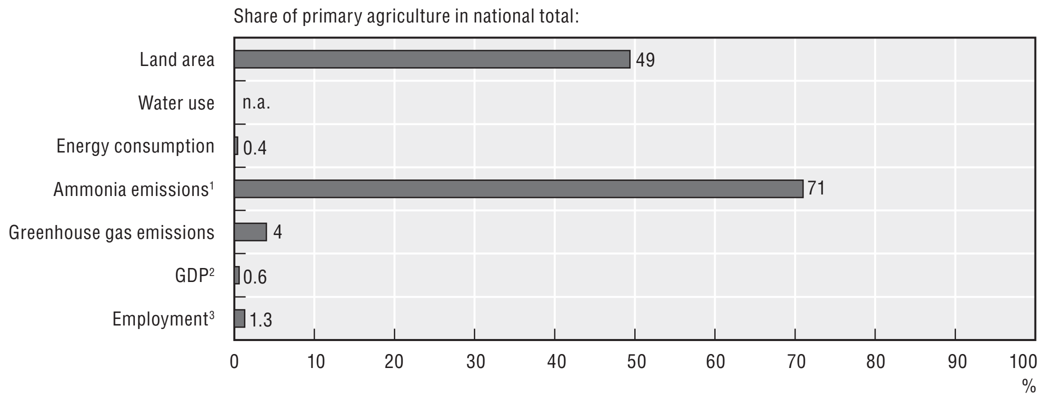
3.17. LUXEMBOURG

Figure 3.17.1. **National agri-environmental and economic profile, 2002-04: Luxembourg**



StatLink http://dx.doi.org/10.1787/300620510217

1. Data refer to the period 2001-03.
2. Data refer to the year 2004.
3. Data refer to the year 2001.

Source: OECD Secretariat. For full details of these indicators, see Chapter 1 of the *Main Report*.

3.17.1. Agricultural sector trends and policy context

Agriculture's contribution to the economy has been small but stable in absolute terms since 1990, such that by 2003-05 the sector contributed 0.5% to GDP and 1.3% of employment, among the lowest shares across OECD countries [1] (Figure 3.17.1). While agricultural value added (annual growth at current prices) remained stable over the period 1990 to 2004 (allowing for temporary fluctuations), in real terms it increased over the period 1986 to 1998, but from 1998 to 2003 it was the only sector in the economy where growth declined by nearly 5% per annum [1, 2].

The area farmed increased by about 1.5% from 1990-92 to 2002-04, now accounting for over 50% of the total land area (Figure 3.17.2). Much of the increase in area cultivated was accounted for by the growth in area under pasture and maize silage, with the area under cereals declining [3, 4]. But some of the apparent expansion in area farmed is, in part, due to improvements in the land registration system linked to changes in agricultural policy. There was an increase in the production of bovine animals (for slaughterings and export of live animals) in the first half of the 1990s, and a slight decrease from 1996 onwards, especially in 2001 due to the BSE crisis. The production of pigs (for slaughtering and export as live animals) increased significantly in the 1990s and went through a cyclic variation from 1999 to 2004 reaching a minimum in 2002. Milk production was remarkably stable over the period 1990 to 2004, due to the EU-wide system of limitation of production. As the milk yield per cow has risen considerably during this period, the number of milk cows has declined [1].

Agriculture uses purchased variable inputs intensively, while the average farm size has increased since 1990. With the reduction in the number of farms (over 2 hectares) from about 3 300 in 1990 to 2 200 by 2005, the average farm size has risen sharply over this period from an average of about 38 hectares (1990) to over 70 hectares (2003-05) [3, 4]. Agriculture remains intensive by comparison with most OECD countries, with the use of some purchased variable inputs increasing since 1990, both pesticides and direct on-farm energy consumption (Figure 3.17.2), but the volume of inorganic fertiliser use declined (nitrogen and phosphorus) [4].

Farming is mainly supported under the Common Agricultural Policy, with additional national expenditure within the CAP framework. Support to EU15 agriculture has declined from 39% of farm receipts in the mid-1980s to 34% in 2002-04 (as measured by the OECD Producer Support Estimate) compared to the OECD average of 30% [5]. Nearly 70% of EU15 farm support is output and input linked, falling from over 98% in the mid-1980s. Annual agricultural budgetary expenditure (less CAP payments) was EUR 78 (USD 98) million in 2005, of which about 10% is for agri-environmental measures [1, 5].

Agri-environmental policies are mainly focused on reducing the intensity of farming and protecting biodiversity [1]. Nutrient policy under the EU *Nitrate Directive* started in 1997, with Luxembourg among the first of EU15 countries to develop an action plan to help those farmers to control nitrate pollution in *Nitrate Vulnerable Zones*. Under the *National Plan for Sustainable Development* (2001), the government established two key goals for agri-environmental policy up to 2010: first, to increase the area under organic management to 4 000 hectares or 5% of total agricultural land area; and second, to expand the area under agri-environmental schemes to 16 000 hectares or 20% of the total agricultural land area [6, 7]. The latter scheme includes measures for livestock extensification, establishing riparian buffer strips along stream and river courses, and biodiversity conservation, such as preserving hedges and hay meadows [1, 4].

Agriculture is impacted by national environmental and taxation policies. Under the *National Plan for Sustainable Development* (2001), the Plan recognises the need to protect soils (including in agriculture) against degradation, and restore the ecological functions of rivers [4, 8]. Farmers are provided an exemption on diesel fuel tax, but the budget revenue forgone from the concession is unknown [9]. To promote renewable energy production from agricultural biomass production, energy crops are provided support of EUR 45 (USD 56) per hectare, while investment grants are available to farmers for construction of biogas facilities of up to 60% of the total investment costs [1, 10, 11]. In addition, feed-in tariffs for electricity and heat produced from agricultural biomass are above average electricity tariff rates [10].

Some international environmental agreements have implications for agriculture. Agriculture is implicated by Luxembourg's commitment to reduce nutrients into the North Sea (*OSPAR Convention*), ammonia emissions (*Gothenburg Protocol*), and greenhouse gases (*Kyoto Protocol*), and also make commitments for biodiversity conversation under the *Convention on Biological Diversity* [4].

3.17.2. Environmental performance of agriculture

Overall the environmental pressure from agricultural activities have eased since 1990, but the intensity of farming remains high and pesticide and energy use have been rising. The key environmental challenges are to: continue to reduce water pollution from farm nutrients and pesticides; maintain soil quality; further reduce ammonia and greenhouse gas emissions; and enhance biodiversity conservation efforts. As agriculture is largely rain-fed there is little use of irrigation.

In general soil erosion is not a concern across agricultural land, except for a few problem areas [8]. Current levels of soil erosion rates and other forms of soil degradation, however, are not very well known due to the lack of a national soil monitoring network, [8]. Overall soil erosion levels are low to moderate [8], while under agri-environmental measures the area under soil conservation practices (*e.g.* reduced tillage, erosion strips) has been increasing, reaching about 2% of agricultural land by 2003 [12].

The overall pressure from farming activities on water quality has been mixed since 1990. This is because agricultural nutrient surpluses have sharply declined, but pesticide use significantly increased since 1990. But determining the extent of agricultural water pollution is difficult due to the absence of pollutant monitoring stations in rivers, lakes and groundwater in predominantly agricultural areas. Some limited national data, however, indicates that over the period 1996-99 to 2000-03 eutrophication of surface water has deteriorated for nitrates but improved for phosphorus (Figure 3.17.3) [4, 7].

Agricultural nutrient surpluses decreased between 1990-92 and 2002-04, but surpluses per hectare of farmland remain amongst the highest in the OECD (Figure 3.17.2). Over this period surpluses (tonnes) of nitrogen fell by 43% and for phosphorus by 76%, mainly because of a: reduction in inorganic fertiliser use (nitrogen and phosphorus) and livestock numbers (*i.e.* lower manure output); and the higher uptake of nutrients, largely because of the increase in fodder maize and pasture production. Despite the reduction in the total volume of nutrient surpluses, the intensity (kg of nutrient per hectare of agricultural land) remains high compared to EU15 and OECD averages. This is mainly due to the elevated livestock density and the high ratio of grassland in comparison to arable land in Luxembourg. Organic fertilisers (on grassland) have a lower efficiency than mineral fertilisers used in regions with a higher ratio of arable crops. By 2002-04 nitrogen surpluses were over 50% above the EU15 average and for phosphorus 10% higher, probably reflecting the orientation of agriculture towards animal production, compared to less intensive nutrient surpluses often associated with arable farming systems. Moreover, the efficiency of nitrogen use (based on the balance volume ratio of inputs to outputs) is below the OECD and EU15 averages, and for phosphorus slightly above.

Given the growth in pesticide use since 1990 environmental risks are likely to have increased. Pesticide use (in volume terms of active ingredients) rose by nearly 70% between 1990 and 1999. The rising use of pesticides in the 1990s can be explained partially by the fact that up to 2002 the level of Value Added Tax (VAT) was particularly low in Luxembourg compared to neighbouring countries, and as a result some pesticides were not correctly reported in national statistics. With the increasing area under agri-environmental schemes (85% of the farms and 89% of the utilised agricultural area in 2005), however, this is helping to encourage farmers to use pesticides and fertilisers more efficiently. Additionally, the increasing area under ***organic management*** also limits the use of pesticides. Despite the rapid growth in the area under organic farming since the early 1990s, however, the share of organic farming in the total agricultural land area was about 2% by 2002-04, compared to the EU15 average of almost 4%, although by 2006 the share for Luxembourg had risen to nearly 3% [1, 6].

Agricultural ammonia emissions declined by 10% between 1990-92 and 2001-03 (Figure 3.17.2). The reduction in emissions was largely due to the decrease in nitrogen fertiliser use and lower livestock numbers, with the latter accounting for over 90% of agricultural ammonia emissions. Agriculture accounts for more than 70% of ammonia emissions, which is low by the average of other OECD countries at over 90%. The contribution of agriculture in total emissions of acidifying substances has risen since 1990 as the reduction in other sources of acidifying emissions have fallen more rapidly [7]. Luxembourg has agreed to a ceiling in total ammonia emissions of 7 000 tonnes by 2010 under the *Gothenburg Protocol*. By 2001-03 emissions totalled 3% in excess of this ceiling, so Luxembourg will need to make a further cut in emissions to meet its commitments under the *Protocol*.

Agriculture greenhouse gas emissions (GHGs) declined by 6% between 1990-92 and 2002-04, close to the EU15 reduction of 7% over the same period, but lower than the economy-wide GHG emission reduction in Luxembourg of 9% (Figure 3.17.2). Luxembourg's commitment under the EU burden sharing agreement, part of the *Kyoto Protocol*, is to reduce total GHGs by 28% in 2008-12 compared to 1990 levels. Much of the decrease in agricultural GHGs was due to lower fertiliser and livestock numbers, with farming contributing 4% of total GHG emissions in 2002-04. There is no information on the trends in the ***soil organic carbon*** content of agricultural soils, but it is possible that with the growth in the area under permanent grassland since 1990 there has been an increase of carbon storage in agricultural soils. The conversion of permanent grassland to arable land is, however, currently excluded through cross-compliance measures and the landscape conservation scheme.

The rise in on-farm energy consumption increased (17%) was just over half the rate of the rest of the economy (31%) over the period 1990-92 to 2002-04 (Figure 3.17.2). While the rise in farm energy consumption contributed to higher GHG emissions, agriculture's share of total energy consumption is very low at less than 0.1% in 2002-04. The use of motor fuels and lubricants per hectare, the main items of on-farm energy consumption, remained stable over the last 10 years. There has been considerable growth in ***renewable energy production*** from agricultural biomass feedstock since the mid-1990s, mainly in the form of biogas [10]. But the contribution of agriculture to total primary energy supply was less than 1%, and this share is projected to change little up to 2010 [11]. Energy crops accounted for about 9% of the total agricultural land area by 2002-04, but there is no domestic biofuel production in Luxembourg [1].

With the overall pressure of agriculture on the environment easing this could have had a beneficial impact on biodiversity since 1990. Determining the impact of agricultural activities on biodiversity is, however, extremely difficult due to the paucity of data and research. In terms of ***agricultural plant genetic diversity***, crop varieties used in production increased in diversity between 1990 and 2002, most notably for cereals [13]. Moreover, there has been a gradual decline between 1985 and 2002 in the number of national crop varieties endangered or not at risk [13]. There is little or no information on the genetic diversity of livestock.

Changes in the use and management of agricultural habitats have been harmful to wild flora and fauna. The conversion of small farmland habitats, such as ditches, hedgerows, stone wall terraces has been a cause of the loss of certain flora and fauna. Also the drainage and fertilisation of nutrient poor wet grasslands has led to the disappearance of some wild plant species from these habitats [4, 14]. Since the introduction of measures concerning the protection of nature and natural resources in 1982 and the implementation of a landscape conservation scheme in 1996, however, the destruction of natural habitats, the reduction of permanent grassland and the drainage of agricultural land has been banned. For bird species whose primary habitat is farmland the trends appear to be mixed. Population numbers of the Northern Lapwing (*Vanellus vanellus*) and Little Owl (*Athene noctua*) have been in long term decline since the 1980s, while numbers of Grey herons (*Ardea cinerea*) have risen over this period [7]. These trends are of concern as agriculture is estimated to have posed a threat, in the late 1990s, to around 55% of important bird habitats through changes in management practices and land use [15].

3.17.3. Overall agri-environmental performance

Overall the high intensity of farm input use exerts considerable pressure on the environment, although the trend of nutrient surpluses has been declining, but pesticide use has risen. Absolute levels of some agricultural pollutants remain high relative to average OECD standards and as a result the sector continues to be a potential source of pollution. Moreover, agricultural practices continue to pose a threat to biodiversity.

The lack of an adequate agri-environmental indicator monitoring system does not provide the necessary support for policy makers to assess agri-environmental measures [4]. While some areas of environmental monitoring related to agriculture have been developed, such as those related to ammonia and greenhouse gas emissions, for most other areas, notably concerning water pollution from agriculture and agri-biodiversity, monitoring is absent or very weak.

Agri-environmental measures have been considerably strengthened and expanded since 2000, compared to those measures first introduced in the early 1990s [1, 4]. In terms of meeting the government's 2010 agri-environment goals of increasing the area under organic management to 4 000 hectares and the area under agri-environmental schemes to 16 000 hectares, by 2005 (estimate) the areas achieved were respectively about 2 900 and 24 000 hectares, with an additional 3 250 hectares under agri-biodiversity schemes (Figure 3.17.4) [6]. Hence, in 2005 around 2% of the total agricultural land area was under organic management, 18% under agri-environmental schemes, and nearly 3% under biodiversity schemes.

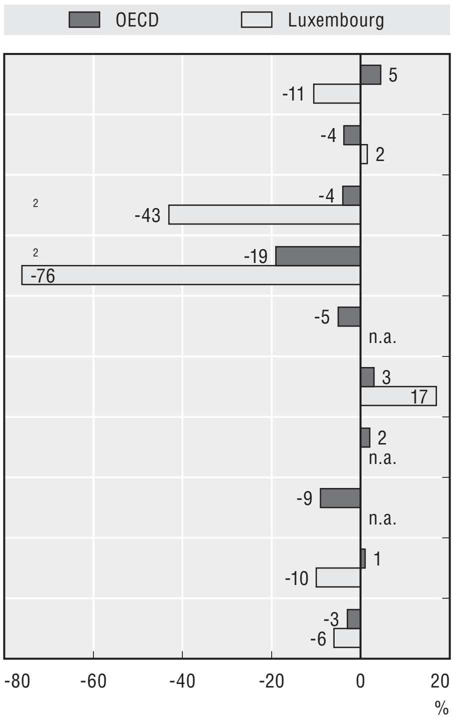
Despite the strengthening of agri-environmental policies some problems persist. The EU Commission has been critical of the weakness of Luxembourg's efforts to adequately address its commitments under the EU *Nitrates Directive* [16]. Despite the reduction in the total tonnes of ***nutrient surpluses*** since 1990 the intensity (kg of nutrient per hectare of agricultural land) remains high in relation to the EU15 and OECD averages (Figure 3.17.2). In addition considerable improvements could be made to raise the efficiency of nutrient use, which is very low by OECD standards, especially for nitrogen. Moreover, risks of water pollution from ***pesticides*** run-off have increased with their growing use since 1990, although data on pesticide use and environmental risks are poor. While ***agricultural GHG emissions*** have decreased since 1990, further reductions might be achieved if the fuel tax exemption for farmers was removed, which acts as a disincentive to lower energy use, improve energy efficiency and further reduce GHG emissions. But the growing use of agricultural biomass to produce ***renewable energy*** (notably biogas) is helping to reduce GHG emissions.

Concerning biodiversity risks of future adverse impacts from farming remain, especially given the intensity of farming in Luxembourg. Meeting the 2010 agri-environmental goals under the *National Plan for Sustainable Development*, however, holds the potential to ease agricultural pressure on wild flora and fauna. Moreover, the recent introduction of agri-environmental measures should ease pressure on the environment, such as those addressing soil erosion and nutrient management.

 ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990 – ISBN 978-92-64-04092-2 – © OECD 2008

Figure 3.17.2. **National agri-environmental performance compared to the OECD average**

Percentage change 1990-92 to 2002-04[1]



Absolute and economy-wide change/level

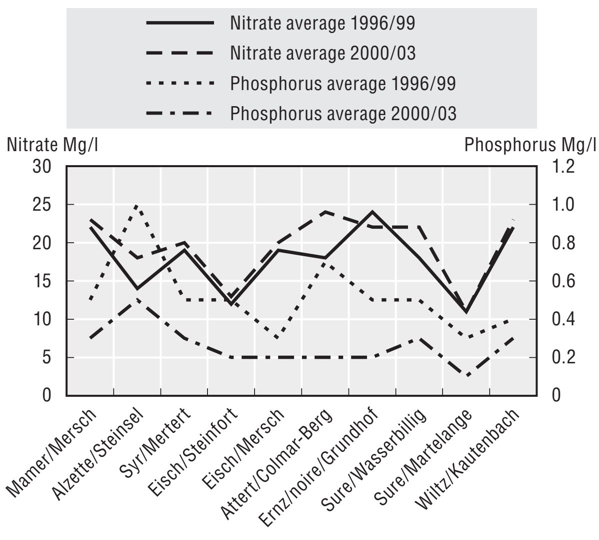
Variable	Unit		Luxembourg	OECD
Agricultural production volume	Index (1999-01 = 100)	1990-92 to 2002-04	89	105
Agricultural land area	000 hectares	1990-92 to 2002-04	2	–48 901
Agricultural nitrogen (N) balance	Kg N/hectare	2002-04	129	74
Agricultural phosphorus (P) balance	Kg P/hectare	2002-04	11	10
Agricultural pesticide use	Tonnes	1990-92 to 2001-03	n.a.	–46 762
Direct on-farm energy consumption	000 tonnes of oil equivalent	1990-92 to 2002-04	+2	+1 997
Agricultural water use	Million m^3	1990-92 to 2001-03	n.a.	+8 102
Irrigation water application rates	Megalitres/ha of irrigated land	2001-03	n.a.	8.4
Agricultural ammonia emissions	000 tonnes	1990-92 to 2001-03	–1	+115
Agricultural greenhouse gas emissions	000 tonnes CO_2 equivalent	1990-92 to 2002-04	–28	–30 462

n.a.: Data not available. Zero equals value between –0.5% to < +0.5%.

1. For agricultural water use, pesticide use, irrigation water application rates, and agricultural ammonia emissions the % change is over the period 1990-92 to 2001-03.
2. Percentage change in nitrogen and phosphorus balances in tonnes.

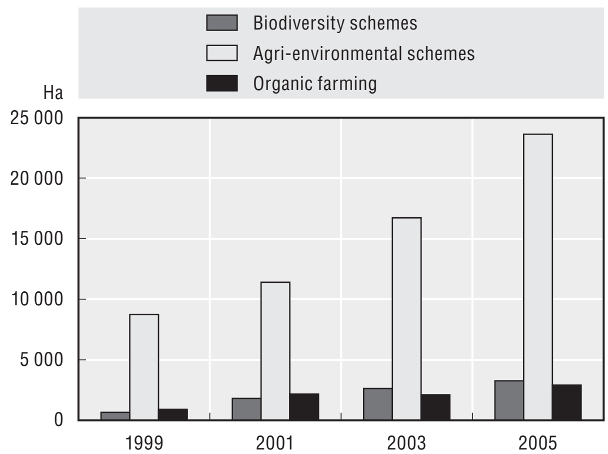
Source: OECD Secretariat. For full details of these indicators, see Chapter 1 of the *Main Report*.

Figure 3.17.3. **Nitrate and phosphorus concentration in river sampling stations**



Source: Water Management Authority, Luxembourg.

Figure 3.17.4. **Agricultural land under agri-environmental schemes**



Source: Agricultural Technical Services Authority.

StatLink http://dx.doi.org/10.1787/300626813520

Bibliography

[1] Ministry of Agriculture, Viticulture and Rural Development (2007), *Rapport d'Activité 2006*, (available in French only), Luxembourg, *www.ma.public.lu/*.

[2] OECD (2006), *OECD Economic Surveys: Luxembourg*, Vol. 2006/9 July, Paris, France, *www.oecd.org/eco*.

[3] Statec Luxembourg (2006), *2006 Luxembourg in figures*, Luxembourg, *www.statistiques.public.lu/fr/*.

[4] OECD (2000), *Environmental Performance Reviews: Luxembourg*, Paris, France, *www.oecd.org/env*.

[5] OECD (2007), *Agricultural Policies in OECD Countries: Monitoring and Evaluation 2007*, Paris, France, *www.oecd.org/agr/policy*.

[6] Ministry of the Environment (2006), *Indicateurs de développement durable* (available in French only), Luxembourg, *www.environnement.public.lu*.

[7] Ministry of the Environment (2006), *L'environnement en chiffres* (available in French only), Luxembourg, *www.environnement.public.lu*.

[8] Cammeraat, E.L.H. (2006), "Luxembourg", in J. Boardman and J. Poesen (eds.), *Soil Erosion in Europe*, John Wiley, London, United Kingdom.

[9] OECD PSE Database, *www.oecd.org/tad*.

[10] Conter, G. (2004), "Favourable Policy Conditions to the Development of Biogas Production as a Sustainable Form of Energy in Luxembourg", in OECD, *Biomass and Agriculture: Sustainability, Markets and Policies*, Paris, France, *www.oecd.org/tad/env*.

[11] IEA (2004), *Energy Policies of IEA Countries – Luxembourg 2004 Review*, Paris, France, *www.iea.org*.

[12] Ministry of Internal Affairs (2004), *Report in accordance of Article 10 of the Nitrate Directive (91/676/CEE)*, Waste Management Agency, Luxembourg.

[13] The Luxembourg response to the OECD Agri-environmental Indicators Questionnaire, unpublished.

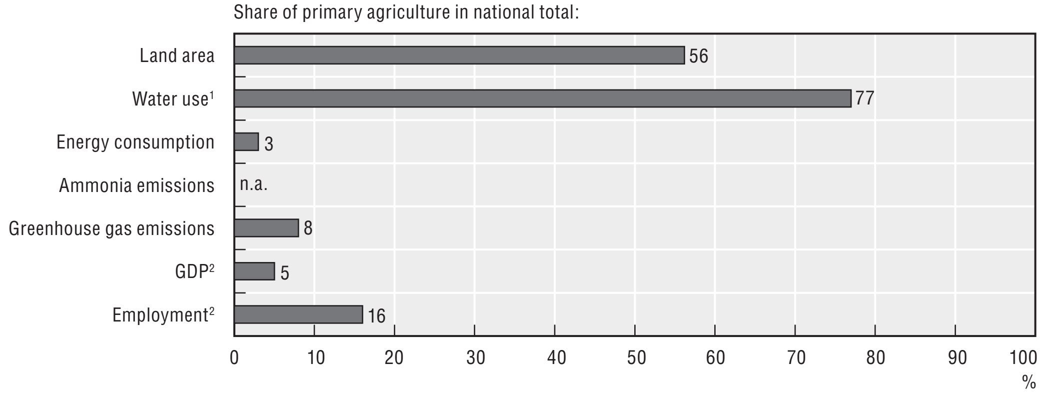
[14] Colling, G., D. Matthies and C. Reckinger (2002), "Population structure and establishment of the threatened long-lived perennial *Scorzonera humilis* in relation to environment", *Journal of Applied Ecology*, Vol. 39, pp. 310-320.

[15] BirdLife International (2004), *Biodiversity indicator for Europe: population trends of wild birds*, The Pan-European Common Bird Monitoring Database, BirdLife International and European Bird Census Council, *www.birdlife.org/publications/index.html*.

[16] EU Commission (2002), *Qualité de l'eau: la Commission poursuit la France, la Grèce, l'Allemagne, l'Irlande, le Luxembourg, la Belgique, l'Espagne et le Royaume-Uni*, Press Communiqué, Brussels, Belgium, *www.waterlink.net/fr/dg11eu59_2002.htm*.

3.18. MEXICO

Figure 3.18.1. **National agri-environmental and economic profile, 2002-04: Mexico**



StatLink http://dx.doi.org/10.1787/300643416640

1. Data refer to the period 2001-03.
2. Data refer to the year 2003.

Source: OECD Secretariat. For full details of these indicators, see Chapter 1 of the *Main Report*.

3.18.1. Agricultural sector trends and policy context

Agriculture plays an important but declining role in the Mexican economy. In 2003 primary agriculture accounted for about 5% of GDP and 16% of employment compared to 8% and 27% respectively in 1990 [1] (Figure 3.18.1). Nevertheless, 25% of Mexico's 103 million population live and work in rural, largely agricultural, areas. The rural population has increased by nearly 2 million over the past decade [2].

Mexico's agricultural sector is one of the most rapidly growing among OECD countries. The volume of agricultural production rose by 34% between 1990-92 and 2002-04, with crop production increasing by 26% and livestock 51% (Figures 3.18.2 and 3.18.3). The area farmed rose by 3%; while the volume of inputs also increased by 22% for pesticides, and 21% for direct on-farm energy consumption, although the use of phosphorus fertilisers remained stable, and nitrogen fertiliser use declined (–5%), as did the use of water (–10%) (Figures 3.18.2 and 3.18.4). Production is expanding by improving efficiency and increasing use of capital-intensive technologies. Nevertheless, farming is characterised by diverse structure and production systems. Large commercial arable farms, largely in the north, are capital intensive and rely on irrigation and purchased inputs. There are also range fed cattle and intensive pig and poultry operations in the north. Subsistence farms, mainly in the centre and south, grow staples such as maize and beans. The southern tropical zone has plantations and subsistence producers of coffee, sugarcane and bananas [2, 3].

Support to agriculture is below the OECD average and has declined over the last decade. Agricultural producer support fell from around 28% of farm receipts in the early 1990s down to 21% by 2002-04 (as measured by the OECD's Producer Support Estimate). This compares to the OECD average of 31% over this period [4]. Nearly 80% of farm support is output and input linked, falling from 100% over the last decade. Agricultural policies consist mainly of market price support provided through border measures and payments to producers (PROCAMPO). The latter include payments for input use and technical assistance aimed at enhancing farm investment, especially in poor areas (*Alianza Contigo*). Border protection with Canada and the United States is being reduced within the framework of the North American Free Trade Agreement (NAFTA) [4].

Policies addressing agri-environmental concerns are limited. Agri-environmental payments are possible under PROCAMPO, for soil and water conservation, although farmer uptake of these payments has been limited to date [3]. A number of programmes support forestry but only one is aimed specifically at the reaforestation of farmland, and eco-certification of shade-grown coffee plantations is being developed [3]. Farmers are exempt from the 15% value added tax on pesticides [5].

Economy-wide environmental and taxation policies and international environmental agreements also affect agriculture. Under the *Law on Energy for Agriculture* diesel fuel and electricity subsidies reduce farmers' energy costs. The programme to subsidise diesel for farm production, implemented since 2003, provided payments of MXN 1.2 billion (USD 106 million) in 2004 [4]. The total agricultural electricity subsidy rose from MXN 3.8 to 5.4 billion (USD 390-480 million) from 2002 to 2004 [4, 6]. Under the *Federal Law on Water Taxes* (1982), a system of water abstraction charges was established, but farmers were exempt from these charges up to 2003, although they are liable for water pollution charges introduced in 1992 under the same law. Budget transfers to the government *National Water Commission* agency reduce farmers' irrigation costs: currently farmers are paying 80% of irrigation operating and maintenance costs compared to 20% in the early 1990s, and government expenditure on irrigation infrastructure and maintenance amounted to MXN 1 468 (USD 135) million in 2006 [4].

The International Boundary and Water Commission resolves water issues at the Mexican-United States border, including allocation of water resources for irrigation, while the *North American Commission for Environmental Co-operation*, established under NAFTA in 1994, addresses regional environmental issues, for example those concerning transgenic maize [7]. The *National Environment Programme* also provides a framework for biodiversity and natural resource conservation.

3.18.2. Environmental performance of agriculture

The main agri-environmental concerns relate to water resources and deforestation, with the latter being of importance for soil conservation and biodiversity. Also of increasing concern are issues related to agricultural pesticide use, especially methyl bromide, water pollution, and greenhouse gas emissions.

Agriculture's use of the country's natural resources is significant, accounting for 56% of land use (2002-04) and nearly 80% of water use (2001-03). Over the period 1990-92 to 2002-04 the growth in the agricultural land area was amongst the highest across OECD countries (Figure 3.18.3). In excess of 75% of the country lies in semi-arid or arid zones where more than half of agricultural production takes place. While overall population density is low by OECD standards, Mexico has the highest rate of population growth across the OECD, which coupled with high rates of industrial growth, urban expansion and a growing but poor rural population, there is considerable pressure on land, water and biological resources.

 ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990 – ISBN 978-92-64-04092-2 – © OECD 2008

Soil erosion is one of Mexico's most serious ecological problems with agriculture identified as the major cause of soil degradation [3, 8]. Between 60-80% of the total land area is affected by erosion, with around 40% suffering high and severe erosion [3, 8]. Recent evidence reveals that agriculture is the major cause of soil degradation from erosion accounting for nearly 80% of affected areas. The soil degrading factors caused by agriculture are overgrazing, excess irrigation, tillage burning, excessive tilling [9] and inadequate adoption of soil conservation practices [8].

Water pollution from agriculture tends to be mainly confined to irrigated areas where farm chemicals are widely used [3]. But the expansion of intensive pig, poultry and dairy operations is leading to a greater incidence of water pollution from livestock effluents, even though overall cattle numbers have declined since 1990. [10]. The national nutrient surpluses of nitrogen and phosphate are very low by OECD standards, with most eutrophic pollution of water usually associated with urban and industrial sectors (Figure 3.18.1) [11]. There has been a slight decrease in nutrient surpluses, mainly because of declining cattle numbers; only a small increase in nitrogen fertiliser use; a drop in the use of phosphate fertilisers; and an increase in crop production (Figure 3.18.4). These changes have led to improvements in nutrient use efficiency (*i.e.* the ratio of nutrient outputs to nutrient inputs).

Pesticide use increased by 22% over the period 1993-95 to 2001-03 (Figures 3.18.2 and 3.18.4). Pesticide use is not widespread, partly because subsistence farmers cannot afford to use them, although total use has expanded over the 1990s. The use of two persistent organic pesticide pollutants, chlordane and DDT, has decreased over the past 20 years, and sales were prohibited as from 1998 and 2002 respectively [3]. Even so, the persistence of these pesticides, and possible continued illegal use [12], is polluting some coastal waters, with risks to human health from fish consumed from these waters [13], although there is little information on the overall impact of pesticides on ecosystems [5] and human health [14]. Recent research reveals, however, that reported incidents of pesticide poisonings have decreased by more than half between 1998 and 2002, although the incidence of poisonings is under-recorded [14].

Demand for water by agriculture is exceeding renewable supply and aquifers are being depleted [10]. Competition for water resources, especially in north-central regions, is intensifying because of the growth in population; economic activity; and water demand from irrigated agriculture. Irrigation accounts for nearly 80% of total water use and 50% of farm output, with 70% of farm exports dependent on irrigation (2001-03) [3]. About a third of agricultural water is from groundwater, with agriculture accounting for 70% of groundwater use (1997) [6]. The overexploitation of aquifers is a growing problem, with 32 overexploited aquifers reported in 1975 rising to 102 in 2005. Nearly 60% of groundwater for all uses is extracted from aquifers above recharge rates [6]. The unsustainable use of groundwater resources has raised concerns for the depletion of water to support aquatic ecosystems, especially wetlands, and a consequent increase in the salinity of soils [6]. Projections to 2010 suggest that water demand may rise sharply and further intensify competition for water between agriculture and other consumers [15].

Competition for water resources is especially acute on the Mexican-United States border, because of the over exploitation of water, notably by agriculture, from the border Rio Bravo river, called the Rio Grande in the US [16, 17]. Only around 45% to 50% of water extracted reaches irrigated fields [3, 6], because of insufficient investment in irrigation infrastructure and the relatively low share of irrigation water and energy costs in farmers total input expenditure [18]. Even so, there has been some improvement in irrigation water application rates (megalitres per hectare of irrigated land) declining by 12% between 1990-92 and 2001-03. The electricity subsidy for agriculture has lowered pumping costs for irrigators, with horticultural producers the main beneficiaries [4].

Trends in agricultural air emissions have shown mixed results since 1990. Agricultural ***ammonia emissions*** may have increased between 1990 and 2004, but ammonia emission data are not regularly collected and Mexico is not a signatory to the *Gothenburg Protocol* to limit emissions. The likely increase in ammonia emissions are from the increase in livestock production since 1990 partly offset by the reduction in the use of nitrogen fertiliser. For ***methyl bromide*** (an ozone depleting pesticide, particularly used in the horticultural sector as a soil fumigant) Mexico along with most OECD countries has substantially reduced its use over the period 1995 to 2004. Under the *Montreal Protocol on Substances that Deplete the Ozone Layer*, Mexico, which is classified as a developing country under the *Protocol*, agreed to reduce methyl bromide use by 2002 to 1995-98 levels, which it has achieved, with a further 20% reduction in 2002-05 and elimination by 2015, except for limited purposes [3].

The over 40% increase in agricultural greenhouse gas (GHG) emissions between 1990 and 1996 was among the highest across OECD countries (Figure 3.18.2). The increase in agricultural GHGs is largely attributed to rising livestock numbers, and agriculture contributes around 8% of national total GHGs. Methane emissions account for nearly 80% of agricultural GHGs (in CO_2 equivalents), mainly from livestock and to a lesser extent rice production, while nitrous oxide accounts for much of the remainder through fertiliser use [3, 19]. Considerable stocks of ***terrestrial carbon*** are being lost with the conversion of forests to agricultural land, but little data exist on the level of these losses [21]. However, there are opportunities for Mexican agriculture to sequester carbon, as carbon accumulated in some agricultural ecosystems is higher than carbon in the soil of secondary degraded forests [20].

Direct on-farm energy consumption rose by 21% compared to an increase of 10% across the economy, over the period 1990-92 to 2002-04, has also contributed to the increase in GHGs (Figure 3.18.4). Agriculture accounted for 3% of total energy consumption in 2002-04. Much of the increase in energy consumption is explained by the expansion in use and size of machinery as a substitute for labour since 1990.

Agricultural expansion over the past decade has resulted in growing pressure on wild species and natural habitats. This is significant because Mexico is identified as one of the world's megadiverse countries, with around 10% of the world's flora and fauna species [3]. The rate of deforestation is amongst the highest in the world at over 1% per annum over the 1990s, with clearing for agricultural purposes identified as the major cause for the lost of temperate and tropical forests. This is closely linked to the growth in the rural population; rural poverty [3]; and an increase in beef production, leading to the conversion of forests into grazing land [22]. Agriculture is also exerting pressure on aquatic environments (rivers, lakes, wetlands and coastal zones), from increasing levels of livestock effluents and diffuse pollution through the use of chemicals in arable farming [3].

There are environmental and economic risks associated with the loss of agricultural genetic resources, especially for crops. Mexico is recognised as a "Vavilov" centre, which is an area where crops, such as maize, were first domesticated and have evolved over several thousand years [23, 24]. Genetic erosion of maize varieties, shows a loss of 80% of local varieties compared to the 1930s [23], and more recently possible contamination of domesticated landraces and wild relatives from transgenic maize [24, 25]. The environmental and socio-economic costs and benefits associated with the use of transgenic maize (many subsistence farmers grow maize as a staple crop), and the loss of genetic resources, are complex and not fully understood, but are the subject of much ongoing research in Mexico and internationally, such as by the *North American Commission for Environmental Co-operation* [7].

3.18.3. Overall agri-environmental performance

Deforestation and conservation of water resources are the two key agri-environmental challenges in Mexico. Agriculture has been identified as a major cause of deforestation, which has adverse environmental implications for biodiversity, soil erosion and loss of carbon stocks. With growing competition for water in the drier regions of the country, agriculture, as the major user of water resources, is under increasing pressure to improve its efficiency of water use.

Mexico will require time and resources to establish adequate monitoring systems to deal with the environmental challenges it needs to address [3]. A start has been made with environmental monitoring, including efforts related to agriculture, such as the 2001 national soil inventory [8]; and the 1998 national survey of biodiversity by the National Commission for Biodiversity. However, these efforts require strengthening if they are to provide useful data for policy makers.

Limiting the adverse impacts of agriculture on the environment poses a formidable challenge. Recent developments suggest, however, some progress is being made toward reducing agriculture's adverse environmental impacts and increasing environmental services. A number of persistent organic pesticide pollutants have been prohibited, and the soil and water conservation infrastructure is being rehabilitated. A new programme on Water Rights has provided MXN 460 (USD 43) million in 2003, and MXN 227 (USD 20) million in 2004, to purchase water rights in areas where aquifers are overexploited, with an estimated 170 million cubic metres of water bought from producers in 2004 [4]. Mexico has a high percentage of "shade grown" coffee compared to other countries, which offers a higher quality habitat for biodiversity, and introduced an eco-certification system to provide incentives to "shade grown" and organic coffee production [3, 26, 27].

The North American Commission for Environmental Co-operation has recommended that Mexico should minimise the impact of growing transgenic maize and also mill transgenic grains immediately they are imported [7]. The government also amended its law on genetically modified crops in 2005 by limiting the release of genetically modified maize in centres of origin such as Oaxaca, Veracruz and Yucatan, in order to safeguard the diversity of domestic maize.

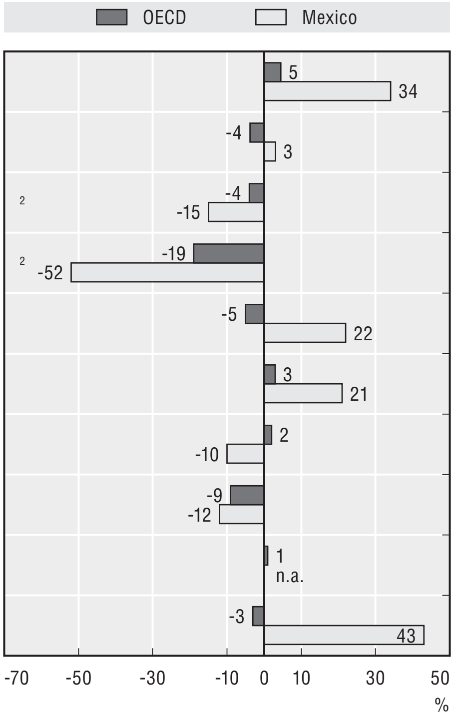
Pressure on the environment from agriculture has increased considerably since 1990. This trend is expected to continue over the next decade as projections indicate further expansion of the agricultural sector [28]. The adverse impacts of agriculture on the environment are attributed to the expansion in the area cultivated and grazed at the expense of forested land; poor soil conservation practices and deforestation resulting in major areas of land subject to elevated levels of erosion; and, also the high rates of water loss in irrigated areas through inefficient irrigation practices. Agricultural water and electricity charges are low by comparison with those paid by industrial and urban consumers, but reforms from 2003 have reduced the level of support [3, 11].

Water policy reforms have helped toward improving water use efficiency and reducing losses and there has been some improvement in irrigation water application rates per hectare irrigated [3, 29]. But subsidies for water charges and electricity for pumping are undermining the efforts to achieve sustainable agricultural water use and, in the case of energy, reduce greenhouse gas emissions. There is also concern that the subsidy to electricity is also exacerbating the pumping of groundwater and the growing overexploitation of this resource above recharge rates [6]. Moreover, the irrigation and electricity subsidy appears to be in contradiction to the new programme to purchase water rights from farmers, raising the costs to the government of achieving their environmental objectives [4].

ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990 – ISBN 978-92-64-04092-2 – © OECD 2008

Figure 3.18.2. **National agri-environmental performance compared to the OECD average**

Percentage change 1990-92 to 2002-04[1]



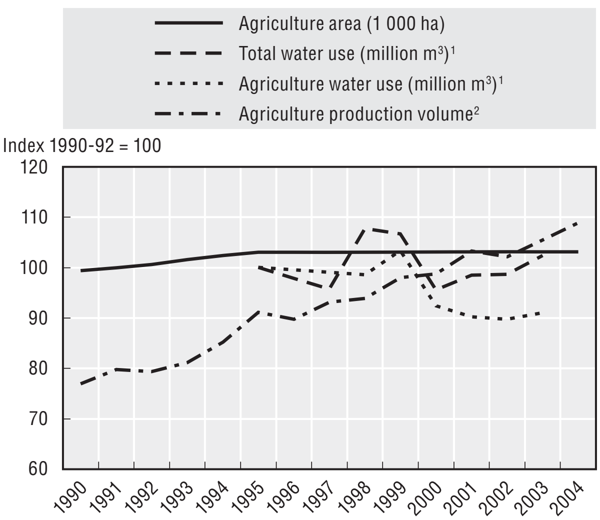
Absolute and economy-wide change/level

Variable	Unit		Mexico	OECD
Agricultural production volume	Index (1999-01 = 100)	1990-92 to 2002-04	134	105
Agricultural land area	000 hectares	1990-92 to 2002-04	3 267	–48 901
Agricultural nitrogen (N) balance	Kg N/hectare	2002-04	22	74
Agricultural phosphorus (P) balance	Kg P/hectare	2002-04	1	10
Agricultural pesticide use	Tonnes	1990-92 to 2001-03	+7 070	–46 762
Direct on-farm energy consumption	000 tonnes of oil equivalent	1990-92 to 2002-04	+476	+1 997
Agricultural water use	Million m^3	1990-92 to 2001-03	–6 049	+8 102
Irrigation water application rates	Megalitres/ha of irrigated land	2001-03	8.7	8.4
Agricultural ammonia emissions	000 tonnes	1990-92 to 2001-03	n.a.	+115
Agricultural greenhouse gas emissions	000 tonnes CO_2 equivalent	1990-92 to 2002-04	+16 811	–30 462

n.a.: Data not available. Zero equals value between –0.5% to < +0.5%.
1. For agricultural water use, pesticide use, irrigation water application rates, and agricultural ammonia emissions the % change is over the period 1990-92 to 2001-03.
2. Percentage change in nitrogen and phosphorus balances in tonnes.

Source: OECD Secretariat. For full details of these indicators, see Chapter 1 of the *Main Report*.

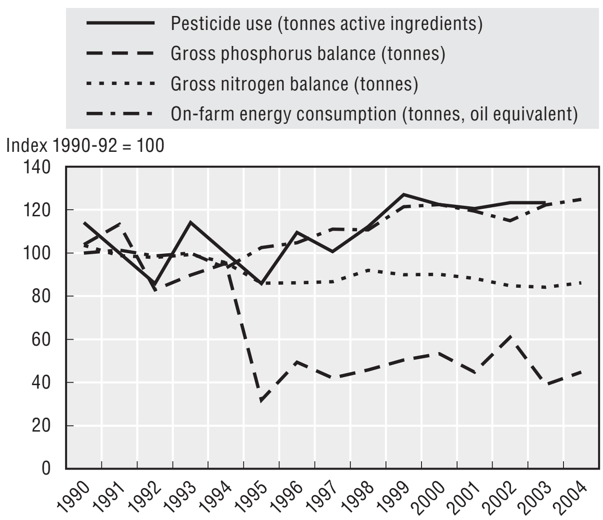
Figure 3.18.3. **Trends in key agri-environmental indicators**



1. Index 1995 = 100.
2. Index 1999-2001 = 100.

Source: OECD Secretariat.

Figure 3.18.4. **Trends in key agri-environmental indicators**



Source: OECD Secretariat.

StatLink http://dx.doi.org/10.1787/300683601738

Bibliography

[1] Mexican response to the OECD Agri-environmental Indicators Questionnaire, unpublished.

[2] USDA, *Briefing Room – Mexico*, electronic updates on Mexican agriculture, *www.ers.usda.gov/Briefing/Mexico/*.

[3] OECD (2003), *OECD Environmental Performance Reviews: Mexico*, Paris, France, *www.oecd.org/env*.

[4] OECD (2005), *Agricultural Policies in OECD Countries: Monitoring and Evaluation 2005*, Paris, France, *www.oecd.org/agr/policy*.

[5] Piña, C.M. and S.A. Forcada (2004), "Effects of an environmental tax on pesticides in Mexico", *UNEP Industry and Environment*, April-September, pp. 33-36.

[6] Piña, C.M., S.A. Forcada, L.A.J. Mosqueira, J.S. Santamaria and A.M. Cruz (2006), *Agricultural demand for groundwater in Mexico: Impact of water rights enforcement and electricity user fees on groundwater level and quality*, paper presented to Envecon 2006 Applied Environmental Economics Conference, 24 March, at The Royal Society, London, United Kingdom, *www.eftec.co.uk/home.php?section=8&uknee=2*.

[7] Commission for Environmental Co-operation (2004), *Maize and Biodiversity: The effects of Transgenic Maize in Mexico*, Ottawa, Canada, *www.cec.org/maize/index.cfm?varlan=english*.

[8] Sanchez-Colon, S. (2004), "Evaluation of Human-induced Soil Degradation in Mexico", in OECD, *Agricultural Impacts on Soil Erosion and Soil Biodiversity: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[9] Navar, J. and T.J. Synnott (2000), "Surface runoff, soil erosion, and land use in Northeastern Mexico", *Terra Volumen*, Vol. 18, No. 3, pp. 247-253, *www.chapingo.mx/terra/contenido/18/3/art247-253.pdf*.

[10] OECD (2003), *Agriculture, Trade and the Environment: The Pig Sector*, Paris, France.

[11] OECD (2004), "Sustainable Management of Natural Resources: Water ", pp. 117-124 in *OECD Economic Survey of Mexico*, Vol. 2003, Supplement No. 1, January 2004, Paris, France.

[12] Jimenez, B., R. Rodriguez-Estrella, R. Merino, G. Gomez, L. Rivera, M.J. Gonzalez, E. Abad and J. Tivera (2005), "Results and evaluation of the first study of organochlorine contaminants (PCDDs, PCDFs, PCBs and DDTs), heavy metals and metalloids in birds from Baja California, Mexico", *Environmental Pollution*, Vol. 133, pp. 139-146.

[13] Carvalho, F.P., F. Gonzalez-Farias, J.P. Villeneuve, C. Cattini, M. Hernandez-Garza, L.D. Mee and S.W. Fowler (2002), "Distribution, fate and effects of pesticide residues in tropical coastal lagoons of Northwestern Mexico", *Environmental Technology*, Vol. 23, pp. 1257-1270.

[14] Commission for Environmental Co-operation (2005), *Children's Health and the Environment in North American: A First Report on Available Indicators and Measures – Country Report: Mexico*, Montreal, Canada, *www.cec.org/files/pdf/POLLUTANTS/CEH-Indicators-fin_en.pdf*.

[15] Troyo-Dieguez, E., S. Merrett, L.F. Beltran-Morales, I. Orona-Castillo, J.L. Garcia, I.A. Nieto-Garibayl, B. Murillo-Amador, H. Fraga-Palomino and S.C. Diaz-Castro (2004), "Analysis of the Irrigation Status and Agricultural Water Uses for Sustainable Development in North-west Mexico", in OECD, *Agricultural Impacts on Water Use and Water Quality: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[16] Schmandt, S. (2002), "Bi-national water issues in the Rio Grande/Rio Bravo basin", *Water Policy*, Vol. 4, pp. 137-155.

[17] Parr Rosson III, C., A. Hobbs and F. Adcock (2003), *The US/Mexico water dispute: Impacts of increased irrigation in Chihuahua, Mexico*, paper presented to the Southern Agricultural Economics Association Annual Meeting, Mobile, Alabama, United States, *http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=6674&ftype=.pdf*.

[18] Scott, C.A. and T. Shah (2004), "Groundwater overdraft reduction through agricultural energy policy: Insights from India and Mexico", *Water Resources Development*, Vol. 20, No. 2, pp. 149-164.

[19] UNFCCC (2001), *2nd National Communication of Mexico on Climate*, submission to the UNFCCC (available in English and Spanish), *http://unfccc.int/resource/docs/natc/mexnc2.pdf*.

[20] Etchevers, J.D., M. Acosta, C. Monreal, C. Hidalgo, J. Padilla and L. Jimenez (2003), "Below-ground (Roots and Soil) Compartments of Carbon in Forest and Agricultural Systems on Hillsides in Mexico", in OECD, *Soil Organic Carbon and Agriculture: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[21] Ellingson, L.J., J.B. Kauffman, D.L. Cummings, R.L. Sanford Jr. and V.J. Jaramillo (2000), "Soil N dynamics associated with deforestation, biomass burning, and pasture conversion in a Mexican tropical dry forest", *Forest Ecology and Management*, Vol. 137, pp. 41-51.

[22] Commission for Environmental Co-operation (1999), *North American Important Bird Areas*, Montreal, Canada, *www.cec.org/pubs_docs/documents/index.cfm?varlan=english&ID=256*.

[23] Food and Agriculture Organisation of the United Nations (FAO) (1998), *The state of the world's plant genetic resources for food and agriculture*, Rome, Italy, *www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPS/Pgrfa/wrlmap_e.htm*.

[24] Brush, S.B. and D. Tadesse (2003), "Crop Diversity in Peasant and Industrialized Agriculture: Mexico and California", *Society and Natural Resources*, Vol. 16, pp. 123-141.

[25] Bellon, M.R. and J. Berthaud (2004), "Transgenic Maize and the Evolution of Landrace Diversity in Mexico. The Importance of Farmers' Behavior", *Plant Physiology*, Vol. 134, pp. 883-888.

[26] Mas, A.H. and T.V. Dietsch (2004), "Linking shade coffee certification to biodiversity conservation: Butterflies and birds in Chiapas, Mexico", *Ecological Applications*, Vol. 14, No. 3, pp. 642-654.

[27] Perfecto, I., J. Vandermeer, A. Mas and L.S. Pinto (2005), "Biodiversity, yield, and shade coffee certification", *Ecological Economics*, Vol. 54, pp. 435-446.

[28] OECD (2006), *Agricultural Commodities Outlook Database*, Paris, France.

[29] OECD (2006), *Agricultural and Fisheries Policies in Mexico: Recent Achievements, Continuing the Reform Agenda*, Paris, France, *www.oecd.org/tad*.

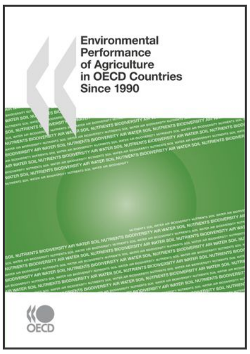
Table of Contents

List of boxes

List of tables

List of figures

ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990 – ISBN 978-92-64-04092-2 – © OECD 2008



From:

Environmental Performance of Agriculture in OECD Countries Since 1990

Access the complete publication at:

https://doi.org/10.1787/9789264040854-en

Please cite this chapter as:

OECD (2008), “OECD Country Trends of Environmental Conditions related to Agriculture since 1990: Luxembourg”, in *Environmental Performance of Agriculture in OECD Countries Since 1990*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/9789264040854-22-en

OECD