, *PSE/CSE Database*, 2012, *www.oecd.org/agriculture/pse*.

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Policies that increase producer prices or subsidise input use (e.g. pesticides, fertilisers, water) without restricting output encourage farmers to increase production, use more inputs, and farm more fragile lands. The opportunity costs of improving the environment in agriculture, are higher than they need be while agricultural production and input support remains. Production and input support policies by providing homogenous incentives across agriculture, fail to recognise the biophysical heterogeneity of agricultural landscapes, leading to a mismatch between the intrinsic capacity of the environment to absorb pollution and the intensity of agricultural production.

This leads to pollution hotspots where inappropriate land use and management is practised in environmentally sensitive landscapes. Agricultural commodity support can also act as a disincentive for farmers to participate in voluntary land and water conservation programmes (National Research Council, 2008). Rising commodity market prices, partly due to agricultural policy reform, may also provide a disincentive for farmers to participate in these programmes.

Policies that seek to reduce the environmental impact of farming and to improve food security also need to be well targeted to be effective. Support provided to farmers needs to encourage greater on-farm productivity and resource use efficiency to achieve environmental benefits. This combined with measures to discourage farming on fragile lands may lead to greater conservation by providing incentives for sustainable agriculture. Indeed, a key part of agricultural policy reforms in many countries is to provide incentives to farmers to develop environmentally beneficial practices that can, for example, help to control water and soil sediment flows from farmland, offer biodiversity conservation possibilities, and develop agriculture's role in carbon sequestration.

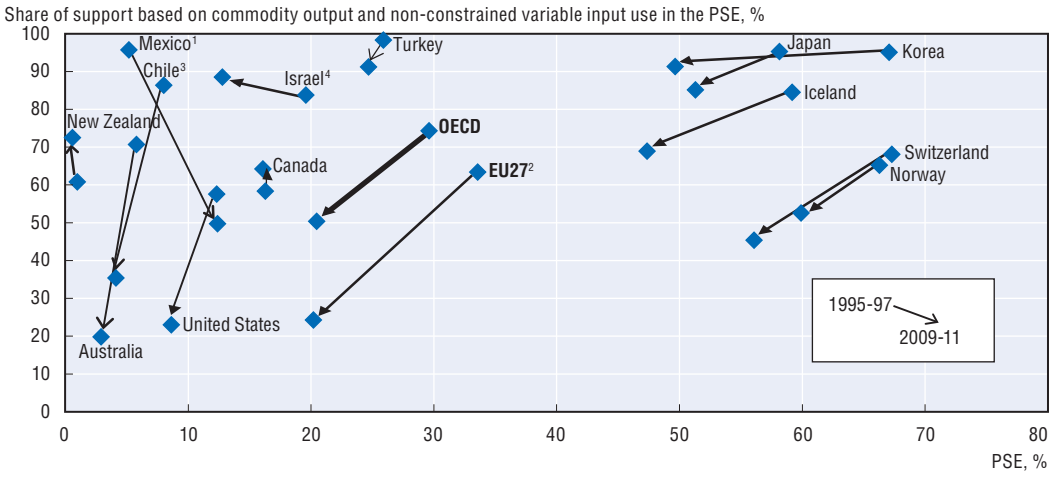
2. ***Change in the way support is delivered toward support more decoupled from production***. The ways in which support is provided to farmers have also changed (Figures 2.2 and 2.3). OECD governments are gradually shifting to support that is more decoupled from current production and which gives greater freedom to farmers in their production choices, such as area payments. This shift in support has also led to the development of a set of targeted agri-environmental measures to reduce environmental pressures, such as regulatory requirements, payments based on land retirement or farming practices, and technical assistance. Even with more decoupled forms of support, however, such as arable crop area payments which are not environmentally neutral, this may provide incentives for bringing additional land into cultivation or to continue cultivation of marginal lands, and hence, contribute to overall environmental pressure (see Chapter 4 in OECD, 2010a).

   These measures mandate or provide incentives for farmers to adopt more environmentally beneficial farming practices, for example, the promotion of extensive farm systems and adoption of crop diversification and conservation tillage practices. The relative importance of these different types of measures varies across OECD countries. Although regulatory requirements constitute the core of these measures in OECD countries, there is a trend since the mid-1990s towards an increase of agri-environmental payments in some OECD countries.

3. ***Development of environmental conditionality.*** Support is also becoming more tied to certain conditions, as well as decoupled from production and input use. In 2006-08, over 30% of support to OECD farmers had some such conditions attached to it, whereas in 1986-88 this share was only 4% (OECD, 2010b). Increasing use of environmental conditionality (cross compliance) that links the provision (withdrawal) of support

Figure 2.3. **Level and composition of agricultural producer support, OECD countries, 1995-2011**

Direction of change, 1995-97 to 2009-11



Notes: Producer Support Estimate (PSE): The annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the arising farm gate level, from policy measures that support agriculture, regardless of their nature, objectives or impacts on farm production or income.
The level of support is presented by the percentage PSE. The composition of support is presented by the share in gross farm receipts of the most production and trade distorting support, including Market Price Support, Payments based on output and Payments based on non-constrained variable input use.

1. For Mexico, the change is measured between 1996-98 and 2009-11.
2. EU15 for 1995-2003; EU25 for 2004-06 and EU27 from 2007.
3. For Chile, change is measured between 1997-99 and 2009-11.
4. For Israel, change is measured between 1997-99 and 2009-11. The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Source: OECD, *PSE/CSE Database, 2012*, *www.oecd.org/agriculture/pse*.

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payments to the requirement they meet a number of specified conditions related to their environmental performance, is being used toward addressing a wide number of environmental concerns in agriculture.

Overall across OECD countries, considering the combination of more stringent environmental regulations, increases in agri-environmental payments, and development of other measures such as market-based instruments, collective action and technical assistance, there has been a trend towards a better integration of environmental issues in farmers' decision making since the early 1990s. This is an important development in understanding the trends in agri-environmental indicators discussed in Chapters 3 to 12 of this report.

The overall decrease in agricultural producer support, in particular their most distortive components, has the natural counterpart that market prices tend to become more important as key drivers of farmers' choices. Over recent years international agricultural commodity markets have been strongly marked by higher and more volatile agricultural commodity prices. Rising real agricultural commodity prices can provide incentives to farmer to increase the scale and intensity of their production, including increasing consumption of inputs such as fertilisers, pesticides, energy and water for irrigation, between inputs and outputs, although these relationships are complex. This potentially affects the opportunity cost of adopting environmentally beneficial farming practices.

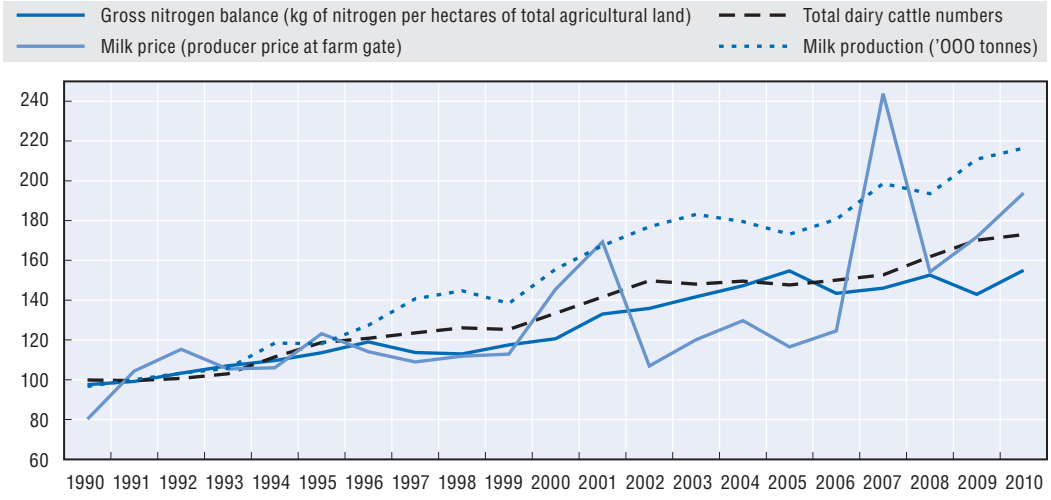
The effects of price volatility and production risks on environmental performance are much more difficult to characterise than the effect of price levels. Furthermore, the recent

period of commodity price volatility occurred over a relatively short period, making it difficult to provide a robust evaluation of their consequences for agriculture and the environment. There are two countervailing effects of price volatility and production risks on the environment in agricultural systems typically found in OECD countries. On the one hand, an increase in price volatility could reduce the optimal scale of production, and hence, input use, due to farmers' risk aversion (the scale effect). On the other hand, if price volatility mainly results from production shocks due to unfavourable conditions (e.g. drought and pests), there is an incentive for farmers to increase the use of risk-reducing inputs such as irrigation water and pesticides, which could have significant consequences for the environmental performance of agriculture.

Illustrative of these developments has been the influence of changing world market conditions on the dairy industry in **New Zealand**, and the consequences for the environment, more specially nitrate pollution of water systems (Figure 2.4). Between 1990 and 2010 the New Zealand national nitrogen surplus (defined in Chapter 4 of this report), increased at a very similar annual rate to that for the national dairy cattle herd, which has been the main source of nitrogen surplus (i.e. farm manure and slurry) in New Zealand (Figure 2.4). At the same time, the profitability of the New Zealand dairy industry has benefitted from the rise in the international price of milk over this period, given there is no support or protection of the New Zealand dairy sector (this price is used as proxy for international dairy product prices, see definitions in the OECD *PSE/CSE Database*).

Figure 2.4. **World milk price, dairy cattle numbers, milk production and nitrogen surplus, New Zealand, 1990-2010**

Index 1990-92 = 100



Notes: The gross nitrogen balance calculates the difference between the nitrogen inputs entering a farming system (i.e. mainly livestock manure and fertilisers) and the nitrogen outputs leaving the system (i.e. the uptake of nitrogen for crop and pasture production).

The milk price used as a proxy for the world market price, measures the transfers from consumers and taxpayers to agricultural producers arising from policy measures that create a gap between domestic market prices and border prices of milk, measured at the farm gate level.

Source: OECD/Eurostat Agri-Environmental Indicators Database; OECD *PSE/CSE Database*, *www.oecd.org/agriculture/pse*; OECD *Aglink Database*, *www.agri-outlook.org*.

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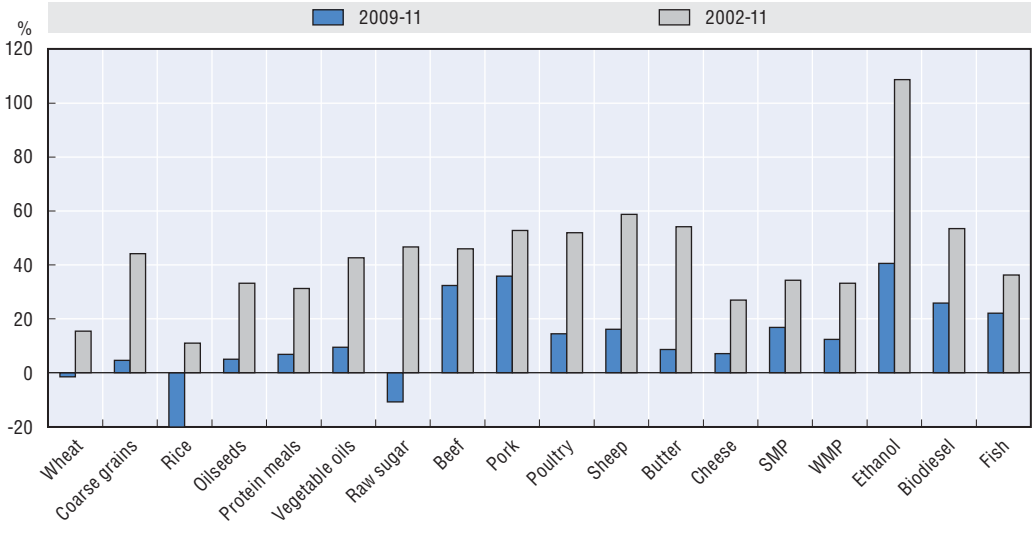
The rise in the world dairy commodity prices over the past decades, but especially since the mid-2000s, has provided a considerable incentive to **New Zealand** livestock producers to intensify dairy production compared to other livestock sectors (e.g. beef and sheep). These developments present a major challenge for New Zealand policy makers and the agriculture sector. In brief, that challenge involves achieving a sustainable dairy industry responding to market signals that can capture the economic and social benefits for farmers and the wider rural community induced by higher dairy prices, while minimising the environmental pollution of rivers, lakes and groundwater from excess nutrients, as well as reducing other environmental impacts associated with dairying (e.g. diminishing greenhouse gas emissions, especially methane).

2.3. Future outlook for the environmental performance of agriculture

According to the OECD-FAO *Agricultural Outlook 2012-2021* (OECD, 2012a), in the next decade, agricultural commodity prices in nominal and real terms are likely to be higher and more volatile on average than they were in the last decade (Figure 2.5). This rise in prices would result from growing world demand for food, in relation to rising population and incomes, particularly in emerging countries, an increase in the demand for meat, and the development of biofuels. Commodity prices increases could provide incentives for farmers to boost production and this may heighten environmental pressures, depending on the farming practices, systems and technologies adopted by the sector, as well as the environmental sensitivity of the location where production increases occur.

Figure 2.5. **Nominal world agricultural commodity price projections for 2012-21 relative to 2009-11 and 2002-11**

Percent change of average nominal prices in 2012-21 relative to different base periods



Note: SMP: Skim Milk Powder; WMP: Whole Milk Powder.
Source: OECD (2012), *OECD-FAO Agricultural Outlook 2012-2021*, *www.agri-outlook.org*.

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At the same time, production costs are projected to reach higher levels than in the previous decade, due to increases in energy, fertilisers and feed costs, as well as growing pressure on natural resources, especially land and water. Over the next decade, the crude oil price is projected to rise, which would translate into higher farm input prices

(e.g. fertilisers, energy to pump water, pesticides), although developments such as shale gas production in some countries could lower natural gas prices and reduce costs of nitrogen fertiliser production. Overall, with the increase in output prices on the one hand, and rising farm input prices on the other hand, the expected environmental outcomes could be ambiguous depending on the intensity and location of production effects.

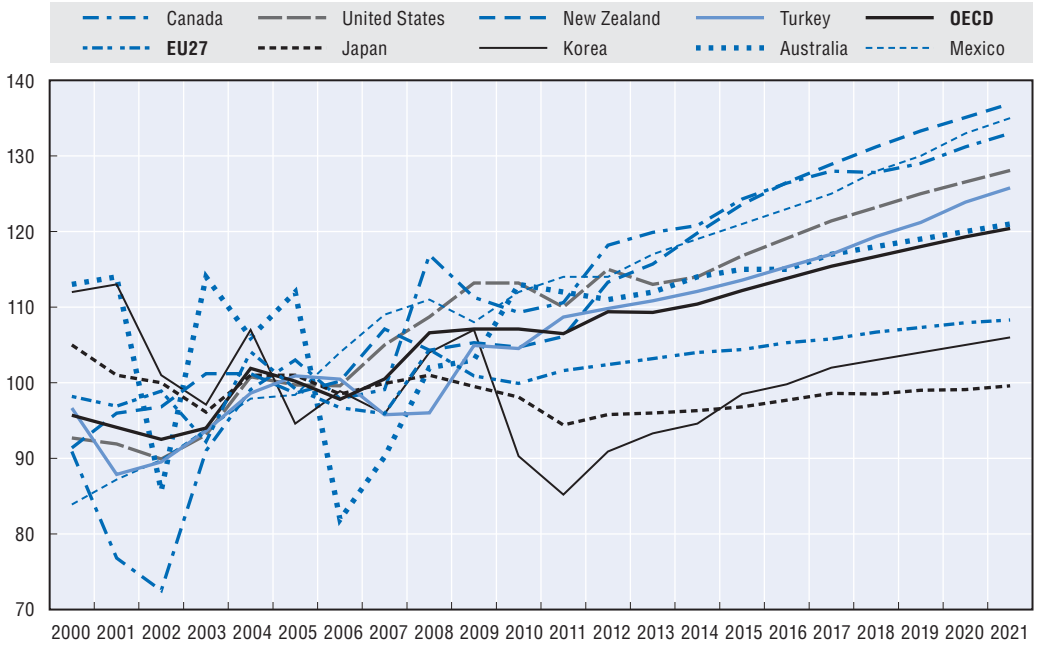
With the projected increase in commodity prices, agricultural production is projected to expand over the next decade, but at a slower rate than in the preceding one, down from 1.5% to 1.2% per annum (OECD, 2012a), with significant international differences across countries and commodities. The overall reduction in the growth rate of farm output is expected to originate from slower rates of improvement in crop productivity compared to earlier decades, while cropland area is expected to remain relatively constant. The livestock sector, however, is expected to grow at a similar rate as in the previous decade.

The outlook for agricultural commodity prices translates into projected growth in agricultural production for nearly all OECD countries over the coming decade (Figure 2.6). From the trends in national agricultural production projections in Figure 2.6, it is possible to discern two broad groupings of OECD countries in terms of their potential pressure on the environment over the coming decade:

- **Group 1:** Countries which are projected to continue with strong growth in production over the coming decade, including: **Australia, Canada, Mexico, New Zealand, Turkey and the**

Figure 2.6. **Agricultural production volume projections, OECD countries, 2000-21**

Index 2004-06 = 100



Note: Net agricultural production measures gross value of product produced, net of "internal" feed and seed inputs to avoid double counting (for example, maize and livestock production), so that the production measure approximates a value added concept.

Source: OECD (2012), *OECD-FAO Agricultural Outlook 2012-2021*, *www.agri-outlook.org*.

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United States.* Most OECD countries in this group have over the past decade largely expanded production by raising productivity and intensifying production on a reduced land area. However, in regions within some of these countries there is a risk of expanding production onto environmentally fragile land or marginal land not previously cultivated. For this group of countries the potential consequences for the environmental performance of agriculture of the projected growth in agricultural production under the "business as usual scenario", might include (trends may vary within and across countries):

1. Heightened pressure on the environment from the increased use of farm inputs (e.g. fertilisers, pesticides, energy and water) and livestock (e.g. more manure, ammonia and methane emissions), although absolute levels of pollution for many of these countries are mostly below the OECD average (e.g. nutrient surplus/ha).
2. Elevated soil erosion as a result of farming more intensively productive agriculture land and/or expanding production onto marginal and fragile land and susceptible to erosion.
3. Expanded production of bioenergy which depending on the crop mix and farm management practices to produce bioenergy feedstocks may lead to heightened soil erosion and water pollution risks, especially where cereals, oilseeds and sugar crops are used as feedstocks for manufacturing biofuels.
4. Regionalised pressures on the environment could alter as a result of the continued structural changes in livestock production toward larger and more concentrated livestock operations, notably in the pig, poultry and dairy sectors, although in some cases larger, concentrated livestock operations can provide efficient levels of waste disposal management.

- **Group 2:** Countries where projected production growth over the coming decade is expected to be modest, comprise the **EU27**, or decline, in the case of **Japan**. Within the EU27, however, there could be some diverging trends, with the agricultural sector continuing to contract in many of the former EU15 countries, but expanding in some of the new EU member states (European Environment Agency, 2010). In addition, crop and livestock production could undergo further intensification and concentration of production on less land to maintain profitability. For this group of countries the potential consequences for the environment under a "business as usual scenario" of the projected low growth or decrease in agricultural production might include (trends may vary within and across countries):

  1. Reduced overall pressure on the environment, with this trend more pronounced in **Japan** given the projected decrease in agricultural production, although the absolute levels of pollution for many of these countries might continue to remain high (e.g. nutrient surplus/ha);
  2. Localised increases in pollution, with structural changes in the livestock sector towards larger concentrated operations.

* **Korea** is the exception in this group, with production declining from the late 1990s to present but then projected to expand back to the levels of the late 1990s, largely explained by growth in beef production stimulated by a rise in Korean consumer demand and higher government support to producers.

For all OECD countries over the medium term there are a number of developments that may generally help toward lowering the pressure of agriculture on the environment and encourage the development of environmental benefits linked to agriculture, including:

1. Efficiencies in lowering farm input use per unit of output, induced by a number of factors including for example, a changing regulatory environment leading to more targeted pesticide use; and the higher prices for inorganic fertilisers and pesticides due to the projected increase in fossil fuel (e.g. gas, oil, coal) prices, which might also encourage greater use of livestock waste as a bioenergy feedstock.
2. Improvements in farm management practices (e.g. conservation tillage), and precision agricultural technologies, such as the use of on-farm global positioning systems (GPS), that can lead to more efficient use of inputs, and also innovations in the agro-food industry (e.g. inputs, seeds and production processes) that could bring benefits by increasing resource efficiency on-farms and lowering environmental pressures along the whole agro-food chain.
3. Growing public pressure to strengthen agri-environmental and environmental policies that can reduce the human health and environmental costs while increasing the environmental benefits associated with agriculture.
4. Agricultural policy reforms with a continued shift towards decoupled support and measures aimed at environmental improvement on-farms.
5. Innovations in policy and market approaches to address environmental issues in agriculture, that seek to change the behaviour of farmers, the agro-food chain and other stakeholders to improve environmental quality, for example, water treatment companies and/or community groups working with farmers to address agricultural water pollution (OECD, 2012c).

The environmental performance of OECD agriculture over the past decade examined in this report, provides some indication that agriculture and policy makers are capable of meeting the future economic, social and environmental challenges for the sector. Examples include efficiency and management improvements in the use of nutrients, pesticides and water resources, and enhancing environmental benefits that can stem from certain management practices, such as conservation tillage and riparian buffers along water courses. But there are signs in regions of some OECD countries where progress in improving environmental performance has been disappointing and more effort is required from all stakeholders, for example, with water pollution and the decline in farmland breeding bird populations.

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