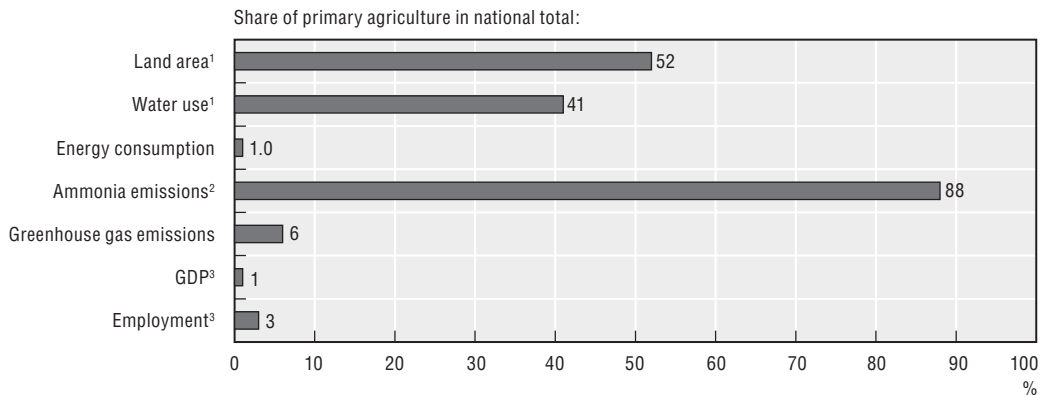


### 3.30. UNITED STATES

Figure 3.30.1. **National agri-environmental and economic profile, 2002-04: United States**



StatLink <http://dx.doi.org/10.1787/301268408146>

1. Data refer to the period 2005.
2. Data refer to the period 2000.
3. Data refer to the year 2004.

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

#### 3.30.1. Agricultural sector trends and policy context

**Agricultural growth has been amongst the most rapid across OECD countries since 1990** (Figure 3.30.2). Nevertheless, agriculture's contribution to the economy has been declining and currently accounts for less than 1% of GDP and under 3% of employment (Figure 3.30.1). Steady global economic growth and gains in population, particularly in developing countries, have strengthened demand for food and agricultural products, and provided a foundation for gains in world agricultural trade, including US agricultural exports. In addition, large growth of US bioenergy industries is increasing demand in the agricultural sector [1].

**About 8% of the 2 million US farms account for 70% of the value of farm production on 30% of agricultural land** [2, 3]. However, smaller farms (e.g. retirement, residential and farms where sales are a small share of household income) are important in terms of agri-environmental performance as they operate on 60% of farmland and account for around 60% of agri-environmental payments [4].

**Agricultural support is currently below the OECD average but above the levels of the mid-1990s.** Producer support declined from 22% of farm receipts in the mid-1980s to 13% in 1995-97 but rose to 17% by 2002-04 (as measured by the OECD's Producer Support Estimate) compared to the OECD average of 30% [5]. The share of support that is most production and trade distorting has declined from 69% of support in the mid-1980s to 66% in 2002-04. The basic legislation governing farm policy for 2002-07 is the *Farm Security and Rural Investment Act of 2002* (the 2002 *Farm Act*). Support is provided through budgetary

payments, loans and interest concessions, minimum prices with government purchases, as well as some import restrictions and export subsidies. Border protection with Canada and Mexico is being reduced under the *North American Free Trade Agreement (NAFTA)*.

**Agri-environmental programmes form a growing dimension of agricultural policy.**

The Conservation Reserve Program (CRP) aims to remove from production highly erodible (HEL) and other environmentally sensitive cropland, while the Wetlands Reserve Program (WRP) seeks to re-convert farmland to wetlands. In exchange for annual payments, land is generally enrolled in the CRP for a period of 10-15 years, but contracts can be renewed. Wetlands restored through WRP may be subject to 30 year or permanent easements. Under the Environmental Quality Incentives Program (EQIP) and the Wildlife Habitat Incentives Program (WHIP) payments defray costs for respectively adopting sustainable farming practices, such as for soil and water quality conservation, and providing wildlife habitat. The Farm and Ranch Lands Protection Program (FRPP) aims to avoid productive farm and ranch land being converted into urban use by purchasing the development rights of farm properties. Cross-compliance provisions also require that to receive payments under commodity programmes farmers must not cultivate HEL (sodbuster) without using a suitable soil conservation system or drain wetlands (swampbuster).

**The 2002 Farm Act substantially increased funding for agri-environmental policies.** For the period 2002-07 funding was USD 3.5 billion annually, a 75% increase over the annual spending for 2000-02 of USD 2 billion annually which was 8% of budgetary payments. The Farm Act expanded the CRP and WRP but its emphasis shifted to supporting conservation practices on working farmland, especially under EQIP [6]. In addition, two measures, the *Conservation Security Program (CSP)* and the *Grassland Reserve Program (GRP)*, implemented in 2002 and 2003 respectively, further strengthened these efforts. The CSP pays farmers who have met a high standard for environmental performance to adopt or maintain practices to further enhance environmental performance, such as improving soil and water quality or wildlife habitat; while the GRP aims to preserve and improve native grass species. The Farm Act also supports technical advice and research to promote sustainable farming.

**Economy-wide environmental and taxation policies also impact on agriculture.**

Between 1994 and 1998, seven agencies provided USD 3 billion annually to address nonpoint source pollution [7, 8]. The *Clean Water Act (CWA)* has responsibility for reducing water pollution, but nonpoint sources of pollution such as agriculture are not directly covered by the CWA [7, 9], although large confined animal feeding operations require pollution permits and implementation of comprehensive nutrient management plans [10]. Policies affecting agricultural water pollution are mainly implemented at the State level, using a mix of measures that vary across States, such as restrictions and taxes on fertiliser and pesticide use, and payments for the adoption of best management practices [4, 11]. However, financial assistance in the form of agri-environmental payments comes primarily from the Federal government, affecting water quality both directly (e.g. EQIP) and indirectly (e.g. CRP, WRP), as adoption of soil and water conservation practices can help to reduce off-farm flows of soils, nutrients and pesticides into water bodies [4, 10, 12, 13]. Also the *Great Lakes Water Quality Agreement*, between the US and Canada [14] addresses concerns related to agricultural water pollution.

**The Federal Energy Policy Act of 2005 mandates that by 2012 a minimum of 7.5 billion US gallons (28 billion litres) of ethanol be blended into gasoline.** Ethanol is a substitute for MTBE (a water contaminant) as a fuel oxygenate, and has the potential to reduce

greenhouse gas emissions [15]. A tax exemption is provided for the use of ethanol and assistance granted to develop ethanol production facilities. There are exemptions on Federal fuel taxes for on-farm machines and vehicles, equivalent to USD 2 385 million of annual budget revenue forgone over the period 2004-06 [5]. Government expenditure on agriculture's share of the interest subsidy on long-term loans for initial capital investment in public irrigation projects amounted to USD 269 million annually over the average period 2004-06 [5]. In terms of international environmental agreements with implications for agriculture, the US is a signatory to the *Montreal Protocol*, which provides a phase out period for the ozone depleting methyl bromide pesticide, and the *Gothenburg Protocol* on long-range transboundary air pollution, which includes ammonia.

### 3.30.2. Environmental performance of agriculture

**Soil, water and biodiversity issues dominate agriculture's impact on the environment.** Specifically, farming's main environmental impacts are on soil erosion, water pollution, competition for water resources between irrigators and other users, and on wildlife habitats and species. Other agri-environmental issues, but of lesser importance, relate to air emissions.

**Agriculture is the major user of land and water resources.** The sector accounted for about 52% of land use and 41% of freshwater withdrawals in 2005 [4]. About 30% of grassland pasture and range and forest land is owned by the Federal government, although most land under arable and permanent crops is privately owned [16]. There exists a vast range of agro-ecological regions and climatic zones affecting agriculture. While population density is low by OECD standards [17], there is growing competition between agriculture and other users for land (especially in Southern and Eastern States) and water resources (especially in Western and Central States), including demand on these resources for recreational and environmental uses [7].

**Soil erosion is a significant problem but its damage to farmland productivity and the environment has been reduced.** About 60% of total soil erosion originates from agriculture, with the remainder resulting from other economic activities (*e.g.* forestry) and natural events (*e.g.* floods and droughts) [18]. Erosion types vary between regions, for example, Western States suffer more from wind erosion while the East is prone to water erosion (Figure 3.30.3). Between 1982-2003 the cropland area eroding at excessive rates decreased by over 40%, and by 2003 approximately 72% of total cropland area was within tolerable erosion levels (Figure 3.30.3) [18]. Farms under agri-environmental programmes that target HEL, experienced a significant reduction in erosion rates [19, 20]. However, 50% of erosion reduction on HEL since the 1980s has been due to land conversion to other uses (*e.g.* to forestry), while erosion rates also declined on land not under Federal programmes [19]. The off-farm damage from soil erosion (*e.g.* costs of dredging rivers, losses to recreational values) are estimated at over USD 2 billion annually [7, 21].

**Farm soil quality is also impaired by other less widespread and costly degradation processes.** About 5% of farmland is affected by soil salinity, largely associated with poor irrigation practices, although in some States (*e.g.* Montana) salinity is impacting on an increasing area [22]. Soil compaction is a problem mainly in the Corn Belt, resulting in yield losses estimated at USD 100 million annually [22]. However, there is no national database to monitor trends in these physical and chemical soil processes, nor for the biological conditions of the soil [23, 24].

**Agriculture is a major and widespread source of water pollution.** Overall the quality of water bodies is improving and drinking water standards are high, but in 2000 about 40% of rivers, 45% of lakes and 50% of estuaries were below the Federal guidelines set for recreational and environmental uses [25]. Agriculture is responsible for 60% of river pollution, 30% of lake pollution, 15% of the pollution in estuarine and coastal areas, and is the major source of groundwater pollution [8, 25].

**Rising levels of agricultural nitrogen and phosphate surpluses over the period 1990 to 2004 risk increasing water pollution** (Figure 3.30.2). Nutrient sources and types in watersheds vary greatly across regions. Fertiliser run-off is important in Midwestern States and run-off from livestock manure in the Mississippi Basin and some Eastern States [26], while phosphorus loadings are high in the Southeast and nitrogen in the Mississippi basin [4, 27]. Part of the problem of nutrient surplus disposal is linked to a greater number of confined animal feeding operations, with over 60% of manure produced on farms that cannot fully absorb the waste [28, 29]. But use of inorganic fertilisers rose by 6% for nitrogen and 4% for phosphate fertilisers, between 1990-92 and 2002-04, compared to a 15% increase in crop production volume over this period, resulting in a lowering of cropland fertiliser use intensity.

**In agricultural areas nutrients levels in rivers and wells have exceeded Federal drinking water standards.** Between 1995 and 2005 about 10% of rivers and 20% of wells exceeded Federal drinking water standards for nitrates in agricultural areas, and 75% of rivers had phosphorus levels above Federal guidelines to prevent excess algal growth [23]. Agricultural nutrient pollution of the Gulf of Mexico accounts for 75% of nitrogen discharges and nearly 50% of phosphorus, derived mainly from the Mississippi basin [30], leading to oxygen deficient water causing algal blooms that damage marine life and commercial fisheries [23, 30, 31, 32]. Water quality in the Great Lakes is also being impaired by agricultural nutrient run-off [14, 26], including pathogens from livestock production [14]. Water pollution from livestock pathogens and other related wastes is a growing problem, but at present there is no national monitoring of these pollutants [4, 33].

**Pesticide use (quantity of active ingredients) decreased since 1990**, with pesticides frequently detected in water but usually at low levels [8]. Agriculture currently accounts for about 75% of total pesticide use [34], and a 4% decrease in pesticide use (1990-92 to 2001-03, Figure 3.30.2) compared to a 15% growth in crop output over the period 1990-92 to 2002-04, indicates the reduction in the intensity of pesticide use. Over the period 1992-98 at least one pesticide was detectable throughout the year in all rivers and 60% of wells, although only 4% of rivers and less than 1% of wells had pesticides that exceeded Federal drinking water standards. But over 80% of rivers had pesticide concentrations exceeding aquatic life guidelines [23], and pesticides in reservoirs have higher concentrations than for rivers [7]. Some highly persistent pesticides, such as DDT, were detected in fish in about 30% of rivers in agricultural areas in the early 2000s, despite being prohibited for more than 30 years [8, 35]. Vulnerability to pesticide leaching varies considerably (related to a variety of factors soils, crop types, climate, etc.), but the greatest vulnerability is in the crop and horticultural growing areas of the Corn Belt, Southeastern States, the Southern Plains, the Lake States and California [7].

**Higher national demand for water is putting pressure on water supplies**, although overall agricultural water use declined by 2% from 1990 to 2000 (Figure 3.30.2). Irrigators are the major users of agricultural water use, with much of the remainder used by livestock producers. The availability of water for agricultural purposes is uneven, and shortages occur in some areas and in some years. In the arid West, drought conditions place

increased demands on non-renewable supplies [4]. The area under irrigation rose by 12% from 1992 to 2002, accounting for approximately 5% of the total agricultural area but providing nearly 50% of the total value of crop sales [4, 36]. Total irrigation withdrawals declined by 12% between 1995-2000 with groundwater withdrawals increasing slightly (3%) and a 16% reduction in surface water withdrawals. Despite the recent decline, surface water provides nearly 60% of irrigators' water needs [4, 37]. Hence, irrigation accounted for about 75% of total groundwater withdrawals in 2000, and an even higher share in many Western and Southern States [37]. Despite the reduction in surface water use by irrigators the overexploitation of some rivers, especially in times of drought, has threatened aquatic ecosystems, such as in the Klamath Basin which has led to Federal restrictions on water supplies to agriculture in this Basin [38]. Of the nearly USD 17 billion irrigation construction expenditure for projects constructed over the last 100 years, and considered reimbursable by the Federal government, irrigators have been allocated USD 3.4 billion to be repaid at zero interest [7]. Water charges are considerably lower than retail prices paid by industrial and urban users [7, 9, 39].

**Irrigated agriculture is depleting groundwater resources beyond natural recharge rates in some regions.** In the High Plains (Ogallala) aquifer, for example, which irrigates more than 20% of US cropland, the water level has fallen and is close to depletion in parts of Kansas and Texas [9]. In the Texas Panhandle groundwater depletion poses a serious threat to the sustainability of the current irrigated agricultural system and associated rural economy [40, 41]. Groundwater depletion is also the main cause of land subsidence in some areas, estimated to cost USD 100 million annually [42]. But there have been improvements in irrigation water use efficiency, including a decline in per hectare water application rates (Figure 3.30.2), and adoption of water conservation practices and technologies, although low-flow systems are used on only 5% of the total irrigated area [4].

**Competition for water resources is also acute on the US-Mexico border,** mainly because of population growth and demands from agriculture as a major user, leading to over exploitation of water from the Rio Grande on both sides of the border [43]. The *International Boundary and Water Commission* resolves water resource allocation issues, including irrigation, at the US-Mexico border.

**Ammonia emissions from agriculture have increased significantly above the OECD average, but emissions from methyl bromide use have declined.** Agricultural **ammonia emissions**, which represent nearly 90% of total ammonia emissions, rose by 15% over the period 1990-92 to 2000, compared to the OECD average increase of 1% (Figure 3.30.2). The *Gothenburg Protocol* seeks to cut ammonia emissions by 17% from their 1990 levels by 2010, although the US (a signatory to the Protocol) has not yet agreed on its emission ceiling targets. Acidification of soils and water from acidifying emissions, originating mainly in Mid-Western States, pose a problem for Eastern States, but the contribution of agricultural ammonia acidifying emissions is unclear [44, 45]. Reporting of ammonia emissions from intensive livestock operations has been required since 2004 [46]. The phase-out targets of emissions resulting from the use of **methyl bromide** (a widely used fumigant in agriculture which is an ozone depleting substance) under the *Montreal Protocol* have been met up to 2003. But the US has been granted an increase in "Critical Use Exemptions" (CUEs), which effectively gives more time for users to develop alternatives equal to about 60% of the total OECD CUEs in 2005 [47].

**The rise in agricultural greenhouse gas emissions is above the OECD average, but soil carbon sequestration and bioenergy production is increasing.** Agricultural greenhouse gases (GHGs) grew by 1% over the period 1990-92 to 2002-04, compared to a 3% decrease for the OECD, especially due to an expansion in crop production (Figure 3.30.2). Agriculture contributed 6% to total national GHG emissions in 2002-04 [48]. US cropland soils sequester about 32.2 million tonnes of carbon dioxide equivalent annually (or 8.8 million tonnes of carbon). **This sequestration amounted to about 4% of total US terrestrial carbon sequestration in 2004.** Annual soil sequestration rates in cropland have increased by 40% since the early 1990s [48]. The use of **agricultural biomass for energy production** grew by 25% over the 1990s, but still provides only about 3% of total energy consumption, less than 1% of transportation fuel mainly from maize based ethanol, and 5% of chemical product output [49]. Federal targets aim to increase these shares to 4% for energy and fuel, and to 12% for chemicals by 2010 [49], which could have significant impacts on crop production patterns, prices and international commodity markets [50, 51].

**As the major land user agriculture has significant impacts on wildlife habitats and species.** A US study of the CRP estimates that agriculture, as a provider of wildlife recreational activity, has led to an increase in recreational spending of USD 300 million annually under the programme [52]. Changes in farmland use that were potentially beneficial to wildlife included an increase in the share of cropland not cultivated from 11% in 1987 to 15% by 2001, and a net conversion of cropland to pasture [53]. A US study found that lands shifting in and out of crop cultivation are generally located in areas with more imperilled plant and vertebrate species than other croplands, but data were insufficient to determine whether these land-use changes had a positive or negative impact on imperilled species [54]. The spatial changes in farmland habitat are highly varied but not regularly monitored [55].

**Wetlands, a key wildlife habitat, account for more than 7% of the non-federal area in the 48 contiguous United States** [4]. Between 1992-97 to 2001-03 average annual losses of wetlands to agriculture were greatly reduced compared to the 1980s and offset by wetland restoration at an average net annual gain of nearly 30 000 hectares during 2001-03 (Figure 3.30.4) [56]. Research suggests that restored wetlands are quickly vegetated and colonised by a variety of wildlife species [57], but may take much longer to return to a “natural” state. The net effect on wildlife of land use changes, within and between agriculture and other uses, are more difficult to measure. Between 1992 and 1997, there was a net conversion of agricultural land to forestry and urban development, although this involved only about 1% of the total agricultural land area [58].

**Increased use of chemicals, water and changes in farmland use has led to pressure on wildlife habitat and species.** Agriculture was estimated in 1995 to negatively affect 380 of over 660 wild species listed as threatened or endangered [22]. Conversion of land for agricultural production and diversion of water for irrigation have had a particularly damaging impact on biodiversity since 1990 [59, 60]. Also pesticide and nutrient run-off are recognised as a widespread threat to terrestrial and aquatic ecosystems [23, 61, 62], with pesticides linked to the decline in pollinators which has reduced yields for certain crops [23, 63]. US research suggests, however, that taking cropland out of production under the CRP and WRP programmes may have had some beneficial wildlife impacts, such as the 30% increase in duck numbers attributed to the CRP [64]. In addition, a number of species have adapted well to specific agricultural systems, such as some mammals in the West [65]. In other cases the uptake of certain farming practices has been beneficial to wildlife, for example, the

avoidance of livestock polluting farm ponds and rivers in Minnesota [61], and in the Northeast the adoption of conservation tillage practices has increased the availability of crop residues in autumn and winter as a food source for bird and mammal populations [66].

**About 55% of the global area under transgenic crops is in the US, with uncertainty in some of the environmental impacts.** In 2006, transgenic crops accounted for 89% of the US planted area under soybeans, 83% for cotton, and 61% for maize. US farmers adopted herbicide tolerant (HT) varieties, which help control weeds, at a faster rate than insect resistant (Bt) varieties [67]. However, a noticeable trend in recent years is the rapid growth of cotton and maize varieties with both HT and Bt (stacked) traits. US studies indicate that the use of transgenic crops is associated with a lower overall volume of pesticide use, although pesticide use varies with the crop and the technology. There is a lack of consensus on the possible long-term impacts on biodiversity of using transgenic crops [13, 68]. Moreover, the degree of genetic erosion in crops remains the subject of debate [69]. However, yields for many major crops have been relatively stable as temporal diversity has replaced spatial diversity. Although there may be greater spatial uniformity of crops planted at any given time today, the release of new varieties with new resistance traits has been steady over time [69]. All major animal breeds in the US confront issues that include small effective population size, limited genetic diversity, and genetic erosion resulting from intense selection for some production traits [70].

### 3.30.3. Overall agri-environmental performance

**Pressure on the environment is likely to continue with the projected expansion of the farm sector.** The expansion of agricultural production, at a rate well above the OECD average, is exerting growing pressure on land, water, and biodiversity, especially in those areas where population densities are highest (e.g. the East Coast) or the growth rate is rapid (e.g. Southern States). With an expansion of the farm sector projected over the next decade the pressure on the environment and competition for natural resources from agriculture might intensify in these regions.

**Monitoring and evaluation of agri-environmental performance is highly developed by OECD standards.** Extensive and regularly updated databases at Federal, State and County levels exist for many agri-environmental issues. Drawing on these databases agri-environmental indicators and spatially referenced agri-environmental models to assist policy evaluation have been developed [71]. However, gaps exist, especially in tracking agriculture's impact on water pollution from livestock pathogens, on soils from damaging processes such as salinisation, and on biodiversity [23]. But efforts are being made to fill these data gaps, including developing a better understanding of agriculture's role in ecosystem service provision, such as soil carbon sequestration and biomass production [49, 72, 73].

**Agricultural pressure on the environment since 1990 has been lowered in some cases,** notably reduced rates of soil erosion, but is increasing for other indicators, especially groundwater depletion but also air pollution. The area of cropland suffering high rates of **soil erosion** has been significantly reduced, but about a quarter of cropland is still subject to high rates of erosion. Farming, the major contributor to **water pollution**, is lightly regulated compared to other polluters [74]. Agricultural water pollution is widespread and increasing loadings of nutrients and livestock pathogens suggest the risks of water pollution from agriculture might be rising in areas where crop or livestock agriculture is intensifying, although pesticide use

declined over the period 1996 to 2003. Most rivers and wells meet Federal drinking water standards in farming areas, but many rivers, lakes, estuaries and coastal waters do not meet Federal guidelines to support recreational and environmental uses.

**Competition for surface and groundwater resources between farmers and other users is becoming acute in drier areas.** In some regions the use of groundwater by irrigators is substantially above recharge rates. Moreover, subsidising irrigation infrastructure and water charges as well as the energy costs to power irrigation facilitates, can be a disincentive to reduce water use or use it more efficiently. Overexploitation of groundwater is becoming more widespread and could undermine the viability of agricultural and rural economies in some regions [9]. Also subsidising on-farm fuel energy costs is a disincentive to improving energy use efficiency and reducing greenhouse gas emissions.

**Air pollution from ammonia and greenhouse gases has increased above average OECD rates.** Carbon stocks in agricultural soils, however, have risen and carbon emissions reduced as a result of bioenergy production from agricultural biomass.

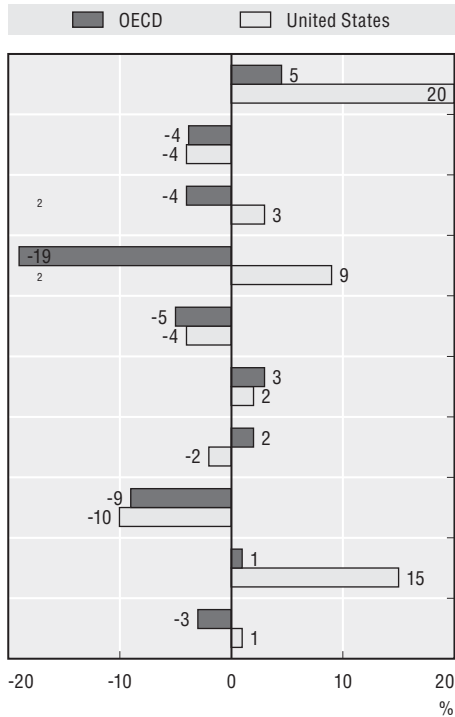
**Conversion of wildlife habitats to agricultural use, increasing water use and pollution, has been harmful to wildlife.** But the overall pressure by agriculture on biodiversity appears to have eased, especially where cropland has been retired from production, including restoration of wetlands, and where changes in farming practices, such as conservation tillage, have enhanced habitat conditions on cropland leading to larger wildlife populations.

**Policies are addressing many of the remaining agri-environmental challenges.** The 2002 Farm Act has increased funding for agri-environmental measures up to 2007, including strengthening the CRP and WRP, and shifting emphasis towards programmes that support conservation practices on working farmland, especially the EQIP. According to US research these programmes have led to improved agri-environmental performance on many fronts. There are signs that farmers have increased fertiliser, pesticide, energy and water use at a much slower rate than the growth in the volume of agricultural production. These developments are in part due to the adoption of soil and water conservation practices by producers [19]. However, these impacts have been offset to some extent by output and input linked support to agriculture which raises production and increases pressure on the environment and thus the cost of achieving specific environmental goals [75].



Figure 3.30.2. **National agri-environmental performance compared to the OECD average**

Percentage change 1990-92 to 2002-04<sup>1</sup>



Absolute and economy-wide change/level

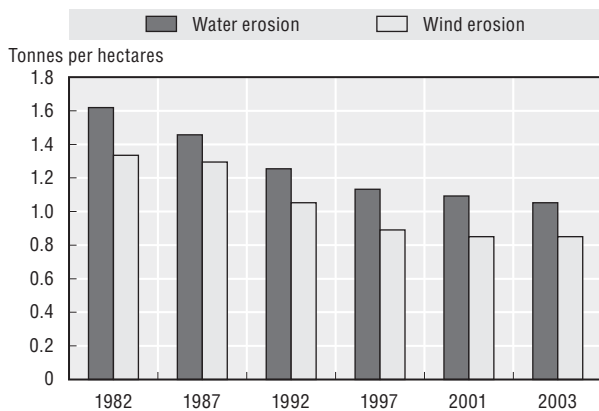
Variable	Unit	United States	OECD
Agricultural production volume	Index (1999-01 = 100) to 2002-04	120	105
Agricultural land area	000 hectares to 2002-04	-17 074	-48 901
Agricultural nitrogen (N) balance	Kg N/hectare 2002-04	37	74
Agricultural phosphorus (P) balance	Kg P/hectare 2002-04	3	10
Agricultural pesticide use	Tonnes to 2001-03	-11 944	-46 762
Direct on-farm energy consumption	000 tonnes of oil equivalent to 2002-04	+370	+1 997
Agricultural water use	Million m <sup>3</sup> to 2001-03	-3 645	+8 102
Irrigation water application rates	Megalitres/ha of irrigated land 2001-03	8.4	8.4
Agricultural ammonia emissions	000 tonnes to 2001-03	+524	+115
Agricultural greenhouse gas emissions	000 tonnes CO <sub>2</sub> equivalent to 2002-04	+4 806	-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.

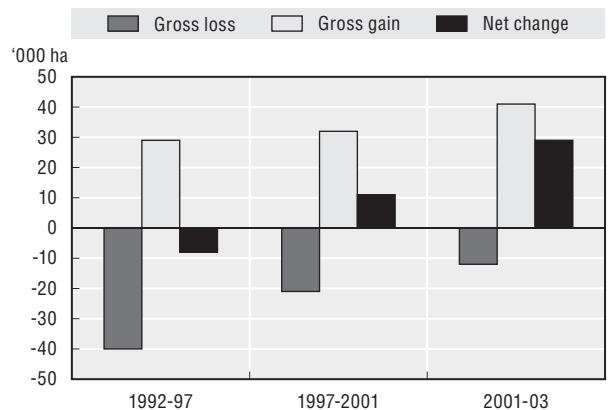
Source: OECD Secretariat. For full details of these indicators, see Chapter 1 of the *Main Report*.

Figure 3.30.3. **Soil erosion on cropland**



Source: Natural Resources Conservation Service, United States Department of Agriculture.

Figure 3.30.4. **Change in palustrine and estuarine wetlands on non-federal land and water area**



Source: Natural Resources Conservation Service (2003), Annual National Resources Inventory.

StatLink <http://dx.doi.org/10.1787/301325486062>

## Bibliography

- [1] USDA (2006), *USDA Agricultural Baseline Projections to 2015*, World Agricultural Outlook Board, Baseline Report OCE-2006-1, Office of the Chief Economist, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/Briefing/Baseline/](http://www.ers.usda.gov/Briefing/Baseline/).
- [2] USDA (2001), *Food and Agricultural Policy: Taking Stock for the New Century*, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/Features/FoodAgPolicy/](http://www.ers.usda.gov/Features/FoodAgPolicy/).
- [3] USDA (2002), *Income, Wealth, and the Economic Well-Being of Farm Households*, Agricultural Economic Report No. 812, Economic Research Service, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/publications/AER812/](http://www.ers.usda.gov/publications/AER812/).
- [4] USDA (2006), *Agricultural Resources and Environmental Indicators, 2006*, Economic Information Bulletin No. EIB16 (Electronic publication), Economic Research Service, US Department of Agriculture Washington DC, United States, [www.ers.usda.gov/publications/arei/eib16/](http://www.ers.usda.gov/publications/arei/eib16/).
- [5] OECD (2007), *Agricultural Policies in OECD Countries: Monitoring and Evaluation 2006*, Paris, France, [www.oecd.org/agr/policy](http://www.oecd.org/agr/policy).
- [6] Claassen, R. (2003), "Emphasis Shifts in US Agri-environmental Policy", *Amber Waves*, Vol. 1, Issue 5, pp. 39-44, [www.ers.usda.gov/AmberWaves/](http://www.ers.usda.gov/AmberWaves/).
- [7] USDA (2003), *Agricultural Resources and Environmental Indicators, 2003*, Agricultural Economic Report No. AH722 (Electronic publication), Economic Research Service, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/publications/arei/](http://www.ers.usda.gov/publications/arei/).
- [8] US Geological Survey (2004), *Water quality in the Nation's streams and aquifers – Overview of selected findings, 1991-2001*, Circular 1265, Washington DC, United States, <http://water.usgs.gov/pubs/circ/2004/1265/>.
- [9] OECD (2002), "Some aspects of sustainable development", pp. 171-188, in *OECD Economic Surveys United States*, Vol. 2002/18, November, Paris, France.
- [10] OECD (2003), *Agriculture, Trade and the Environment: The Pig Sector*, Paris, France.
- [11] OECD Environmentally Related Taxes Database, [www.oecd.org/document/29/0,2340,en\\_2649\\_33713\\_1894685\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/29/0,2340,en_2649_33713_1894685_1_1_1_1,00.html).
- [12] OECD (2003), *Agriculture, Trade and the Environment: The Dairy Sector*, Paris, France.
- [13] OECD (2005), *Agriculture, Trade and the Environment: The Arable Crop Sector*, Paris, France.
- [14] International Joint Commission (2004), *Twelfth Biennial Report on Great Lakes Water Quality*, September, Secretariat to the Great Lakes Water Quality Agreement, [www.ijc.org/php/publications/html/12br/english/report/index.html](http://www.ijc.org/php/publications/html/12br/english/report/index.html).
- [15] Duffield, J.A., (2006), "Overview: Developing new energy sources from agriculture", Guest Editor, J.A. Duffield, *Choices*, The Magazine of Food, Farm, and Resource Issues, 1st Quarter 2006, pp. 5-7.
- [16] Lubowski, Ruben N., Marlow Vesterby, Shawn Bucholtz, Alba Baez, and Michael J. Roberts (2006a), *Major Uses of Land in the United States, 2002*, Economic Information Bulletin No. EIB-14 (Electronic publication), Economic Research Service, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/publications/EIB14/](http://www.ers.usda.gov/publications/EIB14/).
- [17] United Nations Department of Economic and Social Affairs, Population Division (2006). *World Population Prospects: The 2004 Revision Population Database, Vol. III: Analytical Report* (and associated databases), New York, United States, <http://esa.un.org/unpp/>.
- [18] USDA (2007), *National Resources Inventory 2003 Annual NRI – Soil Erosion*, Natural Resources Conservation Service, July, Washington DC, United States, [www.nrcs.usda.gov/technical/land/nri03/SoilErosion-mrb.pdf](http://www.nrcs.usda.gov/technical/land/nri03/SoilErosion-mrb.pdf).
- [19] USDA (2004), *Environmental Compliance in US Agricultural Policy: Past Performance and Future Potential*, Agricultural Economic Report No. 832, Economic Research Service, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/publications/aer832/](http://www.ers.usda.gov/publications/aer832/).
- [20] Claassen, R., K. Weibe and L. Hansen (2004), "Farmers' Choices and the Role of Environmental Indicators in the Development of Soil Conservation Policy", in *OECD, Agricultural Impacts on Soil Erosion and Soil Biodiversity: Developing Indicators for Policy Analysis*, Paris, France, [www.oecd.org/tad/env/indicators](http://www.oecd.org/tad/env/indicators).
- [21] Crosson, P. (2004), "The Economics of Soil Erosion and Maintaining Soil Biodiversity", in *OECD, Agricultural Impacts on Soil Erosion and Soil Biodiversity: Developing Indicators for Policy Analysis*, Paris, France, [www.oecd.org/tad/env/indicators](http://www.oecd.org/tad/env/indicators).

- [22] USDA (1997), *Agricultural Resources and Environmental Indicators, 1996-97*, Agricultural Economic Report No. AH712, Economic Research Service, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/publications/arei/ah712/](http://www.ers.usda.gov/publications/arei/ah712/).
- [23] Heinz Center (2002), *The state of the nation's ecosystems: Measuring the lands, waters and living resources of the United States*, The H. John Heinz III Center for Science, Economics and the Environment, Washington DC, United States, [www.heinzctr.org/ecosystems/index.htm](http://www.heinzctr.org/ecosystems/index.htm).
- [24] Lal, R., C. den Biggelaar and K. Weibe (2004), "Measuring on-site and off-site effects of soil erosion on productivity and environment quality", in OECD, *Agricultural Impacts on Soil Erosion and Soil Biodiversity: Developing Indicators for Policy Analysis*, Paris, France, [www.oecd.org/tad/env/indicators](http://www.oecd.org/tad/env/indicators).
- [25] US Environmental Protection Agency (2002), *National Water Quality Inventory 2000 Report*, Office of Water, Washington DC, United States, [www.epa.gov/305b/index.html](http://www.epa.gov/305b/index.html).
- [26] Smith, R.A. and R.B. Alexander (2000), "Sources of Nutrients in the Nation's Watersheds" in *Managing Nutrients and Pathogens from Animal Agriculture*, Proceedings from the Natural Resource, Agriculture, and Engineering Service Conference for Nutrient Management Consultants, Extension Educators, and Producer Advisors, 28-30 March, Camp Hill, Pennsylvania, United States, [http://water.usgs.gov/nawqa/sparrow/nut\\_sources/nut\\_sources.htm](http://water.usgs.gov/nawqa/sparrow/nut_sources/nut_sources.htm).
- [27] Johansson, R.C. and J. R. Randall (2003), "Incorporating economics into the phosphorus index: An application to US watersheds", *Journal of Soil and Water Conservation*, Vol. 58, No. 5, pp. 224-231.
- [28] Ribaldo, M. (2003), "Managing manure – New Clean Water Act regulations create imperative for livestock producers", *Amber Waves*, Vol. 1, Issue 1, pp. 31-37, [www.ers.usda.gov/AmberWaves/](http://www.ers.usda.gov/AmberWaves/).
- [29] USDA (2004), *Confined Animal Production and Manure Nutrients*, Agricultural Information Bulletin No. 771, Economic Research Service, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/publications/aib771/](http://www.ers.usda.gov/publications/aib771/).
- [30] Goolsby, D.A., W.A. Battaglin, G.B. Lawrence, R.S. Artz, B.T. Aulenbach, R.P. Hooper, D.R. Keeney, and G.J. Stensland (1999), *Flux and Sources of Nutrients in the Mississippi-Atchafalaya River Basin*, National Oceanic and Atmospheric Administration, Coastal Ocean Program Decision Analysis Series, No. 17, Washington DC, United States, [www.nos.noaa.gov/products/hypox\\_t3final.pdf](http://www.nos.noaa.gov/products/hypox_t3final.pdf).
- [31] Ribaldo, M.O., R. Heimlich, R. Claassen and M. Peters (2001), "Least-cost management of nonpoint source pollution: source reduction versus interception strategies for controlling nitrogen loss in the Mississippi Basin", *Ecological Economics*, Vol. 37, pp. 183-197.
- [32] Tanaka, K and J. Wu (2004), *Evaluation of Conservation policies for reducing nitrogen loads to the Mississippi river and Gulf of Mexico*, paper presented to the American Agricultural Economics Association Annual Meeting, Denver, Colorado, 1-4 August, United States, [http://agecon.lib.umn.edu/cgi-bin/pdf\\_view.pl?paperid=14318&ftype=pdf](http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=14318&ftype=pdf).
- [33] Kolpin, D.W., E.T. Furlong, M.T. Meyer, E.M. Thurman, S.D. Zaugg, L.B. Barber and H.T. Buxton (2002), "Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in US Streams, 1999-2000: A National Reconnaissance", *Environmental Science and Technology*, Vol. 36, No. 6, pp. 1202-1211.
- [34] US Environmental Protection Agency (2004), *Pesticides Industry Sales and Usage – 2000 and 2001 Market Estimates*, Biological and Economic Analysis Division, Office of Prevention, Pesticides, and Toxic Substances, Washington DC, United States, [www.epa.gov/oppbead1/pestsales/index.htm](http://www.epa.gov/oppbead1/pestsales/index.htm).
- [35] US Geological Survey (1999), *The Quality of Our Nation's Waters – Nutrients and Pesticides*, USGS Circular 1225, Washington DC, United States, <http://water.usgs.gov/pubs/circ/circ1225/>.
- [36] USDA (2004), *2002 Census of Agriculture*, National Agricultural Statistics Service, Washington DC, United States, [www.agcensus.usda.gov/Publications/2002/index.asp](http://www.agcensus.usda.gov/Publications/2002/index.asp).
- [37] US Geological Survey (2004), *Estimated Use of Water in the United States in 2000*, USGS Circular 1268, Washington DC, United States, <http://water.usgs.gov/pubs/circ/2004/circ1268/>.
- [38] Aillery, M., N. Gollehon, G. Schaible, M. Roberts and W. Quinby (2004), *Policy directions to mitigate water-supply risk in irrigated agriculture: A Federal perspective*, paper presented to the American Agricultural Economics Association Annual Meeting, Denver, Colorado, 1-4 August, United States, [http://agecon.lib.umn.edu/cgi-bin/pdf\\_view.pl?paperid=14319&ftype=pdf](http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=14319&ftype=pdf).
- [39] OECD (2001), *Environmental Indicators for Agriculture Methods and Results*, Vol. 3, Paris, France, [www.oecd.org/tad/env/indicators](http://www.oecd.org/tad/env/indicators).
- [40] Almas, L.K., W.A. Colette and Z. Wu (2004), *Declining Ogallala Aquifer and Texas Panhandle Economy*, paper presented to the Southern Agricultural Economics Association Annual Meeting, Tulsa, Oklahoma, 14-18 February, United States, [http://agecon.lib.umn.edu/cgi-bin/pdf\\_view.pl?paperid=12388&ftype=pdf](http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=12388&ftype=pdf).

- [41] Terrell, B.L., P.N. Johnson and E. Segarra (2002), "Ogallala aquifer depletion: economic impact on the Texas high plains", *Water Policy*, Vol. 4, pp. 33-46.
- [42] US Geological Survey (1999), *Land Subsidence in the United States*, USGS Circular 1182, Washington DC, United States, <http://water.usgs.gov/pubs/circ/circ1182/>.
- [43] Schmandt, S. (2002), "Bi-national water issues in the Rio Grande/Rio Bravo basin", *Water Policy*, Vol. 4, pp. 137-155
- [44] Menz, F.C. and H.M. Seip (2004), "Acid rain in Europe and the United States: an update", *Environmental Science and Policy*, Vol. 7, pp. 253-265.
- [45] Anderson, N., R. Strader and C. Davidson (2003), "Airborne reduced nitrogen: ammonia emissions from agriculture and other sources", *Environment International*, Vol. 29, pp. 277-286.
- [46] US Environmental Protection Agency (2004), *National Emission Inventory – Ammonia Emissions from Animal Husbandry*, National Emission Inventory Data and Documentation, Washington DC, United States, [www.epa.gov/ttn/chief/net/2002inventory.html](http://www.epa.gov/ttn/chief/net/2002inventory.html).
- [47] Osteen, C (2003), "Methyl Bromide Phaseout Proceeds: Users Request Exemptions", *Amber Waves*, Vol. 1, Issue 2, pp. 23-27, [www.ers.usda.gov/AmberWaves/](http://www.ers.usda.gov/AmberWaves/).
- [48] US Environmental Protection Agency (2007), *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2005*, Washington DC, United States, [www.epa.gov/climatechange/emissions/usinventoryreport.html](http://www.epa.gov/climatechange/emissions/usinventoryreport.html).
- [49] US Department of Energy and USDA Biomass Research and Development Initiative (2002), *Vision for Bioenergy and biobased products in the United States*, Biomass Technical Advisory Committee, Washington DC, United States, [www.bioproducts-bioenergy.gov/pdfs/BioVision\\_03\\_Web.pdf](http://www.bioproducts-bioenergy.gov/pdfs/BioVision_03_Web.pdf).
- [50] Nipp, T. (2004), "United States Support for the Agricultural Production of Biomass: the Challenge of Integrating Energy, Agricultural, Environmental and Economic Policies", in OECD, *Biomass and Agriculture: Sustainability, Markets and Policies*, Paris, France, [www.oecd.org/tad/env](http://www.oecd.org/tad/env).
- [51] Ferris, J.N. and S. V. Joshi (2004), *Evaluating the impacts of an increase in fuel-ethanol demand on agriculture and the economy*, paper presented to the American Agricultural Economics Association Annual Meeting, Denver, Colorado, 1-4 August, United States, [http://agecon.lib.umn.edu/cgi-bin/pdf\\_view.pl?paperid=14239&ftype=.pdf](http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=14239&ftype=.pdf).
- [52] USDA (2004), *The Conservation Reserve Program Economic Implications for Rural America*, Agricultural Economic Report No. 834, Economic Research Service, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/publications/aer834/](http://www.ers.usda.gov/publications/aer834/).
- [53] USDA (2004), *National Resources Inventory 2002 Annual NRI – Land Use*, Natural Resources Conservation Service, July, US Department of Agriculture, Washington DC, United States, [www.nrcs.usda.gov/technical/NRI/](http://www.nrcs.usda.gov/technical/NRI/).
- [54] Lubowski, Ruben N., Shawn Bucholtz, Roger Claassen, Michael J. Roberts, Joseph C. Cooper, Anna Gueorguieva and Robert Johansson (2006), *Environmental Effects of Agricultural Land-Use Change: The Role of Economics and Policy*, Economic Research Report No. ERR25, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/Publications/ERR25/](http://www.ers.usda.gov/Publications/ERR25/).
- [55] Brady, S.J. and C.H. Flather (2003), "Estimating wildlife habitat trends on agricultural ecosystems in the United States", in OECD, *Agriculture and Biodiversity: Developing Indicators for Policy Analysis*, Paris, France, [www.oecd.org/tad/env/indicators](http://www.oecd.org/tad/env/indicators).
- [56] USDA (2004), *National Resources Inventory 2002 Annual NRI – Wetlands*, Natural Resources Conservation Service, July, US Department of Agriculture, Washington DC, United States, <http://www.nrcs.usda.gov/technical/NRI/>.
- [57] Rewa, C. (2000), "Biological Responses to Wetland Restoration: Implications for Wildlife Habitat Development through the Wetlands Reserve Program", in USDA, Natural Resources Conservation Service, and Wildlife Habitat Management Institute, *A Comprehensive Review of Farm Bill Contributions to Wildlife Conservation 1985-2000*, Washington DC, United States, [www.whmi.nrcs.usda.gov/technical/comprehensivereview.html](http://www.whmi.nrcs.usda.gov/technical/comprehensivereview.html).
- [58] United States response to the OECD Agri-environmental Indicator Questionnaire, unpublished.
- [59] Stein, B.A., L.S. Kutner and J.S. Adams (eds.) (2000), *Precious Heritage: The Status of Biodiversity in the United States*, Oxford University Press, New York, United States.
- [60] 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](http://www.cec.org/pubs_docs/documents/index.cfm?varlan=english&ID=256).

- [61] Knutson, M.G., W.B. Richardson, D.M. Reineke, B.R. Gray, J.R. Parmelee and S.E. Weick (2004), "Agricultural Ponds support amphibian populations", *Ecological Applications*, Vol. 14, No. 3, pp. 669-684.
- [62] Litmans, B. and J. Miller (2004), *Silent Spring Revisited: Pesticide Use and Endangered Species*, Center for Biological Diversity, Tuscon, Arizona, United States, [www.biologicaldiversity.org](http://www.biologicaldiversity.org).
- [63] US Fish and Wildlife Service (2001), *Why Pollinators are Important*, website information database provided by the US Fish and Wildlife Service, Washington DC, United States, <http://contaminants.fws.gov/Issues/Pollinators.cfm>.
- [64] USDA (2000), *A Comprehensive Review of Farm Bill Contributions to Wildlife Conservation 1985-2000*, Natural Resources Conservation Service and Wildlife Habitat Management Institute, US Department of Agriculture, Washington DC, United States, [www.whmi.nrcs.usda.gov/technical/comprehensivereview.html](http://www.whmi.nrcs.usda.gov/technical/comprehensivereview.html).
- [65] Ingram, K. and J. Lewandrowski (1999), "Wildlife Conservation and Economic Development in the West", *Rural Development Perspectives*, Vol. 14, No. 2, pp. 44-51.
- [66] Mac, M.J., P.A. Opler, C.E.P. Haecker and P.D. Doran (1998), *Status and Trends of the Nation's Biological Resources*, Two Volumes, United States Department of the Interior, United States Geological Survey, Reston, Virginia, United States, <http://biology.usgs.gov/s+t/SNT/index.htm>.
- [67] Fernandez Cornejo, J. (2006), "Adoption of Genetically Engineered Crops Continues to Increase", *Amber Waves*, Vol. 4, Issue 4 (September), pp. 6, [www.ers.usda.gov/AmberWaves/](http://www.ers.usda.gov/AmberWaves/).
- [68] Fernandez-Cornejo, J. and M. Caswell, with contributions from L. Mitchell, E. Golan and F. Kuchler (2006), *The First Decade of Genetically Engineered Crops in the United States*, Economic Research Report No. EIB-11, Economic Research Service, US Department of Agriculture, Washington DC, United States.
- [69] Rubenstein, K. D., P. Heisey, R. Shoemaker, J. Sullivan and G. Frisvold (2005), *Crop Genetic Resources: An Economic Appraisal*, Economic Research Report No. EIB-2, Economic Research Service, US Department of Agriculture, Washington DC, United States.
- [70] National Center for Genetic Resources Preservation, National Animal Germplasm Program (2003), *United States of America, Country Report for FAO's State of the World's Animal Genetic Resources*, Agricultural Research Service, US Department of Agriculture, Washington DC, United States.
- [71] Smith, K. and M. Weinberg (2004), "Measuring the Success of Conservation Programs", *Amber Waves*, Vol. 2, Issue 4, pp. 14-21, [www.ers.usda.gov/AmberWaves/](http://www.ers.usda.gov/AmberWaves/).
- [72] USDA (2004), *Economics of Sequestering Carbon in the US Agricultural Sector*, Technical Bulletin No. 1909, Economic Research Service, US Department of Agriculture, Washington DC, United States, [www.ers.usda.gov/publications/TB1909/](http://www.ers.usda.gov/publications/TB1909/).
- [73] National Research Council (2000), *Ecological Indicators for the Nation*, National Academy Press, Washington DC, United States, <http://books.nap.edu/catalog/9720.html>.
- [74] Aigner, D.J., J. Hopkins and R. Johansson (2003), "Beyond Compliance: Sustainable Business Practices and the Bottom Line", *American Journal of Agricultural Economics*, Vol. 85, December, Issue No. 5, pp. 1126-1139.
- [75] OECD (2003), *Agricultural Policies in OECD Countries Monitoring and Evaluation 2003*, Paris, France, [www.oecd.org/tad](http://www.oecd.org/tad).

## Table of Contents

<b>I. Highlights</b> .....	15
Overall agri-environmental performance. ....	15
Agri-environmental performance in specific areas .....	16
Caveats and limitations .....	19
Matching indicator criteria. ....	20
<b>II. Background and Scope of the Report.</b> .....	23
1. Objectives and scope. ....	23
2. Data and information sources. ....	24
3. Progress made since the OECD 2001 Agri-environmental Indicator Report .....	25
4. Structure of the Report .....	26
Bibliography .....	28
Annex II.A1. List of indicators in Chapter 1 .....	29
Annex II.A2. Indicators in Chapter 1 assessed according to the OECD indicator criteria .....	31
<b>Chapter 1. OECD Trends of Environmental Conditions related to Agriculture     since 1990</b> .....	37
1.1. Agricultural production and land .....	38
1.1.1. Introduction .....	39
1.1.2. Agricultural production .....	39
1.1.3. Agricultural land use. ....	40
1.1.4. Linkages between agricultural production and land use. ....	46
Bibliography .....	47
1.2. Nutrients .....	48
1.2.1. Nitrogen balance .....	52
1.2.2. Phosphorus balance .....	56
1.2.3. Regional (sub-national) nutrient balances. ....	60
Bibliography .....	62
1.3. Pesticides .....	63
1.3.1. Pesticide use .....	63
1.3.2. Pesticide risk indicators .....	67
Bibliography .....	74
1.4. Energy .....	76
Bibliography .....	83
1.5. Soil .....	84
Bibliography .....	90

1.6. Water.....	92
1.6.1. Water use .....	93
1.6.2. Water quality .....	100
Bibliography .....	108
1.7. Air .....	109
Background .....	110
1.7.1. Ammonia emissions, acidification and eutrophication.....	110
1.7.2. Methyl bromide use and ozone depletion .....	117
1.7.3. Greenhouse gas emissions and climate change .....	122
Bibliography .....	130
1.8. Biodiversity .....	133
Background .....	134
1.8.1. Genetic diversity .....	136
1.8.2. Wild species diversity .....	146
1.8.3. Ecosystem diversity.....	148
Bibliography .....	159
1.9. Farm management .....	160
1.9.1. Overview of environmental farm management .....	163
1.9.2. Nutrient management .....	163
1.9.3. Pest management .....	168
1.9.4. Soil management.....	169
1.9.5. Water management.....	172
1.9.6. Biodiversity management .....	173
1.9.7. Organic management .....	174
Bibliography .....	176
<b>Chapter 2. OECD Progress in Developing Agri-environmental Indicators .....</b>	<b>179</b>
2.1. Introduction.....	180
2.2. Progress in developing OECD Agri-environmental Indicators .....	180
2.2.1. Soil: Erosion, biodiversity and soil organic carbon .....	180
2.2.2. Water: Use and water quality .....	184
2.2.3. Biodiversity: Genetic, wild species and ecosystem diversity .....	188
2.2.4. Land: Landscapes and ecosystem functions .....	192
2.2.5. Farm management .....	195
2.3. Overall assessment.....	196
Annex 2.A1. Agri-environmental Indicators of Regional Importance and/or under Development.....	200
Annex 2.A2. A Qualitative Assessment of the Agri-environmental Indicators included in Annex 2.A1 according to the OECD Indicator Criteria .....	202
Bibliography .....	207
<b>Chapter 3. OECD Country Trends of Environmental Conditions related                 to Agriculture since 1990 .....</b>	<b>209</b>
Background to the country sections .....	210
3.1. Australia .....	212
3.2. Austria .....	224
3.3. Belgium.....	234
3.4. Canada .....	243

3.5. Czech Republic .....	256
3.6. Denmark.....	269
3.7. Finland .....	284
3.8. France .....	296
3.9. Germany .....	305
3.10. Greece.....	313
3.11. Hungary .....	324
3.12. Iceland .....	336
3.13. Ireland.....	344
3.14. Italy .....	357
3.15. Japan.....	366
3.16. Korea.....	377
3.17. Luxembourg.....	386
3.18. Mexico.....	393
3.19. Netherlands .....	402
3.20. New Zealand .....	413
3.21. Norway .....	423
3.22. Poland.....	433
3.23. Portugal.....	448
3.24. Slovak Republic .....	459
3.25. Spain.....	472
3.26. Sweden.....	486
3.27. Switzerland .....	498
3.28. Turkey.....	507
3.29. United Kingdom .....	522
3.30. United States .....	532
3.31. European Union.....	545
<b>Chapter 4. Using Agri-environmental Indicators for Policy Analysis .....</b>	<b>551</b>
4.1. Policy context to OECD agri-environmental performance .....	552
4.2. Tracking agri-environmental performance.....	554
4.2.1. Evolution of Agri-environmental Indicators to track sustainable development.....	554
4.2.2. Tracking national agri-environmental performance .....	556
4.2.3. International reporting on environmental conditions in agriculture .....	559
4.2.4. Non-governmental organisations (NGOs) .....	561
4.3. Using Agri-environmental Indicators for policy analysis .....	562
4.3.1. OECD member countries .....	563
4.3.2. International governmental organisations .....	565
4.3.3. Research community .....	567
4.4. Knowledge gaps in using Agri-environmental Indicators.....	568
Bibliography .....	571
<b>List of boxes</b>	
II.1. OECD Expert Meetings on Agri-environmental Indicators: 2001-04 .....	25
1.7.1. Towards a net agricultural greenhouse gas balance indicator?.....	123



1.8.1. Defining agricultural biodiversity .....	134
2.1. Soil biodiversity in agricultural land .....	182
2.2. Agricultural livestock pathogens and water pollution .....	187
2.3. The impact of agriculture on aquatic ecosystems .....	188
4.1. Main agri-environmental measures in OECD countries .....	553
4.2. Selected international and regional environmental agreements relevant to agriculture .....	555

### List of tables

1.1.1. OECD and world agricultural production .....	39
1.1.2. OECD and world agricultural exports .....	40
1.3.1. Germany: Percentage risk indices .....	70
1.7.1. Total OECD emissions of acidifying pollutants .....	114
1.7.2. Ammonia emission targets to 2010 under the Convention on Long-range Transboundary Air Pollution .....	116
1.7.3. Methyl bromide use and progress in meeting the phase-out schedule under the <i>Montreal Protocol</i> .....	120
1.7.4. Critical Use Exemptions (CUEs) for methyl bromide agreed under the <i>Montreal Protocol</i> for 2005 .....	121
1.7.5. Total OECD gross greenhouse gas emissions .....	124
1.7.6. Main sources and types of gross greenhouse gas emissions .....	127
1.8.1. Area of transgenic crops for major producing countries .....	139
1.8.2. Plant genetic resource conservation activities for OECD countries .....	139
1.8.3. Livestock genetic resource conservation activities for OECD countries .....	144
1.8.4. Share of farm woodland in agricultural land area .....	157
1.8.5. Share of farm fallow in agricultural land area .....	157
1.9.1. Countries recording adoption of environmental farm management practices .....	164
1.9.2. Overview of farmer incentives to adopt environmental farm management practices .....	166
2.1. Net water balance in a Japanese rice field irrigation system: 2003 .....	185

### List of figures

II.1. The Driving Force-State-Response framework: Coverage of indicators .....	24
1.1.1. Production, yields and area harvested and future projections for selected commodities and OECD countries .....	41
1.1.2. Volume of total agricultural production .....	43
1.1.3. Share of agricultural land use in the national land area .....	44
1.1.4. Agricultural land area .....	45
1.1.5. Agricultural production volume index and agricultural land area .....	46
1.2.1. Main elements in the OECD gross nutrient (nitrogen and phosphorus) balance calculation .....	50
1.2.2. Gross nitrogen balance estimates .....	51
1.2.3. Gross nitrogen balances for selected OECD countries .....	53
1.2.4. Inorganic nitrogen fertilisers and livestock manure nitrogen input in nitrogen balances .....	54

1.2.5. Agricultural use of inorganic nitrogen and phosphate fertilisers . . . . .	54
1.2.6. Contribution of the main sources of nitrogen inputs and outputs in nitrogen balances . . . . .	56
1.2.7. Nitrogen efficiency based on gross nitrogen balances . . . . .	57
1.2.8. Gross phosphorus balance estimates . . . . .	58
1.2.9. Gross phosphorus balance for selected OECD countries . . . . .	59
1.2.10. Contribution of the main sources of phosphorus inputs and outputs in phosphorus balances . . . . .	60
1.2.11. Phosphorus efficiency based on phosphorus balances . . . . .	61
1.2.12. Spatial distribution of nitrogen balances in Canada and Poland . . . . .	62
1.3.1. Pesticide use in agriculture . . . . .	65
1.3.2. Pesticide use for selected OECD countries . . . . .	66
1.3.3. Belgium: Risk for aquatic species due to use of pesticides in arable land, horticulture and outside of agriculture . . . . .	69
1.3.4. Denmark: The annual trend in frequency of pesticide application . . . . .	70
1.3.5. The Netherlands: Potential chronic effects scores for aquatic and terrestrial organisms and leaching into groundwater . . . . .	71
1.3.6. Norway: Trends of health risk, environmental risk and sales of pesticides . . . .	72
1.3.7. Sweden: National level pesticide risk indicators and the number of hectare doses . . . . .	73
1.3.8. United Kingdom (England and Wales): Total area of pesticide applications . . . .	74
1.4.1. Simplified energy “model” of an agricultural system . . . . .	78
1.4.2. Direct on-farm energy consumption . . . . .	79
1.4.3. Direct on-farm energy consumption for selected OECD countries . . . . .	80
1.4.4. Agricultural employment and farm machinery use . . . . .	81
1.4.5. Composition of on-farm energy consumption in the EU15 and the United States . . . . .	82
1.5.1. Agricultural land area classified as having moderate to severe water erosion risk . . . . .	87
1.5.2. Trends in agricultural land area classified as having moderate to severe water erosion risk . . . . .	88
1.5.3. Agricultural land area classified as having moderate to severe wind erosion risk . . . . .	89
1.6.1. Agricultural water use . . . . .	95
1.6.2. Share of national water use in annual freshwater resources and share of agricultural water use in national use . . . . .	96
1.6.3. Irrigated area, irrigation water use and irrigation water application rates . . . .	97
1.6.4. Share of agricultural groundwater use in total groundwater use, and total groundwater use in total water use . . . . .	99
1.6.5. Share of agriculture in total emissions of nitrates and phosphorus in surface water . . . . .	102
1.6.6. Share of agriculture in total emissions of nitrates and phosphorus in coastal water . . . . .	103
1.6.7. Share of monitoring sites in agricultural areas exceeding national drinking water limits for nitrates and phosphorus in surface water . . . . .	104
1.6.8. Share of monitoring sites in agricultural areas exceeding national drinking water limits for nitrates in groundwater . . . . .	105

1.6.9. Share of monitoring sites in agricultural areas where one or more pesticides are present in surface and groundwater . . . . .	106
1.6.10. Share of monitoring sites in agricultural areas exceeding national drinking water limits for pesticides in surface water and groundwater . . . . .	107
1.7.1. Impacts of agriculture on air quality: Multi-pollutants, multi-effects . . . . .	110
1.7.2. Ammonia emissions from agriculture . . . . .	112
1.7.3. Emissions of acidifying airborne pollutants for the EU15, US and OECD. . . . .	113
1.7.4. Agricultural ammonia emission trends for selected OECD countries . . . . .	114
1.7.5. Share of the main sources of agricultural ammonia emissions in OECD countries . . . . .	117
1.7.6. Methyl bromide use . . . . .	119
1.7.7. Global methyl bromide use by major sectors. . . . .	121
1.7.8. Agricultural gross greenhouse gas emissions . . . . .	125
1.7.9. Gross agricultural greenhouse gas emissions in carbon dioxide equivalent for selected OECD countries . . . . .	126
1.7.10. Agricultural production and agricultural greenhouse gas emissions. . . . .	128
1.7.11. Main sources of methane and nitrous oxide emissions in OECD agriculture . . . . .	129
1.7.12. Contribution of main sources in agricultural greenhouse gas emissions . . . . .	130
1.8.1. OECD agri-biodiversity indicators framework . . . . .	135
1.8.2. Change in the number of plant varieties registered and certified for marketing . . . . .	137
1.8.3. Change in the share of the one-to-five dominant crop varieties in total marketed crop production . . . . .	138
1.8.4. Change in the number of livestock breeds registered and certified for marketing . . . . .	141
1.8.5. Change in the share of the three major livestock breeds in total livestock numbers. . . . .	142
1.8.6. Total number of cattle, pigs, poultry and sheep in endangered and critical risk status and under conservation programmes . . . . .	143
1.8.7. Share of selected wild species that use agricultural land as primary habitat. . . . .	148
1.8.8. Population trends of farmland birds . . . . .	149
1.8.9. Change in agricultural land use and other uses of land. . . . .	152
1.8.10. Permanent pasture and arable and permanent cropland . . . . .	155
1.8.11. Share of arable and permanent cropland, permanent pasture and other agricultural land in total agricultural land area. . . . .	156
1.8.12. Share of national Important Bird Areas where intensive agricultural practices pose a serious threat or a high impact on the areas' ecological functions . . . . .	158
1.9.1. OECD farm management indicator framework . . . . .	162
1.9.2. Share of agricultural land area under nutrient management plans. . . . .	168
1.9.3. Share of total number of farms under nutrient management plans . . . . .	169
1.9.4. Share of total number of farms using soil nutrient testing . . . . .	170
1.9.5. Share of total arable and permanent crop area under integrated pest management. . . . .	171
1.9.6. Share of arable crop area under soil conservation practices . . . . .	172
1.9.7. Share of total arable and permanent crop area under all-year vegetative cover . . . . .	173
1.9.8. Share of irrigated land area using different irrigation technology systems . . . . .	174

1.9.9. Share of agricultural land area under biodiversity management plans . . . . .	175
1.9.10. Share of agricultural land area under certified organic farm management . . . . .	176
2.1. Canadian soil organic carbon stocks in agricultural soils by different classes . . . . .	183
2.2. United States soil organic carbon stocks in agricultural soils by different classes . . . . .	184
2.3. Agricultural, industrial, and household water charges . . . . .	186
2.4. National crop varieties that are endangered . . . . .	189
2.5. National crop varieties that are not at risk. . . . .	190
2.6. Edge density of agricultural fields in Finland. . . . .	190
2.7. Share of Canadian farmland in various classes of the habitat capacity index. . . . .	191
2.8. Cultural landscape features on agricultural land . . . . .	193
2.9. Water retaining capacity of agriculture . . . . .	194
2.10. Water retaining capacity for agricultural facilities . . . . .	195
2.11. Share of farmers participating in agri-environmental education programmes . . . . .	197
3.1.1. National agri-environmental and economic profile, 2002-04: Australia . . . . .	212
3.1.2. National agri-environmental performance compared to the OECD average. . . . .	220
3.1.3. National Landcare membership. . . . .	220
3.1.4. Annual quantities of insecticide and acaricide applied to the cotton crop . . . . .	220
3.2.1. National agri-environmental and economic profile, 2002-04: Austria . . . . .	224
3.2.2. National agri-environmental performance compared to the OECD average. . . . .	231
3.2.3. Area under non-use of inputs, organic farming and erosion control measures of the ÖPUL agri-environmental programme. . . . .	231
3.2.4. Greenhouse gas emissions from agriculture . . . . .	231
3.3.1. National agri-environmental and economic profile, 2002-04: Belgium . . . . .	234
3.3.2. National agri-environmental performance compared to the OECD average. . . . .	240
3.3.3. Total pesticide use . . . . .	240
3.3.4. Greenhouse gas emissions and sinks . . . . .	240
3.4.1. National agri-environmental and economic profile, 2002-04: Canada . . . . .	243
3.4.2. National agri-environmental performance compared to the OECD average. . . . .	252
3.4.3. Share of cropland in different soil organic carbon change classes. . . . .	252
3.4.4. Share of farmland in different wildlife habitat capacity change classes. . . . .	252
3.5.1. National agri-environmental and economic profile, 2002-04: Czech Republic . . . . .	256
3.5.2. National agri-environmental performance compared to the OECD average. . . . .	265
3.5.3. Share of samples above Czech drinking water standards for nitrates in surface water . . . . .	265
3.5.4. Monitored numbers of partridge population . . . . .	265
3.6.1. National agri-environmental and economic profile, 2002-04: Denmark . . . . .	269
3.6.2. National agri-environmental performance compared to the OECD average. . . . .	280
3.6.3. Share of monitoring sites with occurrences of pesticides in groundwater used for drinking . . . . .	280
3.6.4. Share of meadows and dry grasslands, heath, and bogs and marshes in the total land area . . . . .	280
3.7.1. National agri-environmental and economic profile, 2002-04: Finland . . . . .	284
3.7.2. National agri-environmental performance compared to the OECD average. . . . .	292
3.7.3. Nitrogen fluxes in the Paimionjoki river and agricultural nitrogen balances . . . . .	292

3.7.4. Population trends of Finnish farmland butterflies in three ecological species groups. . . . .	292
3.8.1. National agri-environmental and economic profile, 2002-04: France. . . . .	296
3.8.2. National agri-environmental performance compared to the OECD average. . . . .	302
3.8.3. Trends in key agri-environmental indicators. . . . .	302
3.8.4. Trends in key agri-environmental indicators. . . . .	302
3.9.1. National agri-environmental and economic profile, 2002-04: Germany . . . . .	305
3.9.2. National agri-environmental performance compared to the OECD average. . . . .	310
3.9.3. Share of the number of farms and Utilised Agricultural Area (UAA) under organic farming. . . . .	310
3.9.4. Share of renewable biomass and energy crop area in the total agricultural land area . . . . .	310
3.10.1. National agri-environmental and economic profile, 2002-04: Greece . . . . .	313
3.10.2. National agri-environmental performance compared to the OECD average. . . . .	321
3.10.3. Irrigated area and irrigation water application rates . . . . .	321
3.10.4. <i>Ex situ</i> accessions of plant landraces, wild and weedy relatives. . . . .	321
3.11.1. National agri-environmental and economic profile, 2002-04: Hungary. . . . .	324
3.11.2. National agri-environmental performance compared to the OECD average. . . . .	333
3.11.3. Agricultural land affected by various classes of water erosion . . . . .	333
3.11.4. Support payments for agri-environmental schemes and the number of paid applications. . . . .	333
3.12.1. National agri-environmental and economic profile, 2002-04: Iceland . . . . .	336
3.12.2. National agri-environmental performance compared to the OECD average. . . . .	342
3.12.3. Annual afforestation . . . . .	342
3.12.4. Annual area of wetland restoration. . . . .	342
3.13.1. National agri-environmental and economic profile, 2002-04: Ireland . . . . .	344
3.13.2. National agri-environmental performance compared to the OECD average. . . . .	353
3.13.3. River water quality . . . . .	353
3.13.4. Population changes for key farmland bird populations . . . . .	353
3.14.1. National agri-environmental and economic profile, 2002-04: Italy. . . . .	357
3.14.2. National agri-environmental performance compared to the OECD average. . . . .	363
3.14.3. Actual soil water erosion risk. . . . .	363
3.14.4. Regional change in agricultural land area: 1990 to 2000. . . . .	363
3.15.1. National agri-environmental and economic profile, 2002-04: Japan . . . . .	366
3.15.2. National agri-environmental performance compared to the OECD average. . . . .	373
3.15.3. National water retaining capacity of agriculture. . . . .	373
3.15.4. Share of eco-farmers in the total number of farmers. . . . .	373
3.16.1. National agri-environmental and economic profile, 2002-04: Korea . . . . .	377
3.16.2. National agri-environmental performance compared to the OECD average. . . . .	383
3.16.3. Composition of soils . . . . .	383
3.16.4. National water retaining capacity of agriculture. . . . .	383
3.17.1. National agri-environmental and economic profile, 2002-04: Luxembourg . . . . .	386
3.17.2. National agri-environmental performance compared to the OECD average. . . . .	391
3.17.3. Nitrate and phosphorus concentration in river sampling stations. . . . .	391
3.17.4. Agricultural land under agri-environmental schemes . . . . .	391
3.18.1. National agri-environmental and economic profile, 2002-04: Mexico . . . . .	393
3.18.2. National agri-environmental performance compared to the OECD average. . . . .	399

3.18.3. Trends in key agri-environmental indicators . . . . .	399
3.18.4. Trends in key agri-environmental indicators . . . . .	399
3.19.1. National agri-environmental and economic profile, 2002-04: Netherlands . . . .	402
3.19.2. National agri-environmental performance compared to the OECD average . . . .	409
3.19.3. Annual mean concentrations of nitrogen and phosphorus in surface water of rural and agricultural water catchments . . . . .	409
3.19.4. Farmland bird populations . . . . .	409
3.20.1. National agri-environmental and economic profile, 2002-04: New Zealand . . . .	413
3.20.2. National agri-environmental performance compared to the OECD average . . . .	420
3.20.3. Sectoral use of pesticides: 2004 . . . . .	420
3.20.4. Dairy cattle enteric methane emissions per litre of milk . . . . .	420
3.21.1. National agri-environmental and economic profile, 2002-04: Norway . . . . .	423
3.21.2. National agri-environmental performance compared to the OECD average . . . .	430
3.21.3. National sales of pesticides . . . . .	430
3.21.4. Net change in agricultural land for five counties . . . . .	430
3.22.1. National agri-environmental and economic profile, 2002-04: Poland . . . . .	433
3.22.2. National agri-environmental performance compared to the OECD average . . . .	444
3.22.3. Agriculture and forest land at risk to erosion . . . . .	444
3.22.4. Index of population trends of farmland birds . . . . .	444
3.23.1. National agri-environmental and economic profile, 2002-04: Portugal . . . . .	448
3.23.2. National agri-environmental performance compared to the OECD average . . . .	456
3.23.3. Numbers of local breeds under <i>in situ</i> conservation programmes: 2006 . . . . .	456
3.23.4. Relation between land use and Designated Nature Conservation Areas (DNCA): 2004 . . . . .	456
3.24.1. National agri-environmental and economic profile, 2002-04: Slovak Republic . .	459
3.24.2. National agri-environmental performance compared to the OECD average . . . .	468
3.24.3. Agricultural methane (CH <sub>4</sub> ) and nitrous oxide (N <sub>2</sub> O) emissions . . . . .	468
3.24.4. Share of agricultural land under different types of protected areas: 2003 . . . .	468
3.25.1. National agri-environmental and economic profile, 2002-04: Spain . . . . .	472
3.25.2. National agri-environmental performance compared to the OECD average . . . .	482
3.25.3. Area of organic farming . . . . .	482
3.25.4. Share of Dehesa area in total land area for five regions . . . . .	482
3.26.1. National agri-environmental and economic profile, 2002-04: Sweden . . . . .	486
3.26.2. National agri-environmental performance compared to the OECD average . . . .	494
3.26.3. Losses of nutrients from arable areas and the root zone . . . . .	494
3.26.4. Cultural features on arable land . . . . .	494
3.27.1. National agri-environmental and economic profile, 2002-04: Switzerland . . . .	498
3.27.2. National agri-environmental performance compared to the OECD average . . . .	504
3.27.3. Support for agricultural semi-natural habitats . . . . .	504
3.27.4. Input/output efficiency of nitrogen, phosphorous and energy in agriculture . . .	504
3.28.1. National agri-environmental and economic profile, 2002-04: Turkey . . . . .	507
3.28.2. National agri-environmental performance compared to the OECD average . . . .	518
3.28.3. Trends in key agri-environmental indicators . . . . .	518
3.28.4. Trends in key agri-environmental indicators . . . . .	518
3.29.1. National agri-environmental and economic profile, 2002-04: United Kingdom . . . . .	522
3.29.2. National agri-environmental performance compared to the OECD average . . . .	528

3.29.3. Agri-environmental trends . . . . .	528
3.29.4. Greenhouse gas emission trends and projections. . . . .	528
3.30.1. National agri-environmental and economic profile, 2002-04: United States. . . . .	532
3.30.2. National agri-environmental performance compared to the OECD average. . . . .	540
3.30.3. Soil erosion on cropland . . . . .	540
3.30.4. Change in palustrine and estuarine wetlands on non-federal land and water area . . . . .	540
3.31.1. National agri-environmental and economic profile, 2002-04: European Union (15) . . . . .	545
3.31.2. EU15 agri-environmental performance compared to the OECD average. . . . .	548
3.31.3. Agri-environmental trends, EU15 . . . . .	548
3.31.4. Agri-environmental trends, EU15 . . . . .	548

### This book has...



**StatLinks** 

**A service that delivers Excel® files  
from the printed page!**

Look for the *StatLinks* at the bottom right-hand corner of the tables or graphs in this book. To download the matching Excel® spreadsheet, just type the link into your Internet browser, starting with the <http://dx.doi.org> prefix.

If you're reading the PDF e-book edition, and your PC is connected to the Internet, simply click on the link. You'll find *StatLinks* appearing in more OECD books.



**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: United States", in *Environmental Performance of Agriculture in OECD Countries Since 1990*, OECD Publishing, Paris.

DOI: <https://doi.org/10.1787/9789264040854-35-en>

This work is published under the responsibility of the Secretary-General of the OECD. The opinions expressed and arguments employed herein do not necessarily reflect the official views of OECD member countries.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgment of OECD as source and copyright owner is given. All requests for public or commercial use and translation rights should be submitted to [rights@oecd.org](mailto:rights@oecd.org). Requests for permission to photocopy portions of this material for public or commercial use shall be addressed directly to the Copyright Clearance Center (CCC) at [info@copyright.com](mailto:info@copyright.com) or the Centre français d'exploitation du droit de copie (CFC) at [contact@cfcopies.com](mailto:contact@cfcopies.com).