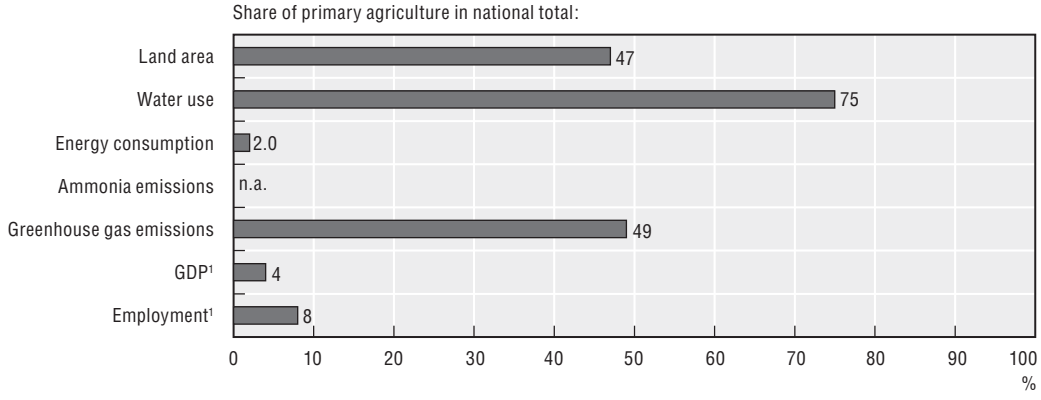
3.20. NEW ZEALAND

Figure 3.20.1. **National agri-environmental and economic profile, 2002-04: New Zealand**



StatLink http://dx.doi.org/10.1787/300760536460

1. Data refer to the year 2004.

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

3.20.1. Agricultural sector trends and policy context

The agricultural sector is important to the New Zealand economy. It contributes about 4% to GDP and 8% to employment, while farm exports accounted for over 50% of the value of merchandise exports in 2004 [1] (Figure 3.20.1).

Agriculture has undergone substantial structural change over the past 20 years, since the government's commitments to economic liberalisation, including the removal of most agricultural support. The farming sector has responded with further diversification, the area under horticulture and vines rose by over 20% and forestry plantations by 40%; and intensification, with some sectors (dairy) relying on greater use of inputs (*e.g.* fertilisers) to increase production, and others (horticulture) focusing on raising value and quality [2]. As a result, the volume of agricultural production grew by 38% over the period 1990-92 to 2002-04 on a declining area of farmland (–3%) (Figure 3.20.2). Also the use of purchased farm inputs (volume) grew more rapidly than output, revealing the intensification of production over the same period, with inorganic nitrogen and phosphate fertiliser use rising by around 420% and 100% respectively; direct on-farm energy consumption 22%; but pesticide use by only 4% (Figure 3.20.2) [3, 4, 5, 6]. Overall this has resulted in improvements over 1985 to 2006 compared to 1972 to 1984 (numbers in brackets), in the total output per annum; input productivity; and factor productivity, by 1.7% (1.1%), 1.9% (0.2%), and 3.1% (–0.5%) respectively [7].

Support to agriculture is the lowest in the OECD. Producer support fell from a peak of over 30% of farm receipts in the mid-1980s to 2% in 2002-04 (as measured by the OECD's Producer Support Estimate) compared to the OECD average of 30% [8]. Support to agriculture is mainly directed at research, pest and disease control, agri-environmental

measures and climatic disaster relief. Budgetary expenditure on agri-environmental measures has grown from about NZD 80 (USD 50) million in 1997 to almost NZD 100 (USD 60) million by 2004 or around 15% of total agricultural support [8, 9].

A range of policy instruments are used by government to achieve agri-environmental objectives [9]. Almost 90% of government agri-environmental budgetary expenditure is provided for research and education, such as the *Public Good Science and Technology Fund* [9]. The *Sustainable Farming Fund* (SFF, established in 2000), has seen an increase in funding for projects up to 2009 at around NZD 10 (USD 6) million annually. SFF projects seek to transfer information and technology from experts to primary producers in order to improve the financial and environmental performance of agriculture and forestry [8, 10]. In 2003 a *Dairying and Clean Streams Accord* was agreed between Fonterra (a private company controlling over 95% of New Zealand's milk supply), the Ministries of Agriculture and Environment, and regional councils, to work together to improve water quality in dairying areas by using voluntary guidance and information tools, such as the adoption of nutrient budgeting [8].

Agriculture is affected by national and international environmental policies. The ***national environmental policy framework*** affecting agriculture is characterised by decentralisation of decision-making and devolution of responsibility to 74 territorial authorities and 12 regional councils. Authorities charge farmers in order to recover the costs associated with programmes and applications, while responsibility for resource management remains with the farmers [7]. Three nationwide overarching policies address environmental concerns: the *Resource Management Act* (RMA, 1991); the *Hazardous Substances and New Organisms Act* (HSNO, 1996); and the *Biosecurity Act* 1993. The RMA integrates measures governing resource management, and its key themes are: sustaining the potential of natural and physical resources; safeguarding the quality of soil, water, air, and ecosystems; and avoiding, remedying or mitigating adverse effects on the environment. With respect to water, while use permits are issued under the RMA through regional councils, there is no direct government funding for irrigation development and farmers pay the full recovery costs for water [11]. The HSNO aims to protect the environment by preventing and managing the adverse effects of hazardous substances, including pesticides and new organisms not currently present in New Zealand. The *Biosecurity Act* is designed to systematically protect the nation's biological system – introduced and indigenous – from the harmful effects of pests and diseases. Farming is also affected by New Zealand's commitments under ***international environmental agreements*** including eliminating the use of methyl bromide (an ozone depleting substance) under the *Montreal Protocol*; safeguarding biodiversity under the *Convention on Biological Diversity*; and reducing greenhouse gas emissions under the UNFCCC and its *Kyoto Protocol*.

3.20.2. Environmental performance of agriculture

The key environmental challenges concerning the agricultural sector include: soil management, water quality, biodiversity and climate change. Pesticide and energy use and the growing demand for water for irrigation are also important. Agriculture dominates land and water use, accounting for 47% of total land use and around 75% of water use. While the area under grazing, arable fodder and fallow land has declined over the 1990s, there has been rapid growth in the area under horticulture, but its share of the agricultural land area is only 1%. With the first Polynesian settlement, but especially since European settlement from the mid-19th century, the establishment of agriculture initiated dramatic

deforestation and impacts on indigenous wildlife. A combination of temperate climate and youthful geology have resulted in "natural" soil erosion rates ten times the world average in some locations, and high average annual yields of soil sediment loss to the ocean [2, 12].

Soil quality has come under pressure from overgrazing [1]. A 2004 assessment of soil quality indicates that about 80% of agricultural land fell within target ranges identified as desirable to maintain soil quality for production and environmental objectives [13]. Overall, however, soil erosion (water and wind) is not a significant issue, mainly because over 75% of farmland is permanent pasture. About 5% of farmland is estimated to suffer moderate to severe rates of erosion (11 tonnes and above of soil loss/hectare/year), but there are no time series data available to assess trends. However, research suggests that soil erosion and loss of organic carbon have been reduced on steep pasture areas, mainly through reversion to forestry and improved management within pastoral systems [13].

Under cropping soils, loss of organic matter; severe degradation and compaction, are still concerns despite the relatively small area involved [13]. The annual expenditure on mitigating soil erosion was estimated in 2002 at NZD 26 (USD 12) million [14], while the annual cost of soil erosion (including agriculture and natural sources) was estimated in 1998 at NZD 127 (USD 68) million [2]. Localised build-up of nitrogen and phosphate under dairy pastures with the potential to pollute water bodies, *i.e.* rivers, lakes, groundwater and coastal waters, is a growing issue [13]. Streams draining catchments with pasture have been estimated to contain 2.5 to 7 times more sediment, phosphorus and nitrogen than streams draining forest catchments [5].

Agriculture, especially since the mid-1990s, has led to deteriorating water quality. Some rivers in farming areas, particularly those flowing through lowland pastoral land, fail to meet environmental water guidelines, while shallow aquifers in dairying and horticultural areas have elevated nitrate levels [2]. Overall, the quality of water bodies is high by international standards, but it is hard to identify trends due to the lack of a national water quality monitoring network [15]. Intensive farming practices are seen as increasing pressure on water quality, especially as urban discharges are being controlled [16]. Nutrients (nitrogen and phosphorus) are the main pollutants of water bodies, but there are concerns in some areas over water pollution from microbial contaminants and soil sediments.

Agricultural nutrient surpluses have risen substantially over the past decade, but surpluses per hectare of farmland are about half the OECD average for nitrogen balance surplus, but slightly above the average for phosphorus (Figure 3.20.2). Between 1990-92 and 2002-04, the increase in tonnes of nutrient surplus (input minus output) has been most marked for phosphorus at nearly 130% compared to nitrogen rising by over 40%. The main reason for the rise in nutrient surpluses over the past decade is that nutrient inputs (mainly inorganic fertiliser use) have grown much more rapidly than nutrient outputs, and the reduction in pasture area (*i.e.* lowering nutrient uptake). The nitrogen content of livestock manure, 95% of which is deposited onto pastures, rose by almost 25% (in terms of tonnes of nitrogen) between 1990-92 and 2002-04 (largely due to the reduction in sheep numbers being more than offset by the growth in cattle numbers). Over the same period inorganic nitrogen fertiliser use increased by over 420%. Dairy farming is the major user of nitrogen fertilisers and accounts for much of the growth in its use, especially for increasing rates of pasture growth [2, 5]. These developments have resulted in increased nitrogen and phosphorus pollution of some rivers and lakes, such as Lake Taupo, a UNESCO *World Heritage Site* [17], and in intensive farming regions such as Waikato and Canterbury.

Farming is estimated to contribute 75% of total nitrogen input to surface water [2], with this share likely rising as other sources of nitrogen pollution (*e.g.* urban sources) are controlled [5]. Over the 2000-03 period less than 30% of dairy farms were using a formal nutrient management plan and regularly testing the soil for nutrient levels [18], but these shares have increased since then. In parts of a few intensively farmed areas, such as Canterbury and Waikato, concentration of nitrate in groundwater exceeds the maximum allowable value for drinking water [2, 19]. There are also localised concerns with microbial pollution from livestock farming (*e.g.* faecal coliforms and *campylobacter*) of water bodies [2, 20, 21], leading to some cases of human infections above reported levels in other OECD countries [15].

While there was a small increase in pesticide use over the past decade the intensity of use is low by OECD standards (Figure 3.20.2). This is because of the dominance of pastoral farming and a limited arable crop and horticultural sector [22]. The trend in pesticide use was variable over the period 1994 to 2003 with about 13% of pesticide use accounted for by the forestry sector, although the current quality of pesticide use (sales) data are poor [23]. Between 1995 and 1998 pesticide use fell, probably due to various initiatives in the horticultural sector to reduce and use pesticides more efficiently (*e.g.* KiwiGreen). From 1999 to 2004 the use of pesticides grew by 27%, but only in 2002 and 2003 did usage surpass the levels of the early 1990s.

The growth in pesticides over this period was in part due to higher viticulture plantings [23]. While horticulture is the most intensive user of pesticides, over 13 kg of active ingredients (a.i.) per hectare (kg a.i./ha) compared to less than 3 kg a.i./ha for other users (*e.g.* arable and pastoral), it is also the most progressive in adopting practices to limit usage and damage to human health and the environment (Figure 3.20.3) [23, 24]. Even so, over the 2000-03 period only 10% of the total arable and permanent crop area was under integrated pest management [18], and the area farmed under certified organic practices was less than 0.5% of the total area farmed in 2003. The monitoring of pesticide residues in water and food indicates pollution is a rare occurrence and contamination levels are very low [24], although there is no regular monitoring of pesticides in water bodies [4].

Demand for irrigation water by the agricultural sector is growing rapidly. Agriculture uses less than 1% of available water resources, but accounts for 75% of total water use, of which nearly 80% is used for irrigation. Over 40% of water used for irrigation is derived from groundwater [2]. But, there are regions where water is becoming scarce through changes in supply and demand patterns, especially the Canterbury region where 70% of the total irrigated area is located. This is leading to growing competition between farming and other water users, and concerns over the maintenance of environmental flows to protect aquatic ecosystems, and for social and cultural values associated with water [2, 11, 16, 25].

The area irrigated almost doubled over the period 1990-92 to 2001-03 with two-thirds of it pasture. While only 4% of total area farmed is irrigated (2001-03), produce from irrigated land accounted for over 10% of agriculture GDP and 12% of farm export value in 2002/03 [11]. Projections indicate that the rapid expansion in agricultural water demand is likely to continue, especially with the expected growth in the dairy and horticultural sectors, and with climate change. Demand for irrigation water is projected to rise by nearly 30% between 2000 and 2010 [2, 26]. Around 40-50% of the irrigated area is under less efficient water application systems, but the horticultural sector is increasingly using micro/drip irrigation systems [11]. A survey also revealed that only 10-12% of irrigators regularly measure soil moisture [2].

Agricultural air emissions are significant in terms of the environmental pressure from greenhouse gases, but less so for ammonia and methyl bromide. While data on agricultural ammonia emissions are limited, what information is available suggests that the critical threshold level for damage to ecosystems is unlikely to be exceeded [27]. New Zealand has agreed, as a signatory to the *Montreal Protocol*, to phase out its use of ***methyl bromide*** by 2005, and by 2004 it was reduced by over 80% compared to 1991 levels. In 2005 "Critical Use Exemption" (CUE), which under the Protocol allows farmers more time to find substitutes, was agreed for up to 24 tonnes (ozone depleting potential), with only strawberry growers seeking to continue use under CUE status [28].

New Zealand is unique among OECD countries in that agriculture is a key sector in national climate change mitigation policy. The sector contributed 49% of total greenhouse gas (GHG) emissions (average 2002-04), with the main sources of emissions originating from livestock (methane). However, there has been a change in the emissions profile due to expansion in dairy and contraction in sheep numbers, while there has also been a large increase in nitrogen fertiliser use, mainly on dairy farms [29]. The growth in agricultural emissions over the period 1990-92 to 2002-04 (14%) was among the highest across the OECD (–3%) (Figure 3.20.2), but slightly below the rate of emission growth for the New Zealand economy (19%), although well above the nation's 0% commitment by 2008-12 under the *Kyoto Protocol*. New Zealand farm emissions, however, contributed only 3% to total OECD agricultural GHG emissions, and enteric methane emissions from dairy cattle per litre of milk per annum declined between 1990 and 2004 (Figure 3.20.4).

Projections suggest that agricultural GHGs will continue to grow up to 2010 but at a slower rate than over the 1990s [29]. While agriculture's capacity to ***sequester carbon*** in soils appears to have declined [13], the conversion of pasture to forestry has led to a net removal of CO_2 through forest sinks. Improvements in energy efficiency in agriculture can also help reduce or lower the rate of GHG emissions, although CO_2 emissions from fossil fuel combustion in farming are only a small share of total agricultural GHGs. ***Direct on-farm energy consumption*** grew substantially less (22%) than the increase in farm production volume (38%), over the period 1990-92 to 2002-04, suggesting an increase in on-farm energy efficiency. Dairy farming, for example, used 1% less direct energy in 2002 than it did in 1996 [2], despite the considerable increase in average production per hectare [30].

New Zealand has been identified as a "biodiversity hotspot" because of the uniqueness of its wild species [31, 32]. Trends in ***agricultural genetic resources*** show that extensive *in situ* conservation is taking place for crops, but that it is under pressure from non-native animals and plant pests. A large part of native flora is represented in *ex situ* collections, but information exchange between collections is poor [18]. For livestock genetic resources there is little information [18].

Overall conservation of wild species and ecosystems has shown mixed results over the past decade, with the decline of many native species and habitats being halted through preservation, improved management, and restoration [33]. Assessing the impact of agriculture on ecosystems and species is difficult because of a lack of data and monitoring [4], and because the interactions between farming and ecosystems are complex. While the quantity of indigenous woody vegetation is increasing with the contraction in the area under pastoral farming, there are signs that the quality of these habitats continues to deteriorate [32]. Also, the intensity and frequency of grazing of natural grasslands affects vegetation cover and the balance of dominant species.

Some farmers have entered into open space covenants through the Queen Elizabeth 2nd National Trust, a non-governmental organisation [31]. The *Trust* provides limited support to protect certain areas of farmers land while they retain ownership. Currently under 0.5% of farmland is included under the covenants. In some areas, elevated nutrient loadings of rivers and lakes from livestock have had adverse impacts on aquatic ecosystems [31]. But in some regions, however, where riparian management programmes are used, water quality has remained stable or improved, even though stock numbers have increased. In the case of the Taranaki region, for example, cow numbers doubled over the past 20 years while most water quality indicators remained the same or improved over this period [34].

3.20.3. Overall agri-environmental performance

New Zealand has a high degree of dependence on its biological assets for generating much of the nation's wealth. Levels of "natural" soil erosion for most land in the country are above the global average. Increasing climatic instability is heightening risks and costs for farmers, and is focusing attention on water resources in some drier regions. Biodiversity conservation is a challenge for farmers, but agriculture also incurs significant costs and threats associated with invasive species.

OECD projections from 2006 to 2015 indicate a continued expansion in farm production, but at a lower rate of growth than over the period 1990-2005 [35]. Higher farm output is most likely to derive from improvements in productivity rather than an extension of the area farmed or greater livestock numbers [35]. For example, the projected rise in milk production of 1.7%/annum (2006-15), in contrast to 4.4%/annum over the period 1990-2005, is expected to result mainly from raising dairy cow yields (1.2%/annum) compared to higher cow numbers (0.5%/annum).

A key impediment to adequately assessing environmental performance in agriculture is the limited availability of nationally comparable data. With the projected expansion in the agricultural sector up to 2015 [35], this heightens the widely recognised need for an improved monitoring system [2, 4] to provide a baseline for tracking the state and trends of: soil [36, 37, 38]; water [15]; biodiversity resources [32]; pesticides [23, 24]; and energy use in agriculture [30]. However, New Zealand uses indicators and other quantitative data extensively in agri-environmental policy assessment, and recently instituted a *Linked Indicator Project*, which examines a range of economic, social, cultural and environmental measures significant to communities and their well-being. These indicators will provide information to support the monitoring and reporting requirements of local authorities, and will cover both urban and rural councils. The project aims to include measures of: energy use, water use, land use and cover, economic and industry activity, as well as a range of standard of living indicators.

Policy changes and voluntary actions by farmers over the past decade suggest the future prospects of reducing agriculture's pressure on the environment are encouraging. After a phase of uncertainty following the comprehensive economic and political reforms in the 1980s, a process of stakeholder consultation, outreach and education across the agro-food sector [39], reinforced by the *Resource Management Act*, has led to growing use of environmental farm plans and farmer investment to address environmental issues [3, 40]. While the uptake of these plans by dairy farmers was initially low [39], the number of plans developed by farmers is increasing.

The 2003 agreement between the dairy industry and the government (Dairying and Clean Streams Accord) to address environmental issues, is a promising development [15, 41]. In 2004, national and local governments have agreed to fund a total package of nearly NZD 82 (USD 54) million that is intended to limit nutrient flows from agriculture into Lake Taupo, such as restrictions on land use and allowing nitrogen trading to occur [8, 16]. Research indicates that to maintain current water quality in the Lake will require a 20% reduction in nitrogen from farming and urban areas [2].

***The government has notified the strawberry industry that after 2007 it will no longer seek Critical Use Exemption of methyl bromide, under the* Montreal Protocol**. This development which should see the end of the use of this ozone depleting substance in New Zealand [28].

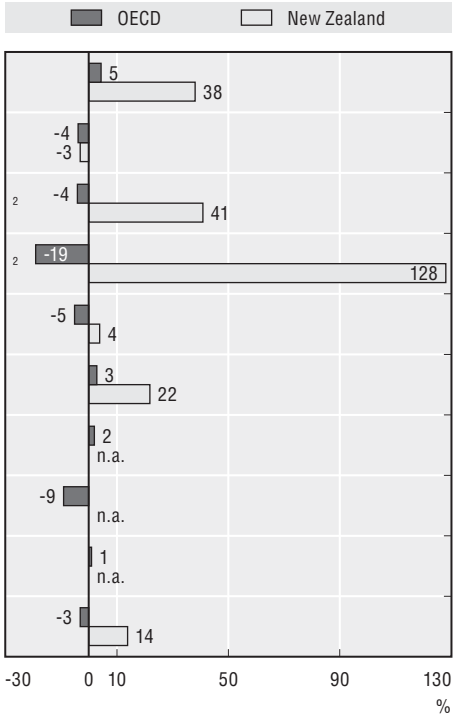
Biosecurity programmes seek to benefit productive farming and forestry systems by controlling or eradicating various pests, which may also help to enhance biodiversity conservation and bring other environmental benefits. For example, the increasingly widespread threat to nitrogen fixation in clover pasture (which accounts for over 50% of the nitrogen inputs into agriculture) from the clover root weevil (*Sitona lepidus*) may encourage farmers to use greater nitrogen fertiliser applications [2].

Overall the quality of the environment impacted by agriculture is high but there are areas of concern, especially given the projected growth in the agricultural sector over the next decade. The agricultural policy reforms from 1984 reduced environmental pressure on marginal land, especially soil erosion, and encouraged forestation and reversion to native bush. Over the 1990s up to 2004 there has been a significant intensification of agriculture, especially dairying, and further diversification, such as into deer farming, horticulture and forestry [2]. This has led, in particular, to elevated levels of nutrients in soils and water bodies, growth in direct on-farm energy consumption, and higher emissions of greenhouse gases from agriculture. Despite the growing demand for water by irrigators in certain regions where scarcity and competition are increasing, there has been little strategic consideration of regional water resources to provide incentives to invest in water or encourage irrigators to use water more efficiently. The government, however, is currently examining the water allocation system under the *Water Programme of Action* [2, 11, 16, 42, 43].

There are many initiatives to encourage greater adoption of environmentally beneficial farm management practices. Moreover, rates of adoption of environmental farm management practices have grown rapidly over the past decade [2], but overall adoption rates remain low. Over the 2000-03 period, for example, less than 30% of dairy farms were using a formal nutrient management plan and regularly testing the soil for nutrient levels, 10% of the total arable and permanent crop area was under integrated pest management [18], and only 10-12% of irrigators regularly monitor soil moisture content [2]. But a joint government and agriculture greenhouse gas research strategy was developed in 2003 to seek to lower emissions [8].

Figure 3.20.2. **National agri-environmental performance compared to the OECD average**

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



Absolute and economy-wide change/level

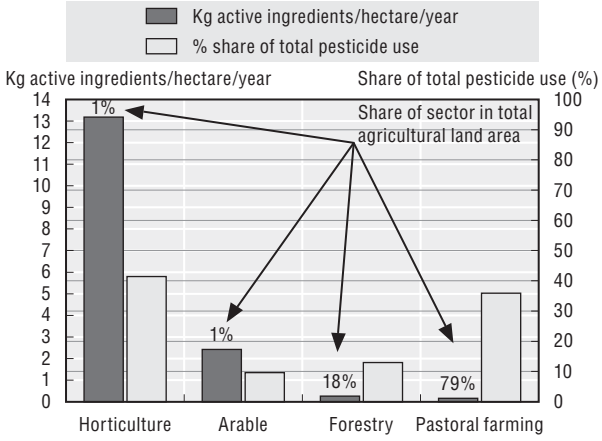
Variable	Unit		New Zealand	**OECD**
Agricultural production volume	Index (1999-01 = 100)	1990-92 to 2002-04	138	105
Agricultural land area	000 hectares	1990-92 to 2002-04	–396	–48 901
Agricultural nitrogen (N) balance	Kg N/hectare	2002-04	46	74
Agricultural phosphorus (P) balance	Kg P/hectare	2002-04	14	10
Agricultural pesticide use	Tonnes	1990-92 to 2001-03	+150	–46 762
Direct on-farm energy consumption	000 tonnes of oil equivalent	1990-92 to 2002-04	+57	+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	n.a.	+115
Agricultural greenhouse gas emissions	000 tonnes CO_2 equivalent	1990-92 to 2002-04	+4 668	–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.

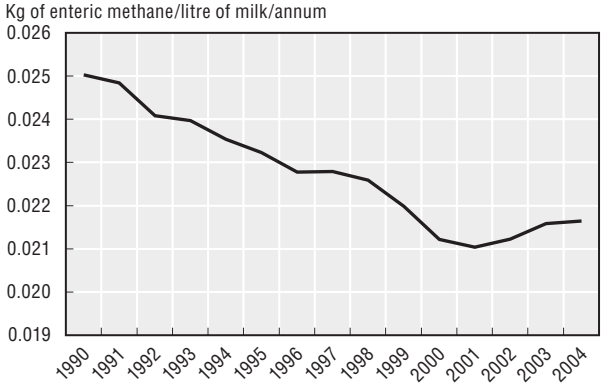
Source: OECD Secretariat. For full details of these indicators, see Chapter 1 of the *Main Report*.

Figure 3.20.3. **Sectoral use of pesticides: 2004**



Source: Ministry for the Environment, New Zealand.

Figure 3.20.4. **Dairy cattle enteric methane emissions per litre of milk**



Source: The National Inventory Report and Common Reporting Format: New Zealand's Greenhouse Gas Inventory 1990-2004 and New Zealand's Greenhouse Gas Inventory 1990-2005.

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