Chapter 4

Nutrients: Nitrogen and phosphorus balances

This chapter reviews the environmental performances of agriculture in OECD countries related to nitrogen and phosphorus balances. It provides a description of the policy context (issues and main challenges), definitions for the agri-environmental indicators presented, and elements related to concepts, interpretations, links to other indicators, as well as measurability and data quality. The chapter then describes the main trends of the agri-environmental indicators, using available data covering the period 1990-2010 and based on a set of tables and figures.

4.1. Policy context

The issue

Inputs of nutrients, such as nitrogen and phosphorus, are necessary in farming systems as they are critical in maintaining and raising crop and forage productivity. Where nutrients are in deficit soil fertility can decline, while with an excess of nutrients necessary for plant growth there is a risk of polluting soil, air, and water (eutrophication). OECD agriculture is a significant source of nitrogen and phosphorus entering the environment as there is in most cases a surplus of nutrients compared to plant requirements. This concerns nearly all OECD countries, to varying degrees, and as a result there is an extensive range of policy instruments (payments, taxes, regulations, farm advice, etc.) used by countries to address nutrient pollution of water (Chapter 9) and air in terms of ammonia emissions (Chapter 10) (OECD, 2012).

Main challenges

A build up of surplus nutrients in excess of immediate crop and forage needs can lead to nutrient losses representing not only a possible cause of economic inefficiency in nutrient use by farmers, but especially a source of potential harm to the environment. This can occur in terms of water pollution (e.g. eutrophication of surface water caused by nutrient runoff and groundwater pollution by leaching), and air pollution, notably ammonia, as well as greenhouse gas emissions. An additional environmental issue concerns the sustainability of phosphorus resources, as world reserves are finite, although this could induce better management and recycling of phosphorus in agriculture.

Agricultural activities will usually involve some loss of nutrients into the environment, as it is technically impossible to achieve zero pollution in most situations. Even in pristine water environments natural sources (e.g. soil minerals) can cause changes in the physical, chemical and biological characteristics of water. The challenge in agriculture is to seek ways to increase production while minimising farm nutrient losses and subsequent damage to the environment (OECD, 2012).

4.2. Indicators

Definitions

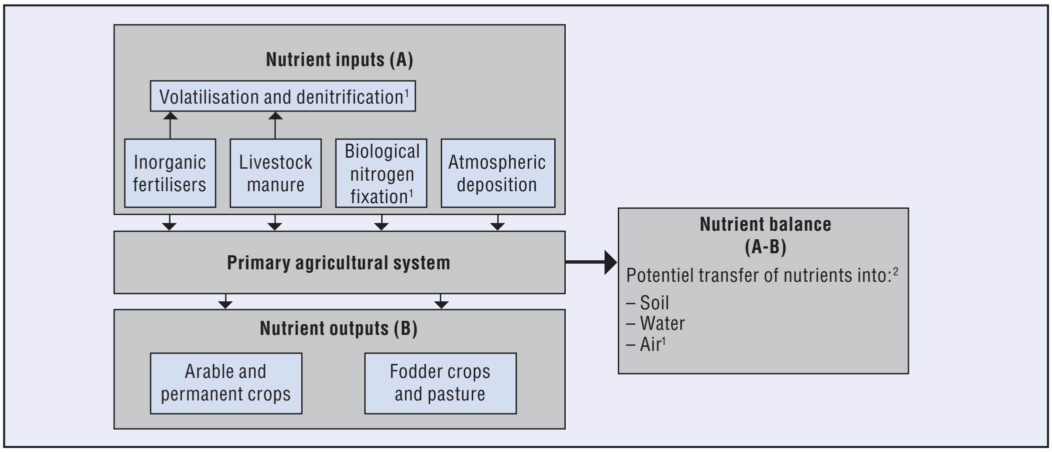
The indicator related to agricultural nutrient balances include changes in:

- Gross agricultural nitrogen (N) and phosphorus (P) balances, surplus or deficit.

Concepts, interpretation, limitations and links to other indicators

The gross nutrient balances (N and P) are calculated as the difference between the total quantity of nutrient inputs entering an agricultural system (mainly fertilisers, livestock manure), and the quantity of nutrient outputs leaving the system (mainly uptake of nutrients by crops and grassland), as elaborated in Figure 4.1 (OECD/EUROSTAT, 2012a; 2012b). This calculation can be used as a proxy to reveal the status of environmental

Figure 4.1. **Main elements in the gross nitrogen and phosphorus balance calculation**



1. Applies to the nitrogen balance only.
2. Nutrients surplus to crop/pasture requirements are transported into the environment, potentially polluting soils, water and air, but a deficit of nutrients in soils can also occur to the detriment of soil fertility and crop productivity.

Source: OECD/Eurostat (2012), *Nitrogen and Phosphorus Balance Handbook*, *www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm*.

pressures, such as declining soil fertility in the case of a nutrient deficit, or for a nutrient surplus the risk of polluting soil, water and air.

The nutrient balances are expressed in terms of changes in the physical quantities of nutrient surpluses (deficits) to indicate the trend and level of potential physical pressure of nutrient surpluses into the environment. The nutrient balance indicator is also expressed in terms of kilogrammes of nutrient surplus (deficit) per hectare of agricultural land per annum to facilitate the comparison of the relative intensity of nutrients in agricultural systems between countries.

When interpreting these indicators it should be noted that they describe potential environmental pressures, and may hide important sub-national variations. More information is needed to describe the actual pressure. They should be read together with information on agricultural land use and farm management approaches. Cross-country comparisons of change in nutrient surplus intensities over time should take into account the absolute intensity levels during the reference period. It should also be noted that these indicators reflect nutrient balances from primary agriculture, and do not consider nutrient flows from other food production systems, such as fisheries or total nitrogen cycles in the economy.

Limitations of nutrient balances include the accuracy of the underlying nutrient conversion coefficients and also the uncertainties involved in estimating nutrient uptake by areas of pasture and some fodder crops. In addition, environmental events like droughts and floods will affect the efficiency of plants to fix nutrients. The soil science of nutrients is also not well understood (e.g. soils vary in their capacity to store nutrients) and there is limited information on the varietal mix of legumes in pastures to accurately estimate pasture uptake of nitrogen (OECD, 2008).

As an environmental *driving force*, nutrient balance indicators link to the *state* of nutrients in water (Chapter 9), emissions of ammonia (Chapter 10) and greenhouse gas emissions (Chapter 11).

Measurability and data quality

OECD and Eurostat data on nitrogen and phosphorus balances are available for all OECD countries, except Chile, until 2009 (Annex 1.A2). Improvements to the underlying methodology, nutrient conversion coefficients and primary data are currently being undertaken by OECD countries in cooperation with Eurostat, as the nutrient balances are revised and updated. For example, Eurostat is examining how to account for biological nitrogen fixation by clover in pasture.

4.3. Main trends

Overall OECD agricultural nutrient surpluses (N and P) have been on a continuous downward trend from 1990 to 2009, both in absolute tonnes of nutrients (Figures 4.2 and 4.3) and in terms of nutrient surpluses per hectare of agricultural land (Figures 4.4 and 4.5). The rate of reduction in OECD nutrient surpluses was more rapid over the 2000s compared to the 1990s.

The lowering of nutrient surpluses has reduced the risk of environmental pressure on soil, water and air. This reflects both overall improvements in nutrient use efficiency by farmers, and the slower growth in agricultural production for many countries over the 2000s (Figure 3.1). There are, however, sizeable variations within and across countries in terms of the intensity and trends of nutrient surpluses.

Despite the overall improvement in lowering nutrient surpluses, nitrogen (N) and phosphorus (P) intensity levels per hectare of agricultural land remain at very high levels in terms of their potential to cause environmental damage. ***Background (or natural) loss*** of N is typically estimated at around 1-2 kg/ha from electrical storms and other sources, while for phosphorus this figure is about 0.1 kg/ha depending on underlying conditions in sediment and rocks (OECD, 2012).

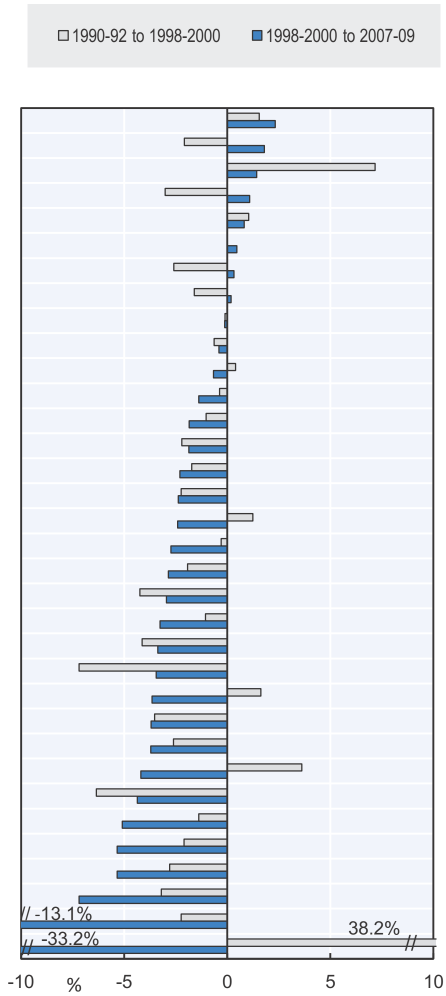
By 2007-09, around two thirds of OECD countries had an annual national nitrogen surplus in excess of 40 kgN/ha nitrogen, with **Belgium**, **Israel**, **Japan**, **Korea** and the **Netherlands** with a surplus in excess of 100 kgN/ha (Figure 4.3). Similarly for phosphorus about a third of OECD countries have a surplus in excess of 5 kgP/ha, with **Israel**, **Japan**, **Korea**, the **Netherlands**, and **Norway**, with a surplus in excess of 10 kgP/ha (Figure 4.5).

Some countries (**Estonia**, **Greece**, **Hungary**, **Italy** and the **Slovak Republic**) experienced an absolute phosphorus deficit in 2007-09 (Figures 4.3 and 4.5). While if prolonged this phosphorus deficit could undermine soil fertility (a possibility in the case of **Hungary** which has experienced a 20 year P deficit), it is likely that in most of these cases crops and pasture can draw on P soil stores accumulated over many years of previous over application of P to soils.

For the few OECD countries where nutrient surpluses have been growing over the past decade, these countries frequently have levels of surpluses expressed in terms of N or P per hectare of agricultural land below the OECD average, such as for **Canada**, **New Zealand** (not for phosphorus) and **Poland**. For **Israel**, however, nutrient surplus in terms of kg of N/P per hectare are appreciably higher than the OECD average and grew over the past 10 years.

The OECD average reduction in P surpluses, both in absolute terms and expressed in kg of P per hectare, has been more than double the rate of reduction per annum compared to N surpluses over the past 20 years (Figures 4.2 to 4.5). To a large extent, especially over the past decade, this reflects the realisation by farmers that their soils had high levels of accumulated phosphorus from which crops and pasture can draw without further

Figure 4.2. **Nitrogen balance volume, OECD countries, 1990-2009**



	Average (Thousand tonnes of nitrogen)			Average annual % change	
	1990-92[1]	1998-2000[2]	2007-09[3]	1990-92 to 1998-2000	1998-2000 to 2007-09
New Zealand	399	451	554	1.5	2.3
Poland	896	757	889	-2.1	1.8
Canada	753	1 311	1 489	7.2	1.4
Czech Republic	327	256	282	-3.0	1.1
Iceland	17	19	20	1.0	0.8
Israel	..	53	55	..	0.5
Switzerland	122	99	102	-2.6	0.3
Japan	935	821	834	-1.6	0.2
Norway	103	102	101	-0.1	-0.1
Turkey	1 493	1 418	1 367	-0.6	-0.4
United States	13 930	14 378	13 534	0.4	-0.7
OECD[4]	**40 052**	**38 869**	**34 270**	**-0.4**	**-1.4**
Mexico	2 885	2 655	2 286	-1.0	-1.9
France	2 100	1 757	1 510	-2.2	-1.9
United Kingdom	1 696	1 424	1 182	-1.7	-2.3
Germany	2 131	1 778	1 432	-2.2	-2.4
Korea	465	513	412	1.2	-2.4
Australia	7 527	7 353	5 730	-0.3	-2.7
EU15	**9 966**	**8 529**	**6 567**	**-1.9**	**-2.9**
Slovenia	50	38	30	-4.2	-3.0
Sweden	197	180	134	-1.1	-3.3
Denmark	460	328	241	-4.1	-3.4
Slovak Republic	177	97	71	-7.2	-3.5
Spain	627	713	510	1.6	-3.7
Finland	204	153	109	-3.5	-3.7
Italy	667	540	398	-2.6	-3.7
Ireland	236	313	213	3.6	-4.2
Greece	309	183	128	-6.4	-4.4
Netherlands	655	586	386	-1.4	-5.1
Belgium	306	258	167	-2.1	-5.3
Austria	195	156	95	-2.8	-5.4
Luxembourg	23	18	10	-3.2	-7.2
Portugal	160	143	54	-2.2	-13.1
Hungary	5	71	3	38.2	-33.2
Estonia	..	..	17	..	..

..: not available.

Notes: The gross nitrogen balance (surplus or deficit) 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).

Countries are ranked in descending order according to average annual percentage change 1998-2000 to 2007-09.

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. Data for 1990-92 average refer to the year 1990 for the United Kingdom; the 1992-94 average for Slovenia; and the 1995-97 average for Portugal.
2. Data for 1998-2000 average refer to the year 2000 for the United Kingdom; and the 2000-02 average for Israel and Portugal.
3. Data for 2007-09 average refer to the 2006-08 average for Belgium, France, Greece, Hungary, Italy, Luxembourg, Mexico, Netherlands, Slovenia and Switzerland.
4. The OECD total excludes Chile, Estonia and Israel.

Source: OECD/Eurostat Agri-Environmental Indicator Database, http://epp.eurostat.ec.europa.eu; and national data for Spain.

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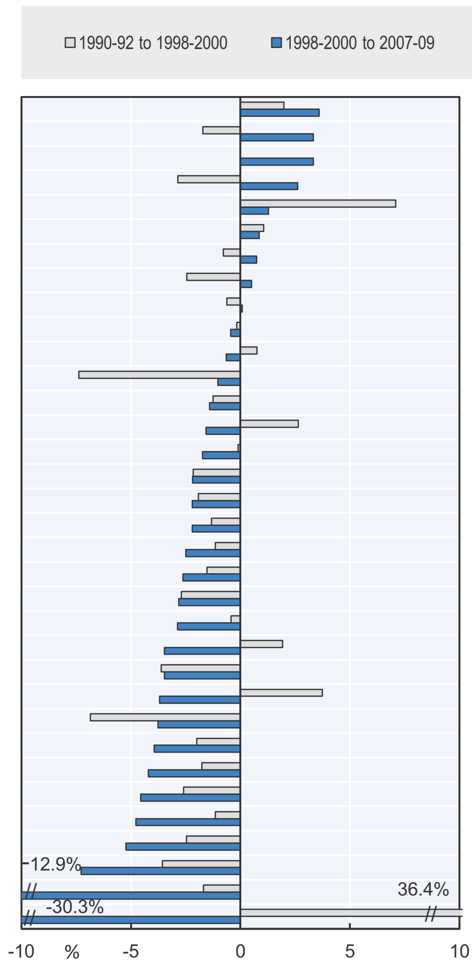
applications of P, at least for a number of years. The understanding that agricultural soils have high stocks of P, has come from, in particular, improved methods and frequency of soil nutrient testing by farmers in many OECD countries (discussed further below).

An encouraging development in a growing number of countries has been the ***decoupling of the growth in agricultural production from changes in nutrient surpluses***. Environmental decoupling occurs when the relative growth rate of the environmentally relevant variable (i.e. here nutrient surpluses) is less than the growth rate of the variable reflecting the economic driving force (i.e. here agricultural production). Between 1998-2000

Figure 4.3. **Nitrogen balance per hectare of agricultural land, OECD countries, 1990-2009**



	Average (kg nitrogen/ha)			Average annual % change	
	1990-92[1]	1998-2000[2]	2007-09[3]	1990-92 to 1998-2000	1998-2000 to 2007-09
New Zealand	30	35	49	2.0	3.6
Poland	49	43	57	-1.7	3.3
Israel	..	103	130	..	3.3
Czech Republic	79	63	79	-2.9	2.6
Canada	12	21	23	7.1	1.3
Iceland	7	8	8	1.1	0.9
Japan	180	169	180	-0.8	0.7
Switzerland[4]	80	65	68	-2.4	0.5
Norway	103	98	99	-0.6	0.1
Turkey	37	36	35	-0.2	-0.4
United States	33	35	33	0.7	-0.6
Slovak Republic	76	41	37	-7.4	-1.0
Mexico	28	25	22	-1.2	-1.4
Korea	213	263	228	2.6	-1.6
Australia	16	16	14	-0.1	-1.7
Germany	123	103	85	-2.2	-2.2
France	69	59	50	-1.9	-2.2
OECD[5]	**86**	**78**	**63**	**-1.3**	**-2.2**
Italy	38	35	28	-1.1	-2.5
United Kingdom	140	120	97	-1.5	-2.6
Slovenia	90	77	61	-2.7	-2.8
Sweden	58	56	43	-0.4	-2.9
Spain	16	19	14	1.9	-3.5
Denmark	166	123	90	-3.6	-3.5
Ireland	53	71	50	3.7	-3.7
Greece	60	34	25	-6.9	-3.8
EU15	**109**	**93**	**65**	**-2.0**	**-3.9**
Finland	80	70	47	-1.8	-4.2
Austria	56	46	30	-2.6	-4.6
Netherlands	331	302	204	-1.2	-4.8
Belgium	227	186	121	-2.5	-5.2
Luxembourg	183	137	75	-3.6	-7.3
Portugal	41	38	14	-1.7	-12.9
Hungary	1	12	1	36.4	-30.3
Estonia	..	..	21	..	..

..: not available.

Notes: Balance (surplus or deficit) expressed as kg nitrogen per hectare of total agricultural land.

Countries are ranked in descending order according to average annual percentage change 1998-2000 to 2007-09.

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1. Data for 1990-92 average refer to the year 1990 for the United Kingdom; the 1992-94 average for Slovenia; and the 1995-97 average for Portugal.
2. Data for 1998-2000 average refer to the year 2000 for the United Kingdom; and the 2000-02 average for Israel and Portugal.
3. Data for 2007-09 average refer to the 2006-08 average for Belgium, France, Greece, Hungary, Italy, Luxembourg, Mexico, Netherlands, Slovenia and Switzerland.
4. In the case of Switzerland, total agricultural area includes summer grazing.
5. The OECD total excludes Chile, Estonia and Israel.

Source: OECD/Eurostat Agri-Environmental Indicator Database, *http://epp.eurostat.ec.europa.eu*; and national data for Spain.

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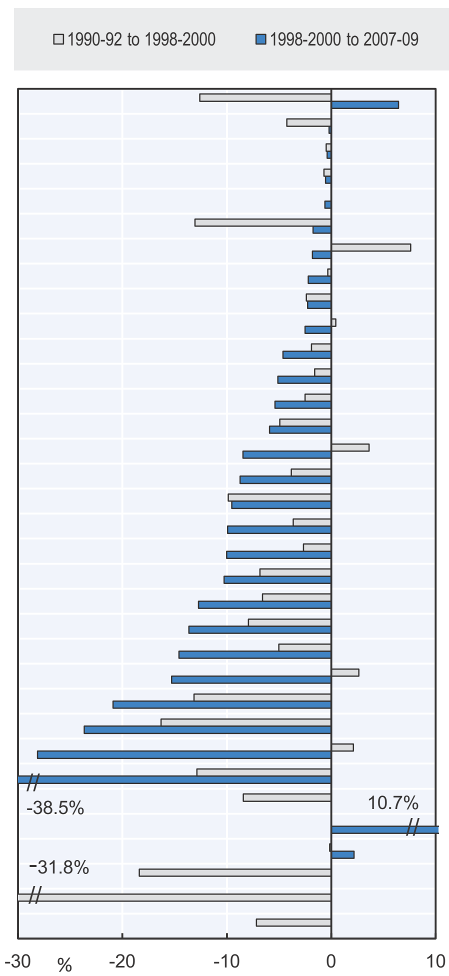
and 2007-09, while overall OECD volume of agricultural production increased by more than 1% per annum, the nitrogen balance (tonnes) declined by over 1% per annum, while the phosphorus balance (tonnes) decreased by over 5% per annum (Figures 4.6 and 4.7).

Much of this improvement has resulted from the increasing adoption of nutrient management practices encouraged by extensive agri-environmental measures across many countries. The much greater decoupling for phosphorus compared to nitrogen is largely explained by the growing realisation by farmers in many OECD countries of the accumulation of P in soils, especially with the more widespread use of soil nutrient testing.

Figure 4.4. **Phosphorus balance volume, OECD countries, 1990-2009**



	Average (Thousand tonnes of phosphorus)			Average annual % change	
	1990-92[1]	1998-2000[2]	2007-09[3]	1990-92 to 1998-2000	1998-2000 to 2007-09
Poland	138	47	82	-12.6	6.4
Mexico	216	153	150	-4.3	-0.2
Norway	16	15	15	-0.5	-0.4
Iceland	4	4	3	-0.7	-0.6
Israel	..	18	17	..	-0.6
Switzerland	17	6	5	-13.1	-1.7
New Zealand	76	137	116	7.6	-1.8
Korea	103	101	82	-0.3	-2.2
Japan	339	279	227	-2.4	-2.3
United States	1 173	1 213	965	0.4	-2.5
Turkey	354	304	198	-1.9	-4.6
United Kingdom	162	138	91	-1.6	-5.1
OECD[4]	**4 153**	**3 384**	**2 053**	**-2.5**	**-5.4**
Denmark	44	29	17	-4.9	-5.9
Slovenia	6	7	4	3.6	-8.5
Netherlands	74	54	26	-3.8	-8.7
Finland	52	23	9	-9.9	-9.5
Portugal	39	32	16	-3.6	-9.9
Ireland	46	37	14	-2.7	-10.0
Austria	31	18	7	-6.8	-10.3
EU15	**1 399**	**812**	**239**	**-6.6**	**-12.7**
France	431	223	69	-7.9	-13.6
Belgium	46	30	9	-5.0	-14.6
Spain	107	132	30	2.6	-15.3
Germany	228	74	11	-13.1	-20.9
Czech Republic	40	10	1	-16.3	-23.6
Australia	294	348	18	2.1	-28.1
Luxembourg	3	1	0	-12.9	-38.5
Canada[5]	-8	-4	7	-8.4	n.c.
Greece[5]	33	-5	-12	n.c.	10.7
Hungary[5]	-48	-48	-57	-0.1	2.2
Italy	87	17	-47	-18.4	n.c.
Slovak Republic	33	2	-3	-31.8	n.c.
Sweden	15	8	-1	-7.2	n.c.
Estonia	..	..	-6	..	..

..: not available.
n.c.: not calculated.
Notes: The gross phosphorus balance (surplus or deficit) calculates the difference between the phosphorus inputs entering a farming system (i.e. mainly livestock manure and fertilisers) and the phosphorus outputs leaving the system (i.e. the uptake of phosphorous for crop and pasture production). Countries are ranked in descending order according to average annual percentage change 1998-2000 to 2007-09.
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. Data for 1990-92 average refer to the year 1990 for the United Kingdom; and the 1995-97 average for Portugal and Slovenia.
2. Data for 1998-2000 average refer to the year 2000 for the United Kingdom; and the 2000-02 average for Israel, Portugal and Slovenia.
3. Data for 2007-09 average refer to the 2006-08 average for Belgium, Estonia, France, Germany, Greece, Hungary, Italy, Luxembourg, Mexico, Netherlands, Slovenia and Switzerland.
4. The OECD total excludes Chile, Estonia and Israel.
5. For Canada, Greece and Hungary, the average annual percentage change refers to change in phosphorus deficit.

Source: OECD/Eurostat Agri-Environmental Indicator Database, http://epp.eurostat.ec.europa.eu; and national data for Spain.

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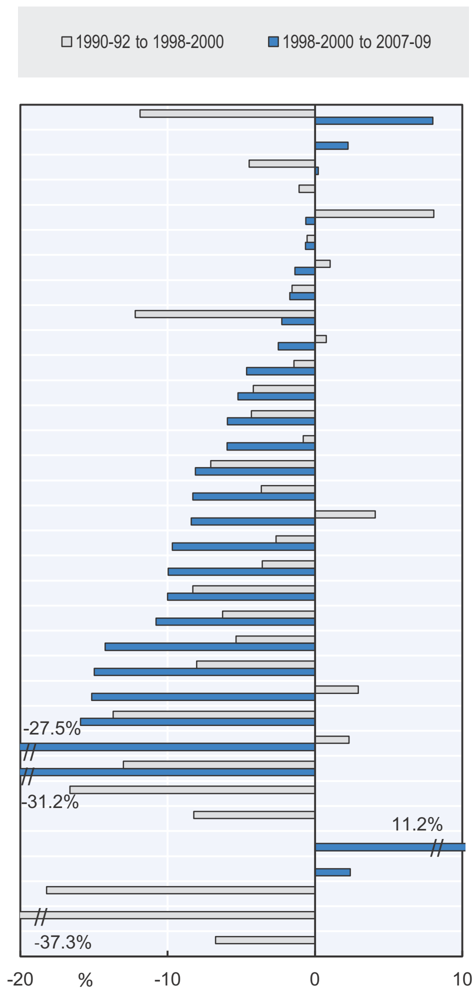
Moreover, gains in P use efficiency have also been achieved through changing livestock husbandry practices, especially by altering animal feed dietary composition (OECD, 2008).

The physical properties of P in the environment are different compared to N, but ***the accumulation of P in farm soils beyond crop needs in many OECD countries is a growing environmental concern*** (OECD, 2008). The retention of particulate P in soils is generally high compared to N, hence, it is usually transported with long time lags into surface water

Figure 4.5. **Phosphorus balance per hectare of agricultural land, OECD countries, 1990-2009**



	Average (kg phosphorus/ha)			Average annual % change	
	1990-92[1]	1998-2000[2]	2007-09[3]	1990-92 to 1998-2000	1998-2000 to 2007-09
Poland	7	3	5	-11.9	8.0
Israel	..	34	40	..	2.2
Mexico	2	1	1	-4.5	0.2
Norway	16	15	15	-1.1	0.0
New Zealand	6	11	10	8.1	-0.6
Iceland	2	2	1	-0.5	-0.7
Korea	47	52	46	1.0	-1.4
Japan	65	57	49	-1.6	-1.7
Switzerland[4]	11	4	3	-12.2	-2.3
United States	3	3	2	0.8	-2.5
Turkey	9	8	5	-1.4	-4.6
OECD[5]	**13**	**9**	**6**	**-4.2**	**-5.2**
Denmark	16	11	6	-4.3	-5.9
United Kingdom	13	12	7	-0.8	-6.0
Austria	9	5	2	-7.1	-8.1
Netherlands	38	28	14	-3.6	-8.3
Slovenia	12	15	9	4.1	-8.4
Ireland	10	8	3	-2.7	-9.7
Portugal	10	8	4	-3.6	-10.0
Finland	21	10	4	-8.3	-10.0
EU15	**14**	**9**	**3**	**-6.3**	**-10.8**
Belgium	34	22	6	-5.4	-14.3
France	14	7	2	-8.0	-15.0
Spain	3	3	1	2.9	-15.1
Germany	13	4	1	-13.7	-15.9
Australia	1	1	0	2.3	-27.5
Luxembourg	20	7	0	-13.0	-31.2
Czech Republic	10	2	0	-16.6	n.c.
Canada[6]	0	0	0	-8.2	n.c.
Greece[6]	6	-1	-2	n.c.	11.2
Hungary[6]	-8	-8	-10	0.0	2.4
Italy	5	1	-3	-18.2	n.c.
Slovak Republic	14	0	-2	-37.3	n.c.
Sweden	5	3	0	-6.8	n.c.
Estonia	..	..	-7	..	..

..: not available.
n.c.: not calculated.
Notes: Countries are ranked in descending order according to average annual percentage change 1998-2000 to 2007-09.
Balance (surplus or deficit) expressed as kg phosphorus per hectare of total agricultural land.
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. Data for 1990-92 average refer to the year 1990 for the United Kingdom; and the 1995-97 average for Portugal and Slovenia.
2. Data for 1998-2000 average refer to the year 2000 for the United Kingdom; and the 2000-02 average for Israel, Portugal and Slovenia.
3. Data for 2007-09 average refer to the 2006-08 average for Belgium, Estonia, France, Germany, Greece, Hungary, Italy, Luxembourg, Mexico, Netherlands, Slovenia and Switzerland.
4. In the case of Switzerland, total agricultural area includes summer grazing.
5. The OECD total excludes Chile, Estonia and Israel.
6. For Canada, Greece and Hungary, the average annual percentage change refers to change in phosphorus deficit.

Source: *OECD/Eurostat Agri-Environmental Indicator Database*, *http://epp.eurostat.ec.europa.eu*; and national data for Spain.

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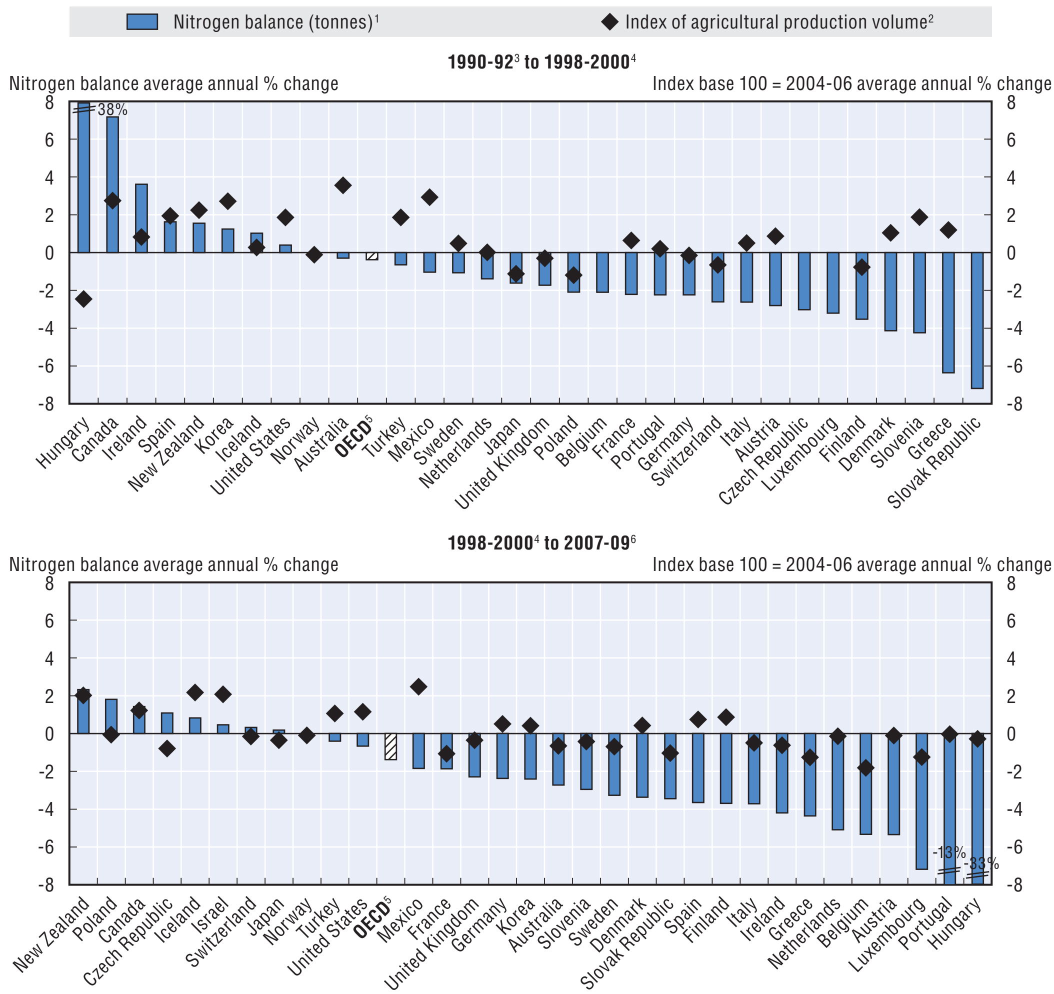
through soil erosion rather than leaching into groundwater, unlike the more rapid transport of N from soils into water bodies. Hence, it is likely that there will be a considerable time lag for many countries between reductions in P surpluses leading to lower P concentrations in water supplies. Indeed, P concentrations in rivers and lakes could continue to rise over decades into the future, while the implications for groundwater are unclear (OECD, 2012).

Figure 4.6. **Nitrogen balance and agricultural production volume, OECD countries, 1990-2009**



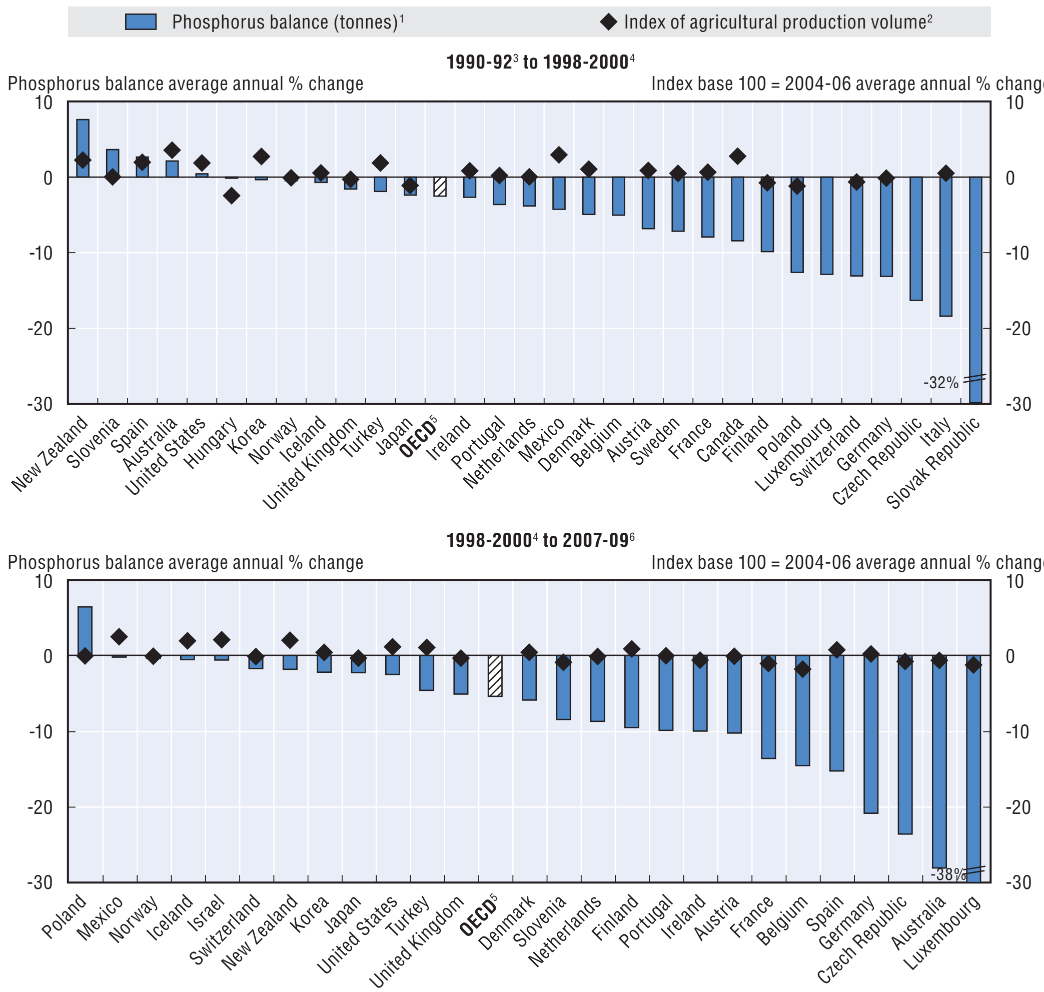
Notes: Countries are ranked in descending order according to nitrogen balance average annual percentage change.
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. The gross nitrogen balance (surplus or deficit) 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).
2. The FAO indices of agricultural production show the relative level of the aggregate volume of agricultural production for each year in comparison with the base period 2004-06. They are based on the sum of price weighted quantities of different agricultural commodities produced after deductions of quantities used as seed and feed weighted in a similar manner. The resulting aggregate represents, therefore, disposable production for any use except as seed and feed. All the indices at the country, regional and world levels are calculated by the Laspeyres formula. Production quantities of each commodity are weighted by 2004-06 average international commodity prices and summed for each year. To obtain the index, the aggregate for a given year is divided by the average aggregate for the base period 2004-06.
3. Data for 1990-92 average refer to the year 1990 for the United Kingdom; the 1992-94 average for Slovenia; and the 1995-97 average for Portugal.
4. Data for 1998-2000 average refer to the year 2000 for the United Kingdom; and the 2000-02 average for Israel and Portugal.
5. The OECD total excludes Chile, Estonia and Israel.
6. Data for 2007-09 average refer to the 2006-08 average for Belgium, France, Greece, Hungary, Italy, Luxembourg, Mexico, Netherlands, Slovenia and Switzerland.

Source: FAOSTAT (2012), "Food and Agriculture Organisation of the United Nations", *http://faostat.fao.org*; *OECD/Eurostat Agri-Environmental Indicator Database*, *http://epp.eurostat.ec.europa.eu*; and national data for Spain.

StatLink http://dx.doi.org/10.1787/888932792711

Figure 4.7. **Phosphorus balance and agricultural production volume, OECD countries, 1990-2009**



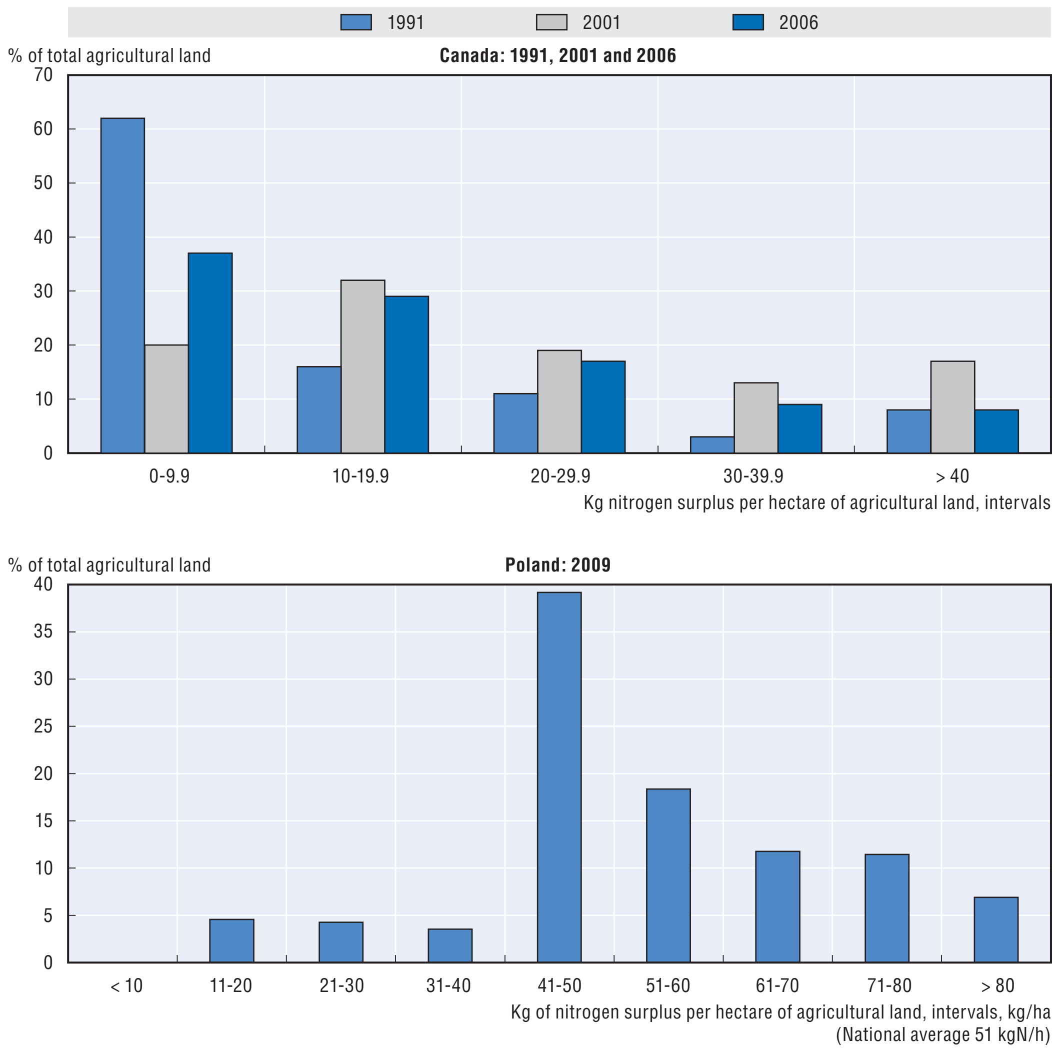
Notes: Countries are ranked in descending order according to phosphorus balance average annual percentage change.
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. The gross phosphorus balance (surplus or deficit) calculates the difference between the phosphorus inputs entering a farming system (i.e. mainly livestock manure and fertilisers) and the phosphorus outputs leaving the system (i.e. the uptake of phosphorus for crop and pasture production). Countries with a phosphorus deficit are not included in the figure, as follows: Canada, Estonia, Greece, Hungary, Italy (1998-2000 to 2007-09), Slovak Republic (1998-2000 to 2007-09) and Sweden (1998-2000 to 2007-09).
2. The FAO indices of agricultural production show the relative level of the aggregate volume of agricultural production for each year in comparison with the base period 2004-06. They are based on the sum of price weighted quantities of different agricultural commodities produced after deductions of quantities used as seed and feed weighted in a similar manner. The resulting aggregate represents, therefore, disposable production for any use except as seed and feed. All the indices at the country, regional and world levels are calculated by the Laspeyres formula. Production quantities of each commodity are weighted by 2004-06 average international commodity prices and summed for each year. To obtain the index, the aggregate for a given year is divided by the average aggregate for the base period 2004-06.
3. Data for 1990-92 average refer to the year 1990 for the United Kingdom; and the 1995-97 average for Portugal and Slovenia.
4. Data for 1998-2000 average refer to the year 2000 for the United Kingdom; and the 2000-02 average for Israel, Portugal and Slovenia.
5. The OECD total excludes Chile, Estonia and Israel.
6. Data for 2007-09 average refer to the 2006-08 average for Belgium, France, Germany, Greece, Hungary, Italy, Luxembourg, Mexico, Netherlands, Slovenia and Switzerland.

Source: FAOSTAT (2012), *Food and Agriculture Organisation of the United Nations*, *http://faostat.fao.org*; *OECD/Eurostat Agri-Environmental Indicator Database*, *http://epp.eurostat.ec.europa.eu*; and national data for Spain.

StatLink http://dx.doi.org/10.1787/888932792730

Figure 4.8. **Spatial distribution of nitrogen balances, Canada and Poland, 1991-2009**



Source: Panel A: Eilers, W., R. MacKay, L. Graham and A. Lefebvre (eds.) (2010), "Environmental sustainability of Canadian agriculture", *Agri-environmental indicator report series*, Report #3, Agriculture and Agri-Food Canada, Ottawa, Canada, *http://publications.gc.ca/collections/collection_2011/agr/A22-201-2010-eng.pdf*. Panel B: Polish Ministry of Agriculture and Rural Development.

StatLink http://dx.doi.org/10.1787/888932792749

In most countries there is considerable variation in the level and trends of ***regional nutrient surpluses*** around national average values. Regional variations are explained by the spatial distribution of intensive livestock farming and cropping systems that require high nutrient inputs, such as maize and rice relative to wheat and oilseeds, as well as differing climates and types of soil, and also varying topography across the agricultural regions.

National nutrient balance indicators can mask important regional (sub-national) variations across a country, especially where more intensive agricultural production systems are spatially concentrated in a small part of the overall agricultural land area. While **Australia**, **Canada**, **Mexico**, and the **United States,** for example, have nutrient surplus intensities below the OECD average (expressed as kgN/P/ha of agricultural land, Figures 4.3 and 4.5) there are regions within these countries where excess nutrients place a considerable burden on the environment or where nutrient deficits have potential to undermine crop productivity.

In **Canada**, for example, the national N balance spatially disaggregated reveals some important developments not revealed by the average national value (Figure 4.8). In 1991, about 60% of agricultural land had a N surplus of less than 10 kg/N/ha, but by 2006 this fell to a share of under 40%, as nitrogen surplus gradually rose over the 1990s and 2000s (Figures 4.2 and 4.3). Similarly in **Poland**, where the national average N surplus in 2009 was 51 kgN/ha, but nearly one quarter of agricultural land had a surplus greater than 60 kgN/ha (Figure 4.8).

References

OECD (2012), *Water Quality and Agriculture: Meeting the Policy Challenge*, Paris, France, *www.oecd.org/agriculture/water*.

OECD (2008), *Environmental Performance of Agriculture in OECD Countries Since 1990,* OECD Publishing, *www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm*.

OECD/EUROSTAT (2012a), *OECD/EUROSTAT Nitrogen Balance Handbook*, OECD Publishing, *www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm*.

OECD/EUROSTAT (2012b), *OECD/EUROSTAT Phosphorus Balance Handbook*, OECD Publishing, *www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm*.

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