Organisation for Economic Co-operation and Development
Organisation de Coopération et de Développement Économiques

ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990:

Norway Country Section

This country section is an extract from chapter 3 of the OECD publication (2008) ***Environmental Performance of Agriculture in OECD countries since 1990***, which is available at the OECD website indicated below.

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A summary version of this report is published as ***Environmental Performance of Agriculture: At a Glance***, see the OECD website which also contains the agri-environmental indicator time series database at: http://www.oecd.org/tad/env/indicators

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BACKGROUND TO THE COUNTRY SECTIONS

Structure

This chapter provides an analysis of the trends of environmental conditions related to agriculture for each of the 30 OECD member countries since 1990, including an overview of the European Union, and the supporting agri-environmental database can be accessed at *www.oecd.org/tad/env/indicators*. Valuable input for each country section was provided by member countries, in addition to other sources noted below. The country sections are introduced by a figure showing the national agri-environmental and economic profile over the period 2002-04, followed by the text, structured as follows:

- ***Agricultural sector trends and policy context:*** The policy description in this section draws on various OECD policy databases, including the *Inventory of Policy Measures Addressing Environmental Issues in Agriculture* (*www.oecd.org/tad/env*) and the Producer and Consumer Support Estimates (*www.oecd.org/tad.support/pse*).
- ***Environmental performance of agriculture:*** The review of environmental performance draws on the country responses to the OECD agri-environmental questionnaires (unpublished) provided by countries and the OECD agri-environmental database supporting Chapter 1 (see website above).
- ***Overall agri-environmental performance:*** This section gives a summary overview and concluding comments.
- ***Bibliography:*** The OECD Secretariat, with the help of member countries, has made an extensive search of the literature for each country section. While this largely draws on literature available in English and French, in many cases member countries provided translation of relevant literature in other languages.

At the end of each country section a standardised page is provided consisting of three figures. The first figure, which is the same for every country, compares respective national performance against the OECD overall average for the period since 1990. The other two figures focus on specific agri-environmental themes important to each respective country.

Additional information is also provided for each country on the OECD agri-environmental indicator website (see address above) concerning:

- Details of national agri-environmental indicator programmes.
- National databases relevant to agri-environmental indicators.
- Websites relevant to the national agri-environmental indicators (*e.g.* Ministries of Agriculture)
- A translation of the country section into the respective national language, while all 30 countries are available in English and French.

Coverage, caveats and limitations

A number of issues concerning the coverage, caveats and limitations need to be borne in mind when reading the country sections, especially in relation to making comparisons with other countries:

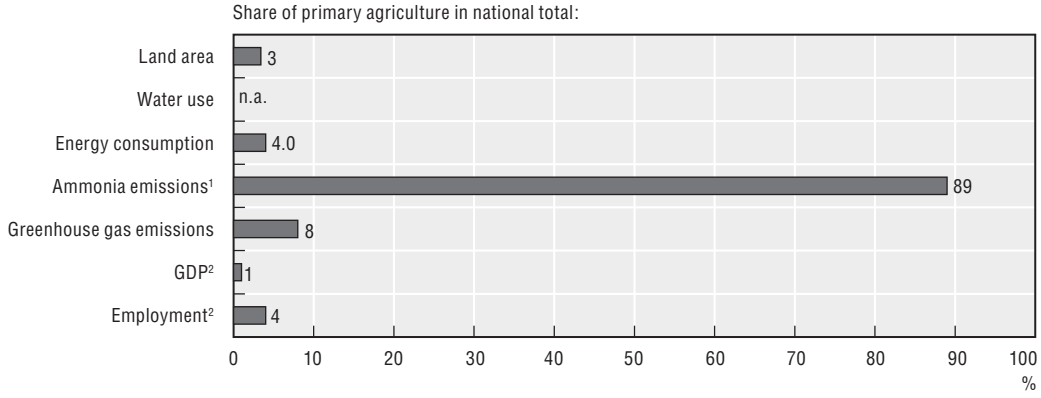
Coverage: The analysis is confined to examination of agri-environmental trends. The influence on these trends of policy and market developments, as well as structural changes in the industry, are outside the scope of these sections. Moreover, the country sections do not examine the impacts of changes in environmental conditions on agriculture (*e.g.* native and non-native wild species, droughts and floods, climate change); the impact of genetically modified organisms on the environment; or human health and welfare consequences of the interaction between agriculture and the environment.

Definitions and methodologies for calculating indicators are standardised in most cases but not all, in particular those for biodiversity and farm management. For some indicators, such as greenhouse gas emissions (GHGs), the OECD and the UNFCCC are working toward further improvement, such as by incorporating agricultural carbon sequestration into a net GHG balance.

- ***Data availability, quality and comparability*** are as far as possible complete, consistent and harmonised across the various indicators and countries. But deficiencies remain such as the absence of data series (*e.g.* biodiversity), variability in coverage (*e.g.* pesticide use), and differences related to data collection methods (*e.g.* the use of surveys, census and models).
- ***Spatial aggregation*** of indicators is given at the national level, but for some indicators (*e.g.* water quality) this can mask significant variations at the regional level, although where available the text provides information on regionally disaggregated data.
- ***Trends and ranges in indicators***, rather than absolute levels, enable comparisons to be made across countries in many cases, especially as local site specific conditions can vary considerably. But absolute levels are of significance where: limits are defined by governments (*e.g.* nitrates in water); targets agreed under national and international agreements (*e.g.* ammonia emissions); or where the contribution to global pollution is important (*e.g.* greenhouse gases).
- ***Agriculture's contribution to specific environmental impacts*** is sometimes difficult to isolate, especially for areas such as soil and water quality, where the impact of other economic activities is important (*e.g.* forestry) or the "natural" state of the environment itself contributes to pollutant loadings (*e.g.* water may contain high levels of naturally occurring salts), or invasive species that may have upset the "natural" state of biodiversity.
- ***Environmental improvement or deterioration*** is in most individual indicator cases clearly revealed by the direction of change in the indicators but is more difficult when considering a set of indicators. For example, the greater uptake of conservation tillage can lower soil erosion rates and energy consumption (from less ploughing), but at the same time may result in an increase in the use of herbicides to combat weeds.
- ***Baselines, threshold levels or targets for indicators*** are generally not appropriate to assess indicator trends as these may vary between countries and regions due to difference in environmental and climatic conditions, as well as national regulations. But for some indicators threshold levels are used to assess indicator change (*e.g.* drinking water standards) or internationally agreed targets compared against indicators trends (*e.g.* ammonia emissions and methyl bromide use).

3.21. NORWAY

Figure 3.21.1. **National agri-environmental and economic profile, 2002-04: Norway**



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

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

3.21.1. Agricultural sector trends and policy context

Agriculture is a small sector in the economy, with its share of GDP and total employment at under 1% and 4% respectively in 2004 [1] (Figure 3.21.1). While the volume of farm production remained stable between 1990 to 1997, it then declined by about 2% to 2004, largely reflecting a drop in livestock output [2]. Chemical input use has declined more rapidly than farm output suggesting production intensity is diminishing, with the volume of purchased farm input use decreasing between 1990-92 and 2002-04 by around 6% and 17% for nitrogen and phosphate inorganic fertilisers respectively, 26% for pesticides (1990-2003). Direct on-farm energy consumption rose by over 24% (Figure 3.21.2), however, this number should be used with caution because of uncertainties in the data series.

Norway is one of a few OECD countries where the area farmed increased by 4% from 1990-92 to 2002-04. This largely reflects the growth in the area under pasture, partly offset by a reduction in the arable and permanent crop area [1]. Some of the apparent increase in area farmed was due to improved registration and reporting by farmers due to the transition from a farm support system based on production to one based on area. Another reason for the growth in agricultural land is related to stricter requirements with regards to the minimum area for manure spreading [3]. The share of farmland in the total area is the lowest across OECD countries at around 3% in 2002-04, because of limits to cultivation due to topography, climate and the length of the growing season [1]. Cereal production dominates the lowlands in eastern and central areas, while grassland, mainly for dairy, accounts for much of the remaining farmland [3].

Agricultural support remains high compared to the OECD average. Support to farmers (as measured by the Producer Support Estimate) has on average remained unchanged at around 70% of farm receipts between 1986-88 and 2002-04, while the OECD average decreased from 37% to 30%. The share of output and input linked support, still accounts for 72% of the PSE in 2002-04, although it has fallen from almost 90% in 1986-88. Border measures and budgetary payments to farmers including area, headage, and deficiency payments are the main policy instruments supporting agriculture. A significant proportion of these payments are differentiated by region and farm size [4]. Total agricultural budgetary support was nearly NOK 11 (USD 1.6) billion in 2004 [1, 4].

Greater policy attention is being given to agri-environmental concerns. Over the 1990s, area-based payments under the *Acreage and Cultural Landscape Programme* were provided on the condition that farmers employ environmentally friendly production methods. Expenditure on this programme in 2003 accounted for about NOK 3 (USD 440 million) billion or one quarter of total budgetary support to farmers. In 2003, the programme was separated into two: the *Cultural Landscape Programme*, under which all farmers complying with environmental requirements receive a per hectare payment; and the *Acreage Support Programme* which provides payments to less-favoured areas, encouraging certain crops and providing support to small farmers. For farmers who do not meet the environmental requirements under these programmes, a penalty is imposed of between NOK 8 000 to 18 000 (USD 1 200-2 700) per farm according to the area farmed. Since 1990, support has also been provided to organic farming. The government's goal is that 15% of total food production and food consumption should be organic in 2015. By the end of 2005, 4.2% of total agricultural land was under organic practices, and organic products constitute about 1% of total food sales.

Agriculture is also impacted by a range of national environmental and taxation measures. As part of its environmental taxation policy taxes have been applied to farm chemicals [5]. A tax on mineral fertilisers introduced in 1988 (NOK 1.2/kg nitrogen, NOK 2.3/kg phosphorus, USD 0.15 and 0.30, respectively) was abolished in 1999, to reduce the associated costs for farmers, and replaced by compulsory nutrient management planning and a whole farm management plan. Pesticides were first subject to a tax in 1988, which was subsequently increased up to 15.5% of the wholesale price in 1996 [6, 7]. As a follow up to the *National Action Plan for Risk Reduction* (1998-2002), a new area-based tax system was implemented in 1999. A base rate of NOK 20 (USD 2.4) per hectare was multiplied with a factor for each tax class. The tax classes were differentiated according to environmental and health risks. The tax per kg or litre of product was calculated by using a standardised area dose for each product. The base rate for the pesticide tax was raised to NOK 25/ hectare in 2005 (USD 2.5-3.2), providing an annual revenue of about NOK 100 (USD 15) million [4, 5]. Farmers benefit from a fuel tax concession which amount to over NOK 310 (USD 40) million of tax revenue forgone annually over 2002-04 [4, 8]. Biofuels (and biofuel/diesel mixes) are exempt from the fuel and the carbon dioxide (climate change) taxes [9]. Since 2003 a bioenergy programme provides financing to promote bioenergy heat production from agricultural and forestry biomass [10].

Agriculture is also impacted under international environmental agreements, including Norwegian commitments to lower nutrient emissions into the North Sea (*OSPAR Convention*), ammonia emissions (*Gothenburg Protocol*), methyl bromide (*Montreal Protocol*) and greenhouse gases (*Kyoto Protocol*). A target has also been set to halt the loss of all biodiversity by 2010 to meet commitments under the *Convention of Biological Diversity* [5, 11].

3.21.2. Environmental performance of agriculture

Agriculture plays an important role in terms of the protection of cultural landscapes and biodiversity. There is public concern over the conversion of arable land for urban use and conversion of marginal farmland with a high nature and landscape value to scrub or forestry. In response the government aims to half the loss of biodiversity by 2010, maintain landscapes and public access to them, and halve the annual conversion of high quality arable land to other uses by 2010 [11]. National targets (from all sources including agriculture) have also been set for the discharge of nutrients into the North Sea to be reduced by 50% by 2005 from a 1985 base year, and annual ammonia emissions should not exceed 23 000 tonnes as from 2010 [11]. As agriculture is largely rain-fed, its use of water resources is small [3]. Irrigation is very limited, mainly used in vegetable and potato production, and covered around 4% of the total agricultural land area in 2004, however, farmers have the capacity, in terms of equipment, to irrigate 11% of the total agricultural area.

The share of farmland subject to a medium to high risk of soil erosion declined over the 1990s, from around a third of the total area down to a quarter [2]. Similarly the share of agricultural land in the very high soil erosion risk class (> 8 tonnes/hectare) fell from 3% to 1% over the past decade [2]. Soil erosion is largely an issue in the south-eastern area of the country, mainly land under cereal production and in the cases where fields are ploughed in autumn [3, 12, 13, 14]. To a large extent the improvement in reducing soil erosion rates has been linked to an increase in the share of the cereal area not tilled between harvesting and spring, rising from about 20% in the early 1990s to nearly 45% by 2002-04 [3]. Payments were introduced for no autumn tillage in 1991, and increased by 2001 to NOK 580-1 670 (USD 65-185) per hectare depending on erosion risk [12], with all the no-tilled area receiving a payment by 2002-04 [3]. Sediment load to water bodies has also been reduced through payments to develop sedimentation ponds and riparian buffer zones which were expanded over the 1990s [12, 13]. The reduction in soil erosion rates, and improvements in tillage and crop residue management practices, has led to an increase in the soil organic carbon content of agricultural soils [14].

Agriculture remains a major source of water pollution. Due to a coastal climate, the low share of agricultural land and low population density in Norway the vast proportion of freshwater resources are of high quality. For water bodies in more central areas the overall drinking and environmental water quality has been improving since 1990, but still remains a problem for both surface and coastal waters in the main agricultural areas [3, 5, 11, 15]. While some agricultural water pollutants have declined since 1990 (inorganic fertilisers and pesticides), the increase in livestock numbers, and resultant growth in manure, has increased the risks of nitrogen and phosphorus pollution of water bodies from manure.

Agriculture is the major source of eutrophication in surface waters in some agricultural areas and coastal waters. With most point sources of nutrient pollution of water (*e.g.* urban sources) having been reduced significantly, agricultural non-point pollution sources are now the main source of pollution in many cases [5, 16]. Even so, nutrient surpluses (input minus output of nutrients, nitrogen and phosphorus) declined over the period 1990 to 2004, both in absolute terms and per hectare of agricultural land (Figure 3.21.2). Much of the reduction in surpluses has been due to lower fertiliser use and the near stable uptake of nutrients by crop and pasture. However, this has to some extent been offset by an increase in nutrient inputs from livestock manure due to growing livestock numbers,

notably pigs and poultry, although cattle and sheep numbers remained largely unchanged, with a decline in the national dairy herd. Eutrophication is a particular problem where much of the surrounding land is under agriculture, such as in South-Eastern Norway [11].

The decline in nitrogen surpluses, however, led to a small reduction in nitrate concentrations in surface waters of predominantly agricultural and forestry catchments over the period 1991 to 2002, although phosphorus concentrations have risen, reflecting the long time lags involved with phosphorus transport into water [17]. Agriculture accounted for respectively 56% and 47% of total nitrogen and phosphorus inputs into Norwegian *coastal waters* (North Sea) in 2002, although since 1985 surplus agricultural nitrogen flowing into coastal waters declined by 28% with a reduction of 38% for phosphorus [3]. The share of farms and agricultural land under a nutrient management plan rose over the 1990s and from 1999 became compulsory [2]. During the period of the fertiliser tax, 1988 to 1999, the volume of nitrogen fertiliser use showed little change but declined slightly from 2000 to 2004, while for phosphorus use declined significantly from 1988 to 1999 but since 2000 has remained stable.

Pesticide sales decreased by 26% from 1990-92 to 2001-03 (volume terms of active ingredients), among the largest rate of reduction across OECD countries (Figures 3.21.2 and 3.21.3) [3]. The trend in pesticide sales, however, has shown considerable annual variability over this period. Much of the variation was explained by farmers stockpiling pesticides prior to expected government increases in pesticide taxes, such as in 1998 and at the end of 1999, after which pesticide sales fell by around a half in 2000 and 2001, recovering again in 2002 [7]. Pesticides are applied to about a third of farmland, mainly cereals and horticultural crops, as only 6% of harvested grassland and pasture was sprayed, with the average number of treatments per year ranging from around 1 for pasture to over 9 times for apples [18]. Human health and environmental risk indicators reveal that from 1996 to 2000 pesticide sales fell by 8% but the risk indicators declined by over 30%, although from 2000 to 2003, the sales and risk indicators both rose. These results, however, have to be treated with caution, especially because of the recent stockpiling of pesticides by farmers [7].

Nearly all surface water monitoring sites in agricultural areas detected the presence of one or more pesticide compounds, although the share was much lower for groundwater at over 25% between 1995 and 2002 [2, 19]. For surface water the frequency of pesticide detection, concentrations and environmental risk for the majority of pesticide compounds declined over the period 1996 to 2000 [20]. Monitoring of pesticides in groundwater has not been as extensive as for surface water as it only provides around 10% of drinking water supplies [2, 6]. Pesticides have been detected in 50% of farm drinking wells that have been monitored, with 30% of the wells with concentrations above drinking water standards [2]. As a consequence of the greater adoption of low or no tillage practices to reduce soil erosion on land growing cereals, this has led to an increase in pesticide use. From 1992/93 to 2001/02 over 40% of cereal area was sprayed for couch grass (*Elymus repens*) on which there was no tillage, compared to under 20% of the cereal area ploughed in autumn [3].

Air pollution from agriculture is stable or declining. The trend in agricultural ***ammonia emissions*** overall remained stable over the period 1990-92 to 2001-03 (compared to a 7% reduction for the EU15), although did rise slightly between 1990 to 1996 and then declined (Figure 3.21.2) [21]. The main sources of agricultural ammonia emissions are livestock (nearly 90%), the use of fertilisers and treatment of straw with ammonia [3]. Agriculture

contributed to 88% of ammonia emissions in 2004, but around 15% of total acidifying substances in 2003, and while ammonia emissions have changed little over the past decade, their share in acidifying substances has risen because of the greater reduction in sulphur dioxide emissions by other sectors [3]. Under the *Gothenburg Protocol* Norway has agreed to an ammonia emissions ceiling of 23 000 tonnes by 2010, which was the level reached in 2001-03 [11]. The share of the total land area where critical loads for acidification were exceeded declined from around 20% in 1990 to below 15% in 2000 [21]. But, in southern Norway common plant species have declined probably due to acid rain, however, agriculture is a minor source of acid rain as Norway is a downstream country for acid rain from the United Kingdom and Central and Eastern Europe [22].

By 2003 Norway had exceeded its commitment to reduce methyl bromide use (an ozone depleting substance) by 70% under the *Montreal Protocol* with a decrease of nearly 80% from the 1991 base year. While many OECD countries have applied for exemptions on using methyl bromide, as they are unable to meet the requirement for a total phase out by 2005, Norway has not done so [23].

Agricultural greenhouse gas (GHG) emissions decreased by 3% over the period 1990-92 to 2002-04, compared to a reduction of 7% for the EU15 (Figure 3.21.2) [10]. Farming contributed about 8% of total Norwegian GHG emissions in 2002-04, while its commitment under the *Kyoto Protocol* is an increase of total GHGs of 1% from the 1990 base year by 2008-12. In 2003, agriculture was the most important source of nitrous oxide, about 50% of total emissions, and accounted for around 40% of methane emissions, with agricultural GHGs mainly derived from livestock and the use of fertilisers [10]. Projections indicate a slight reduction in agricultural GHGs up to 2010 [10].

Direct on-farm energy consumption grew by 24% between 1990-92 to 2002-04, compared to an increase of 4% across all OECD countries and a 17% rise in total Norwegian energy consumption, even though farming only accounts for 4% of total energy consumption. But data on agricultural energy consumption should be used with caution because of uncertainties in the data series. The production of ***bioenergy***, heat and fuel, from agricultural biomass provides under 1% of total energy consumption, although the potential exists to increase this share [9].

Agriculture continues to exert pressure on biodiversity but there are recent signs that the pressure could be easing, especially with low nutrient surpluses and pesticide use, although information on agri-biodiversity is poor. There is little information on the trends and state of ***agricultural genetic resources*** (crops and livestock), but there are plans for national management of genetic resources in agriculture [11]. A programme was started in 2003 to document crop genetic resources [24], and all endangered breeds of livestock are under a conservation programme, and there are also extensive *ex situ* collections of livestock genetic material [2].

For wild species about 3% of indigenous plants species and about 10% of bird species are endangered by the intensification in agricultural areas [5]. For vascular plant species there appears, however, to be considerable regional variation in species richness and abundance depending on the structure of the agricultural landscape and intensity of land use [25]. There is also evidence in some localities (Finnmark) of lichen cover decreasing from 1987 to 2000 as a result of overgrazing by reindeer [26]. Farmland bird populations showed a downward trend over the 1996 to 2003 period, markedly so for the Skylark (*Alauda arvensis*)

and Curlew (*Numeniusarquata*) [27]. There are signs, however, of some stability and even increase in numbers of certain bird species associated with farming since the mid-1990s, including the Northern Lapwing (*Vanellus vanellus*) and Barn Swallow (*Hirundo rustica*) [27].

Several conflicting trends in agricultural land use and structure are affecting biodiversity, as well as farmed cultural landscapes, which makes it difficult to measure the overall change. These include further concentration of farming in the fertile south-east; conversion of farmland to scrub or forestry in some marginal areas (*e.g.* Hjartdal); conversion of forest to farmland in other regions (*e.g.* Rogaland) [3, 5, 11, 28]; the loss of small habitat features on farmland, including ponds and water meadows [28]; and an increase in the area under pasture while the arable crop area has declined (Figure 3.21.4).

Farming provides cultural landscape amenity, but there are concerns over the deterioration in its quality and conversion to other landscape forms [11]. As much of the total land area is forested and alpine mountains, farmland covers only 3% of the land area, maintaining an "open" farmed landscape is considered important given demands for outdoor recreation and agri-tourism [11, 29, 30]. The *Norwegian Monitoring Programme for Agricultural Landscapes*, the so-called 3Q programme started in 1998 and conducted on a 5-year inventory cycle, has few results to date to draw any clear conclusions as to trends in farmed landscapes [31, 32, 33]. Limited evidence suggests, however, that there is a growing polarisation of farmed landscapes with an increasing uniformity of landscapes in highly intensive agricultural areas, while farmed landscapes with greater heterogeneity are being converted to forest or left to overgrowth [33, 34, 35].

3.21.3. Overall agri-environmental performance

Overall the pressure from agriculture on the environment has decreased. With the slight decline in agricultural production from 1990 to 2004, especially since 1997, and the reduction in use of fertilisers and pesticides, and with an increase in the total agricultural area, the intensity of agriculture has diminished (Figure 3.21.2). This has brought a lowering of environmental pressure, as revealed through the decrease in nutrient surpluses, environmental pesticide risk indicators, and stable or declining air emissions from agriculture. Despite these improvements agriculture remains a major source of water pollution and farming activities continue to threaten biodiversity especially from abandonment of farmed land, but also from an increase in the homogeneity of farmed landscapes.

There is an extensive environmental monitoring system, which includes tracking the impact of agriculture. The *Agricultural Environmental Monitoring Programme* (JOVA) measures numerous variables from 8 selected water catchments; health and environmental pesticide risk indicators are being used to track the *Action Plan* on pesticides; and for agricultural landscapes the *Norwegian Monitoring Programme for Agricultural Landscapes* has since 1998 started to develop an inventory of landscape changes. Some areas of agri-environmental monitoring require strengthening notably biodiversity, but also agricultural ammonia emissions [9]. The Government plans to further expand environmental monitoring and research programmes [11], including for pesticides [6]. Statistics Norway delivers an annual report of statistics concerning environmental measures in agriculture [36].

There has been a shift toward greater use of agri-environmental measures and some environmental targets have been met. The recent shift in emphasis from agricultural price support to area based payments on condition that farmers employ environmentally friendly production methods have to some extent reduced the policy incentive for intensive

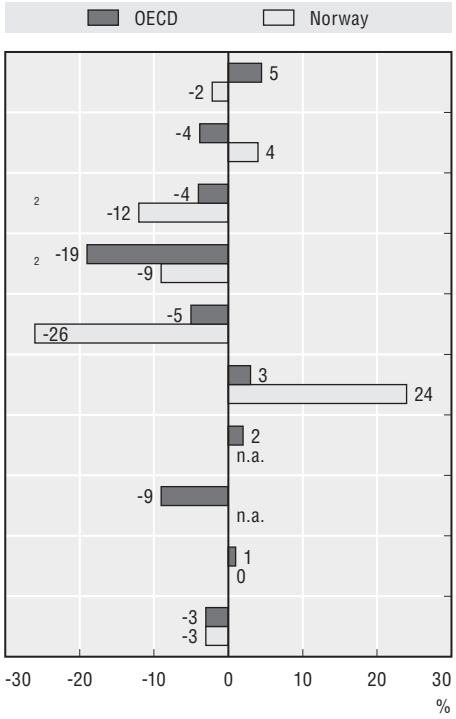
production [4]. However, the most production distorting policies still account for the largest share of support (over 70%) to agricultural producers [4]. The use of environmental taxes on fertilisers (although ended in 1999) and pesticides are consistent with the polluter-pays-principle, while for pesticides the decision to sharpen the focus of the tax on the most harmful compounds should enhance the effectiveness of the measure [4, 7].

The goal to further reduce health and environmental risks from pesticide use has been extended under the *Action Plan for Pesticide Risk Reduction* with a reduction target of 25% for the period 2004-08, and a total reduction target of 50% over the period 1998 to 2008 [6]. For methyl bromide the government is close to meeting the complete phase out by 2005 [3]. The *National Environmental Programme* was introduced in 2004 to better coordinate a range of agri-environmental payments provided over the 1990s, with the objective of protecting cultural landscapes and heritage, biodiversity, reducing pollution, and increasing public access to the countryside. Under the programme all farmers are required to establish an environmental plan, such as maintaining a checklist of the environmental situation and performance of the farm and a map indicating cultural monuments and valuable landscape features. The programme also provides a greater role for 18 regional administrations, with about NOK 350 (USD 52) million in 2005 and NOK 390 (USD 61) million in 2006 available for environmental measures based on regional priorities [1, 4].

Despite progress in reducing agricultural pressures on the environment a number of concerns remain. While the government's target to reduce nutrient discharges (including from agriculture) into the North Sea (by 50% compared to 1985 levels), has been met for phosphorus (a 66% reduction), the reduction of 40% for nitrogen by 2004 indicates that further effort will be required to achieve the target [5. 11, 17]. There are still challenges regarding phosphorus in some freshwater bodies, and they are being targeted through Norway's implementation of the *Water Framework Directive* [37]. The target to halt the loss of biodiversity by 2010 will also require further action in agriculture, mostly regarding the loss of agricultural land and livestock grazing to shrub and overgrowth, but also due to intensive agriculture in some regions. With a slight increase in ammonia emissions over the 1990s, the 2010 *Gothenburg Protocol* target was already reached by 2003, but projections suggest that agricultural ammonia emissions are likely to remain stable up to 2010 [21]. While energy taxes are used widely across the economy to meet environmental objectives, farmers are provided a concession on these taxes which acts as disincentive to limit on-farm energy use, improve energy efficiency and further reduce GHG emissions. There is also potential to make greater use of agricultural biomass to further increase renewable energy production for heating [9].

Figure 3.21.2. **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		Norway	**OECD**
Agricultural production volume	Index (1999-01 = 100)	1990-92 to 2002-04	98	105
Agricultural land area	000 hectares	1990-92 to 2002-04	40	–48 901
Agricultural nitrogen (N) balance	Kg N/hectare	2002-04	77	74
Agricultural phosphorus (P) balance	Kg P/hectare	2002-04	13	10
Agricultural pesticide use	Tonnes	1990-92 to 2001-03	–236	–46 762
Direct on-farm energy consumption	000 tonnes of oil equivalent	1990-92 to 2002-04	+155	+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	+0	+115
Agricultural greenhouse gas emissions	000 tonnes CO_2 equivalent	1990-92 to 2002-04	–147	–30 462

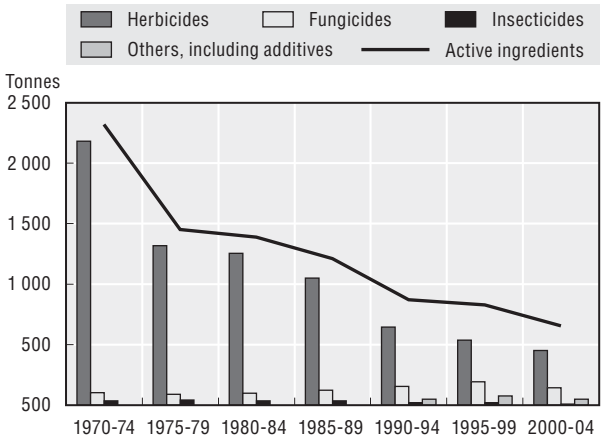
n.a.: Data not available. Zero equals value between –0.5% to < +0.5%.

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 3.21.3. **National sales of pesticides**

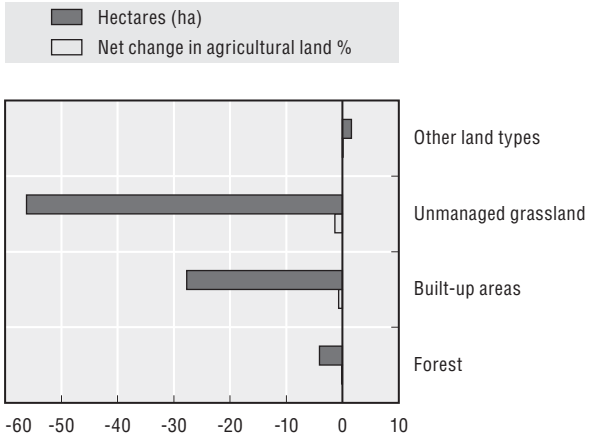
Tonnes of active ingredients



Source: Statistics Norway (2005), Natural Resources and the Environment 2004, Oslo, Norway, *www.sst.no/english*.

Figure 3.21.4. **Net change in agricultural land for five counties**

1998-2004



Source: Norwegian Forest and Landscape Institute.

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