CHAPTER 3

Farming trends

This chapter looks at some recent farming trends in New Zealand. It begins with a broad overview and examines trends within each farming sector. It then investigates the use of natural capital and takes a closer look at the state of the environment in intensive farming areas. New Zealand does not currently have a well developed set of indicators supported by comprehensive data in this area, so the trends identified in this chapter are based on available sources of data.

3.1 Overview of farming today

New Zealand's farming systems have developed through a significant modification of the original land cover and indigenous biodiversity. Over the past century, the area of land under pasture has increased from less than two million hectares to about 14 million hectares. More than half of New Zealand's land area is now classified as farmland.[1] In general, farming in this country has gone through a series of distinct phases, as summarised below:[2]

Pre-1840s ***Exploitation of resources and early farming***

- birds and seafood provided the first settlers to New Zealand with an abundant source of food. Over time, hunting and harvesting depleted many of these sources.
- kumara gardening developed, particularly in the upper North Island.
- following the arrival of Europeans in New Zealand, native forests and populations of marine animals were further exploited and depleted before more widespread farming began.

1840s-1860s ***Extensive pastoralism***

- animals were grazed on the grasslands of the East Coast of the North Island and tussock grasslands of the South Island.
- natural limits to further production were reached by the 1870s.

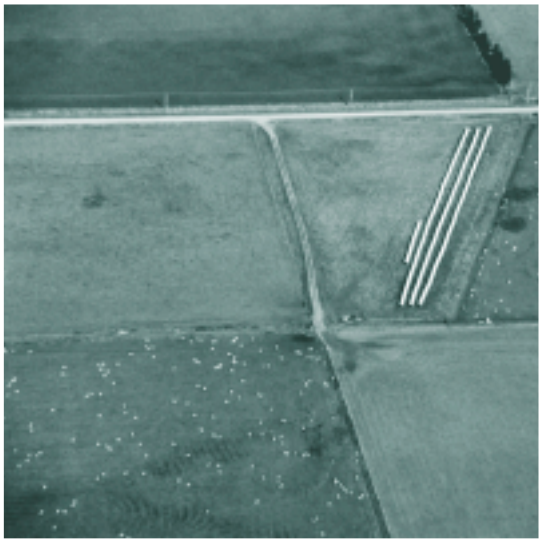
1870s-1920s ***Expansion***

- forests across much of New Zealand were cut and burned for farming.
- a wheat boom in the 1870s contributed to the rapid depletion of soils.
- the development of refrigeration in 1882, and expansion of the railway system, enabled exports of meat, butter and cheese.
- a permanent grassland system began to evolve.

1920s-1940s ***Early intensification***

- after World War I, farming settlements developed with varying success, often on unsuitable land.
- soil science and fertiliser technologies developed, and improved grass species for pasture began to be introduced.

1950s-1970s ***Diversification***



- the development of suitable pasture species (such as perennial ryegrass and clover) contributed to the 'grasslands revolution'. Affordable sources of phosphate fertilisers also helped to lift soil fertility for grazing purposes.
- new mechanical and electrical technologies were introduced, including tractors, shearing plants, electric fences, milking sheds, milk tankers and planes for aerial topdressing.
- after World War II, about 90 percent of farm products were exported to Britain.
- Britain joined the European Community in 1973 and New Zealand's status as 'Britain's other farm' ended.
- new export products such as casein and milk powder were developed as well as new markets in countries such as America, Japan and Korea.
- improved stock breeding techniques, such as artificial insemination, were developed, as well as improved pest control methods.
- horticulture, deer and goat farming expanded rapidly in the 1970s.
- the role of producer boards was expanded.
- farm output roughly doubled between 1945 and 1970.
- the level of government support for farming increased significantly during the mid 1970s in response to falling agricultural prices.

1980s-today ***Further intensification, diversification and development of certification schemes***

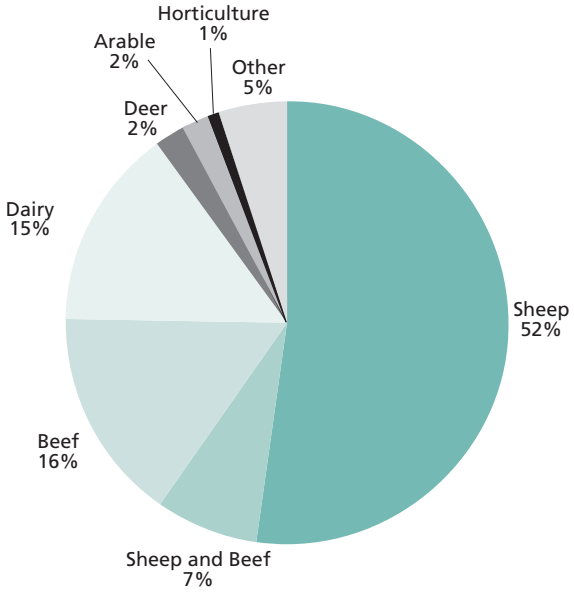
- amidst a period of massive change and upheaval in New Zealand society, the farming sector was deregulated from 1985 onwards, with all farming subsidies removed. Agricultural reforms encouraged farmers to aim for higher and higher levels of productivity (see also Chapter 4).
- farmers responded to deregulation in various ways. Since the 1980s there has been ongoing diversification into areas such as kiwifruit, forestry, viticulture and organics. As the rest of this chapter will highlight, there has also been further intensification in many farming sectors.
- the approaches taken toward intensification have differed significantly. In general, two dominant trends have emerged. While some sectors have mostly relied on more material and energy inputs to boost production volumes, others have focused on high value production and quality through various certification schemes.
- the dairy industry in particular has expanded substantially, with growing demand for dairy products as markets have globalised.

- new technologies are still being developed, including those from genetic sciences.

As this brief history suggests, farming has played a significant role in New Zealand's economy for over 100 years. Farming products, excluding forestry, earn more than 40 percent of New Zealand's export income.[3] Dairy and meat products are New Zealand's biggest single export earners. Overall, farming contributes approximately six percent of gross domestic product (GDP) in New Zealand.[4] If first-stage processing and manufacturing of products from farms are taken into account, farming contributes about 17 percent.[5] Thus, the importance of farming in New Zealand's overall economy is substantial.

As noted in Section 1.1, there are approximately 70,000 farms in New Zealand today.[6] More than half of New Zealand's land area is used for farming, excluding forestry. Figure 3.1 illustrates the land area used by different types of farming in 2002. The dominant land use for farming in New Zealand is sheep farming.

Figure 3.1 Land area distribution of different farming types in 2002 (excluding forestry)*



Source: Statistics New Zealand, 2003a

*Viticulture is included within horticulture, as vineyards make up only about 0.13 percent of the total land area farmed in New Zealand. The total area of land used for farming is approximately 14 million hectares.

Current farming systems in New Zealand vary according to climate, topography and soil types, and the farming activities undertaken. Table 3.1 details the hectares farmed and livestock numbers for the different farming sectors discussed in the report.

Table 3.1 Number of hectares farmed and livestock numbers by selected sectors of New Zealand farming, 2002.

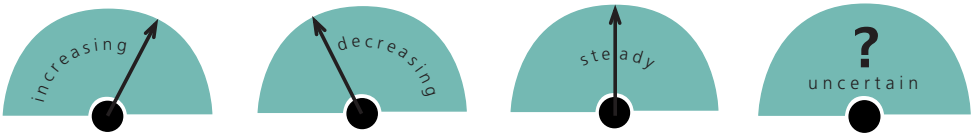
Sector	Hectares farmed	Livestock numbers
Sheep &	10,348,291	39,545,609
Beef cattle		4,494,678
Dairying	2,048,211	5,161,589
Deer	341,447	1,643,938
Cropping	123,176	-
Vegetable growing	52,721	-
Pipfruit orchards	12,680	-
Kiwifruit	12,000	-
Grape growing	17,400	-

Source: Statistics New Zealand, 2003a

3.2 Trends in farming sectors

New Zealand does not currently have a well-developed set of indicators supported by comprehensive data to thoroughly examine farming trends. The quality of information varies. Detailed data is available in some areas, but in other cases gaps are present. Some measurement systems have changed over time, making it difficult to develop a clear picture of any consistent trends. Our assessments are therefore based on the best available information. In some cases, regional data is used to illustrate a trend when national data is unavailable.

Although it has not been possible to build a complete picture, we have been able to identify the *broad* direction of trends within each farming sector. These trends are depicted as:



The focus for each sector is on:

- *scale* – hectares farmed, stock numbers, etc.
- *inputs* – nitrogen fertiliser urea,[7] irrigation[8]
- *outputs* – production volumes
- *intensity* – outputs relative to scale and inputs.

We begin with a brief overview of each farming sector and then examine trends from the mid-1990s onward. The actual years of coverage vary according to the available data.

3.2.1 Dairying

Overview

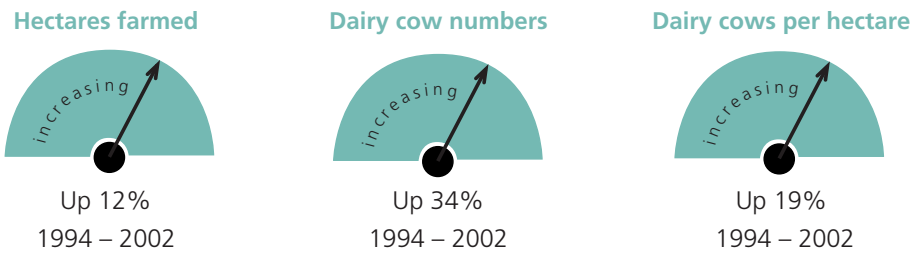
Dairying is the largest industry in New Zealand, accounting for 20 percent of export income.[9] New Zealand's dairy products make up almost a third of internationally traded dairy products.[10] The vast majority of dairy herds (83 percent) are located in the North Island.[11] Most herds supply milk on a seasonal basis for manufacturing. Cows are milked in spring, summer and autumn, but dried off in winter when pasture production is lower. The remaining herds supply milk year-round for the domestic milk industry. The seasonal milk production system has historically relied on highly productive, rotationally grazed pasture and cow herds of high genetic merit.[12] The warm climate and productive pastures of New Zealand have enabled herds to graze on pasture year-round, avoiding the need for indoor housing and expensive feed supplements that characterise some overseas systems.[13]

Trends

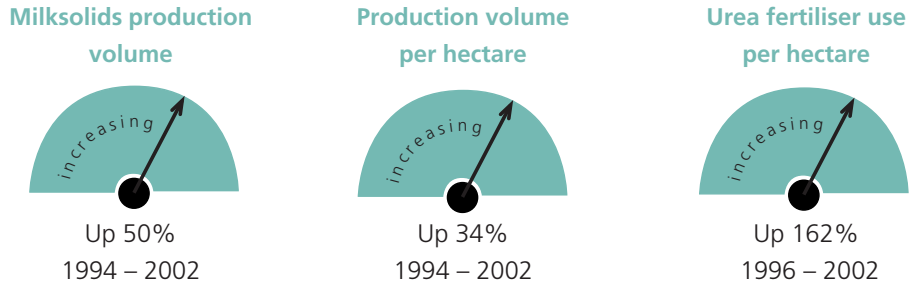
The dairy farming sector is clearly growing and becoming more intensive. Between 1994 and 2002, the number of dairy cows increased by 34 percent while the area of land directly used for dairy farming increased by only 12 percent.[14] Over this same period, production of milksolids, on a per-hectare basis, increased by 34 percent, and milksolids production per cow also increased.[15] While the size of the average dairy herd has been increasing, there has been a drop in the overall number of herds.[16] This suggests a trend toward amalgamation of farms and expansions by individual farmers.

The dominant trend in this sector is a move away from traditional pasture-based systems toward systems that are highly dependent on inputs from outside the farm. A key feature is the increasing use of feed supplements such as maize and cereal silage. Maize silage is now the single biggest crop grown in the arable sector, with over a million tonnes produced in the year to June 2002 (see also Section 3.2.6).[17]

The use of synthetic fertilisers based on fossil fuels on dairy farms is also increasing. Total energy input into the average New Zealand dairy farm has doubled over the last 20 years, mostly due to the increase in nitrogen fertiliser usage.[18] Dairying is also expanding into relatively dry regions such as Canterbury and Otago where significant irrigation is required to enable intensive dairy farming.



Source: Statistics New Zealand, 2003a



Source: Statistics New Zealand, 1996; Statistics New Zealand, 2003a; Livestock Improvement Corporation Limited, 2003

3.2.2 Sheep and beef[19]

Overview

The meat industry is one of New Zealand's oldest industries. Over 90 percent of sheep meat produced in New Zealand is exported, amounting to about 55 percent of the world's export trade.[20] Eighty-three percent of beef production is exported, which makes up around eight percent of world beef exports.[21]

There is a wide range of sheep and beef farm types and systems that vary according to land type, topography, climate, scale, and farmer preference. Many farms have both sheep and beef cattle, which complement each other in pasture-based grazing systems. Some farms also run deer or cultivate arable crops. Traditionally, sheep and beef farms have run on low input pasture grazing systems, sometimes supplemented with hay, silage and fodder cropping.[22]

Trends

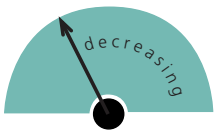
Sheep numbers nationally fell by 42 percent between 1980 and 2003.[23] Sheep numbers peaked in 1982 at 70.3 million.[24] Beef cattle numbers also decreased, by 13 percent between 1980 and 2003.[25] Beef cattle numbers peaked in 1975 at 6.3 million.[26] However on intensive sheep and beef farms, beef cattle numbers have risen between 44 percent and 77 percent in the same period.[27] Stock units per hectare on intensive farms have declined, from between 10.8 and 13.4 in 1981 to between 10.2 and 12.6 in 2002.[28]

Despite the decline in livestock numbers, national production from sheep and beef farms has increased. Lambing rates nationally have increased 25 percent between 1980 and 2003.[29] Calving rates have remained relatively stable.[30] The most significant change has been the increase in livestock weights. The export carcass weight of lamb has increased 25 percent between 1980 and 2003. Similarly, mutton carcass weight has increased 18 percent and beef carcass weight has increased by 13 percent.[31] Thus the increase in production in the sheep and beef sector has not been achieved through increased stocking

rates, but rather through increased lambing rates and livestock weights. Both improved lambing rates and livestock weights are partly a result of improved animal nutrition, which is largely due to an increase in fertiliser use by these sectors.[32]

Fertiliser use in the sheep and beef sector generally has increased. Although fertiliser use per hectare is far below that of the dairy sector or some horticultural sectors, the sheep and beef sector covers a far larger land area. There has been an increase in fertiliser use in the intensive sheep and beef sector of between 24 and 28 percent between 1991 and 2002.[33] In the 2001-2002 year on North Island Hill farms an average of 309 kilograms per hectare of fertiliser was applied to pasture; on North Island Intensive Finishing farms, 352 kilograms per hectare; and on South Island Intensive Finishing farms 345 kilograms per hectare was applied.[34] The amount of nitrogen contained in the fertilisers used on intensive sheep and beef farms has also increased. For example between 1991 and 2002 on North Island Intensive Finishing farms the percent of nitrogen in the fertiliser applied to pasture increased from 1.3 percent to 4.2 percent.[35]

Hectares farmed: intensive farms



Down 7%
1981 – 2002

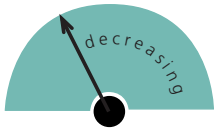
Sheep numbers on intensive farms

Down 20% on North Island farms and up 28% on South Island farms
1981 – 2002

Beef cattle numbers on intensive farms

Up between 44-77%
1981 – 2002

Stock per hectare on intensive farms



Down between 5-20%
1981 – 2002

Source: MWES, 1982; MWES, 2003a; MWES, 2004

Lambing rates on intensive farms

Up between 11-19%
1981 – 2002

Fertiliser use on intensive farms[36]

Up between 168-263%
1991 – 2002

Fertiliser use per hectare on intensive farms[37]

Up between 24-28%
1991 – 2002

Source: MWES, 1982; MWES, 1992; MWES, 2003a

3.2.3 Deer

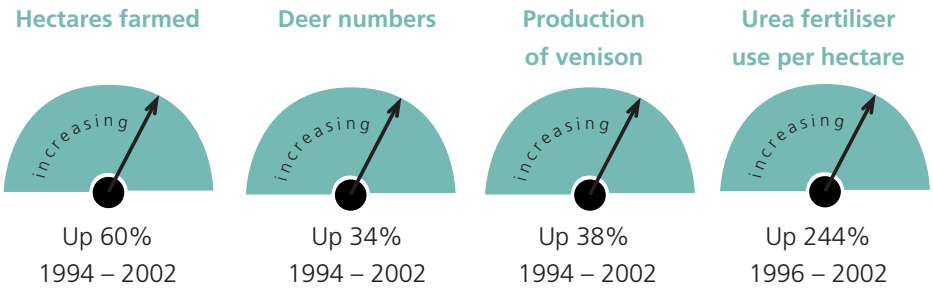
Overview

The New Zealand farmed deer industry began over 25 years ago, providing venison, velvet and other products for export. New Zealand is the world's largest producer and exporter of

farmed venison, 90 percent of which goes to Europe.[38] Deer are frequently run as a secondary enterprise in conjunction with other pastoral livestock, but there are nearly 2,000 farms where they provide over 50 percent of revenue.[39] These specialist farms carry 63 percent of all deer.[40] Deer are farmed in all regions of New Zealand, but are most common in Canterbury, the Bay of Plenty and Southland. Most deer graze on pasture, but supplementary feeds in winter may include silage, hay or grain.[41]

Trends

The number of hectares farmed, deer numbers, and the production volume of venison have all increased in recent years. Deer per hectare and production of venison per hectare vary from year to year, due in part to world prices. If prices are low farmers may keep their stock from slaughter until the following year, when prices hopefully improve. Urea fertiliser usage has also increased significantly in this sector.



Source: Statistics New Zealand, 1996; Statistics New Zealand, 2003a

3.2.4 Horticulture

Overview

Fruit growing accounts for about 40 percent of horticultural land use in New Zealand, with vegetable growing accounting for the remainder.[42] Key fruit crops include kiwifruit and apples. Major vegetable crops include potatoes, onions, peas and beans, squash and sweet corn. Avocados, capsicums and carrots are emerging export earners.

Crops, orchards and market gardens are generally classified as intensive forms of land use, requiring high inputs of fertilisers, mechanical energy, labour, pesticides and herbicides.[43] Crop volumes produced can vary greatly from year to year due to factors beyond the control of growers, such as climate (e.g. frost and hail), pests, and levels of pollination.

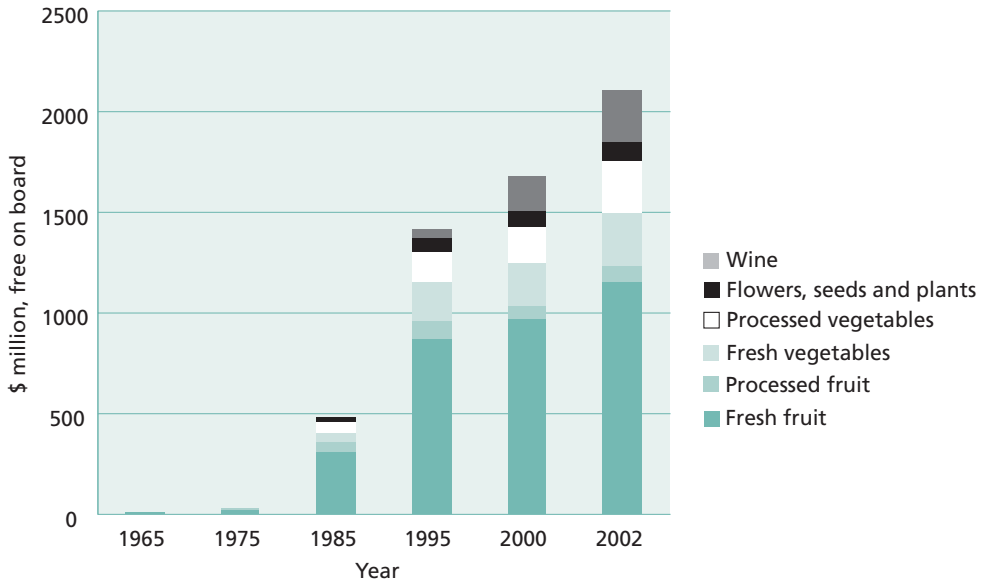
Trends

The overall size of the horticulture sector, in terms of hectares farmed, is gradually increasing—up six percent between 1994 and 2002.[44] Horticultural exports have increased phenomenally in the last 25 years (see Figure 3.2). Trends vary according to crop. For example, between 1994 and 2002 the change in *hectares farmed* for the following

crops were:

- *apples* – decreased by 24 percent
- *kiwifruit* – increased by 2 percent
- *onions and potatoes* – both increased by 12 percent
- *squash* – decreased by 12 percent
- *avocadoes* – increased by 121 percent.[45]

Figure 3.2 Horticultural exports from New Zealand 1965 to 2002 ($million, free on board).



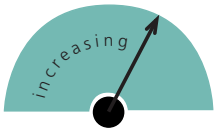
Source: HortResearch, 2002

The area of land under irrigation for horticultural use has increased markedly, from 26,623 hectares in 1985 to 79,692 hectares in 2002, including viticulture.[46] The intensity of nitrogen fertiliser use differs according to horticultural crop. For example, the vegetable sector applied an average of 167 kilograms of urea per hectare in 2002, whilst the kiwifruit sector applied 75 kg/ha, and the pipfruit sector applied 43 kg/ha.[47] Between 1996 and 2002, urea application per hectare increased by 49 percent in the kiwifruit sector and 3 percent in the pipfruit sector.[48]

Unfortunately, 1994 urea figures were unavailable for the vegetable sector, so no comparison between years can be made. However, available figures for another nitrogen fertiliser, diammonium phosphate (DAP) between 1996 and 2002 show that there was a 150 percent increase in DAP application per hectare by this sector.[49]

The broad trend in horticulture is toward environmental management systems that reduce pesticide use, though the picture varies according to crop type.

Hectares farmed



Up 6%
1994 – 2002

Land under irrigation

Up 199%
(including viticulture)
1985 – 2002

DAP fertiliser use per hectare

Up 150%
in the vegetable sector
1996 – 2002

Source: Statistics New Zealand, 1996; Statistics New Zealand, 2003a; Lincoln Environmental, 2000c

3.2.5 Viticulture

Overview

Although vineyards only make up a small proportion of farming land in New Zealand, the wine industry has grown dramatically over the last two decades. Wineries are now found in ten out of 12 New Zealand regions. The three largest wine grape production areas are Marlborough, Hawke's Bay and Gisborne. New Zealand is a niche producer of quality wines, making up less than 0.5 percent of global wine production.[50] Average selling prices in major export markets are high by international standards. Most New Zealand wineries are small. Only 10 wineries produce more than 2 million litres of wine per year, 35 wineries produce between 200,000 and 2 million litres of wine and the remaining 376 produce less than 200,000 litres.[51]

Trends

There were 421 wineries in New Zealand in 2003, compared with 190 in 1994.[52] The area of land planted in wine grapes grew by 142 percent between 1994 and 2002.[53] Much of this recent planting is just starting to come into production. Irrigated viticultural land has increased in the last 20 years, and is now more than 12,000 hectares (see Figure 3.3 – viticulture is included within horticulture data on the graph).[54]

Hectares farmed

Up 142%
1994 – 2002

Production: tonnes of wine grapes

Up 66%
1990 – 2002

Source: Statistics New Zealand, 2003a; http://www.nzwine.com/statistics

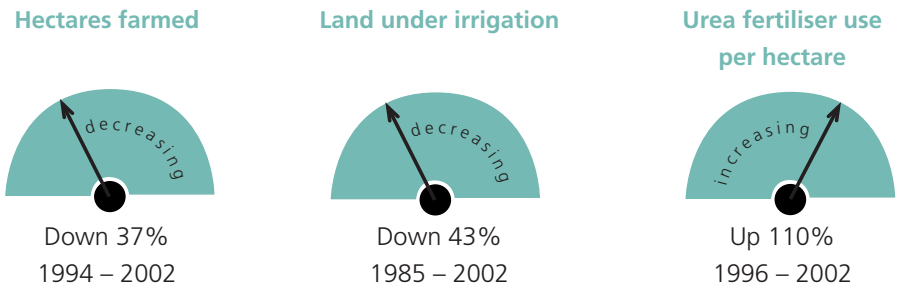
3.2.6 Arable crops

Overview

The arable industry produces milling, malting and feed grains, including wheat, barley, maize, oats and peas. New Zealand is a relatively small player in world grain production terms with less than 0.5 percent of world production.[55] The industry is located primarily in Canterbury, which produces 80 percent of the total crop, but production is also significant in Southland, Otago, Manawatu, Hawke's Bay and the Waikato.[56] Arable farms usually run a variable but significant number of livestock as well, including sheep, beef cattle, dairy cattle or deer.

Trends

The overall size of the arable sector is shrinking, and is becoming increasingly focused on producing silage for the dairy industry. Maize silage is now the single largest crop.[57] While arable land under irrigation has decreased, urea application on a per hectare basis by the arable sector has increased.[58]



Source: Statistics New Zealand, 1996; Statistics New Zealand, 2003a; Lincoln Environmental 2000c

3.3 Trends in the use of inputs

This section examines some key inputs to farming in New Zealand. It looks at recent trends in water use for irrigation as well as nutrient/fertiliser inputs and energy use. The trends identified are based on available data and research.

3.3.1 Water for irrigation

The area of irrigated land in New Zealand has been increasing at a rate of about 55 percent each decade since 1965 (see Figure 3.3). Water abstraction from irrigation schemes is also increasing steadily. Most of New Zealand's irrigated land (70 percent) is located in the Canterbury region, and it is here that irrigation pressures are most obvious.[59]

Water is an increasingly critical component of New Zealand's rural economy. The move to more intensive farming systems is usually accompanied by a demand for increased quantity and reliability in water supply. Irrigation undoubtedly supports farming, water being the key to plant growth and hence farm productivity. However, irrigation can also contribute to the development of farming systems that require higher inputs of fertiliser and energy as well as water. For example, irrigated dairy farms use nearly double the electricity of non-irrigated dairy farms (30.6 gigajoules per hectare compared to 16.9).[60] Similarly, nitrogen

fertiliser use is much greater on dairy farms with irrigation (135 kilograms of nitrogen per hectare compared to 68 on non-irrigated dairy farms).[61] Chapter 5 looks at irrigation issues in much more detail.

Land under irrigation

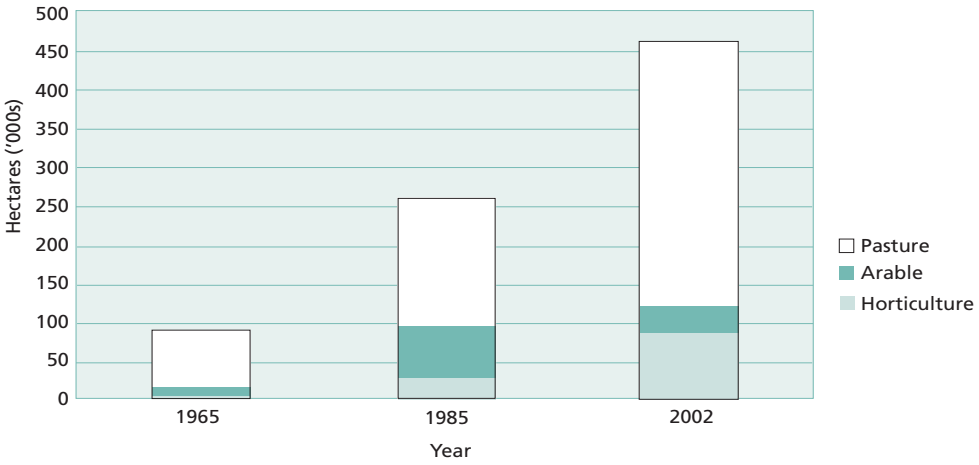
Increasing at a rate of around 55% nationally each decade

Water abstraction

Increasing for both surface and groundwater abstraction in the Canterbury region

Source: Lincoln Environmental 2000c; Statistics New Zealand, 2003a

Figure 3.3 Hectares under irrigation in New Zealand



Source: Lincoln Environmental 2000c; Statistics New Zealand, 2003a

3.3.2 Nutrients and fertilisers

Synthetic fertiliser usage across most farming sectors has increased significantly in New Zealand in recent years.[62] In particular, use of nitrogen fertiliser in New Zealand has soared, as has the proportion of total fertiliser being applied as nitrogen. This trend highlights a new technology that has moved from being innovative in the early 1990s to mainstream and widely adopted in 2001. The *intensity* of nitrogen fertiliser use, that is, the amount of fertiliser applied *per hectare* in New Zealand also increased in most sectors. For example, the intensity of urea use increased by 670 percent in the sheep and beef sector and by 160 percent in the dairy sector between 1996 and 2002.[63] Although there has been a huge increase in urea use by the sheep and beef sector, per hectare use is still *far below* that of the dairy sector or some horticultural sectors.

New Zealand is moving away from systems that use natural processes for providing nitrogen in soil to a greater reliance on synthetic substitutes.

In general, New Zealand is moving away from systems that use natural processes for providing nitrogen in soil (e.g. nitrogen-fixing clover in pasture) to a greater reliance on synthetic substitutes. Chapter 5 looks at nutrients and fertilisers in more detail and considers the risks and challenges associated with current trends.

Synthetic fertiliser consumption

Up 21%
1996 – 2002

Nitrogen fertiliser: urea consumption

Up 160%
1996 – 2002

Source: Statistics New Zealand, 1996; Statistics New Zealand, 2003a

3.3.3 Energy

The energy required to produce a good or service is called *direct energy*, while *indirect energy* is the energy embodied in products that are consumed in producing the good or service. Overall, the amount of direct energy used by the farming sector increased by about 30 percent between 1992 and 2002.[64] More recently, direct energy use has increased in some farming sectors and decreased in others. For example, dairy farming used about one percent less direct energy in 2002 than it did in 1996, despite increased production during the period.[65]

However, these figures do not account for all of the energy used in farming. Energy is used indirectly in the manufacture of farm inputs such as fertiliser and machinery. Given the significant increases in the use of fossil fuel derived fertilisers over recent years, New Zealand farmers are generally using much more energy to grow food on their farms.

Direct energy use

Increasing gradually, but generally by less than the increase in economic activity

Indirect energy use

Growing significantly due to increasing use of fossil-fuel based fertilisers

Source: EECA, 2003; Statistics New Zealand, 2003a

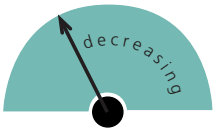
3.4 Trends in the state of natural capital

This section looks at the state of natural capital in intensive farming areas, based on available data and research. The primary focus is on water, although trends for soil and atmosphere are also discussed.

3.4.1 Water

Water quality in areas of intensive pastoral farming is poor relative to the Ministry for the Environment microbiological water quality guidelines and Australian and New Zealand Environment Conservation Council (ANZECC) water quality guidelines—a fact known for many years.[66] Water quality declines markedly in lowland streams and rivers in pasture-dominated catchments. Many rivers draining farmland are unsuitable for swimming because of faecal contamination from farm animals, poor water clarity, and nuisance algal growths caused by excess nutrients. Furthermore, groundwater quality in aquifers that exist under pastoral farming areas, in particular dairying areas, tend to have elevated nitrate concentrations sometimes exceeding drinking water standards.[67]

Surface water quality



Most rivers in farming areas, particularly in lowlands, generally fail to meet recommended guidelines as a result of contamination from increased nutrients, turbidity and animal faecal matter.

Groundwater quality

Although the state of groundwater quality is not known comprehensively at a national level, many shallow aquifers beneath dairying or horticultural land have elevated nitrate levels.

In those regions with intensive farming systems, such as Waikato and Canterbury, where data has been gathered, declining water quality has been confirmed in some areas. Chapter 5 looks at these issues in more detail. More detailed information on trends and issues relating to water in the Canterbury, Hawke's Bay, Southland and Waikato regions follows.

Water trends in the Canterbury Region

Water allocation and abstraction

Surface water

The volume of surface water allocated for abstraction doubled between 1985 and 2001. There is a concern that some rivers are currently over allocated.

Groundwater

Regional groundwater allocation increased by 50 percent between 1996 and 2001.

Water quantity

Surface water

Average surface water flows were almost all below their long-term means. ECan attributes this trend primarily to climatic conditions, with increases in surface water abstraction having a minor effect.

Groundwater

In some areas the magnitude of annual groundwater level variations has increased in response to growing groundwater abstraction.

Surface water quality

Microbiological

In 2000-2001, 28% of sites tested for microbiological water quality were in 'alert' mode, 10% in 'action' mode and 62% were considered acceptable.

Inorganic

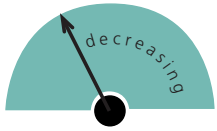
Concentrations of nutrients in the main rivers are considered to be low but they increase downstream and are worst closest to the coast.

Groundwater quality

Microbiological

Microbial contaminants are found in approximately 10-15 percent of groundwater samples abstracted from wells.

Inorganic



Nitrate concentrations are above drinking water standards in localised areas, but elevated concentrations are widespread over some areas, and there are indications that concentrations are increasing.

Future demand

Proposed irrigation schemes

Proposed schemes include:

- Central Plains water enhancement scheme (84,000 ha)
- Rangitata South irrigation scheme (20,000 ha)
- Barhill Chertsey irrigation scheme (40,000 ha)
- South Canterbury augmentation and irrigation development (Aoraki) (30,000 ha).

Regulatory framework

Environment Canterbury notified its Proposed Natural Resource Regional Plan for public submissions on 3 July 2004. Chapter 4 of the plan deals with water quality; Chapter 5 deals with water quantity; Chapter 6 deals with beds and margins of rivers and lakes; and Chapter 7 deals with wetlands.

Source: Environment Canterbury, 2002a; Environment Canterbury, 2004; Lincoln Environmental, 2002

Water trends in the Hawke's Bay Region

Water allocation and abstraction

Surface water

20% decrease in number of surface water consents, but 65% increase in number of hectares irrigated between 1995 and 2003. Although more water has been allocated, it is used over more hectares. This suggests an overall increase in efficiency.

Groundwater

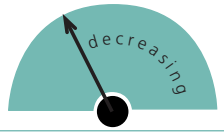
9% increase in the number of groundwater consents granted between 1996 and 2003, 89% of which have been for irrigation.

Water quantity

Surface water

Hawke's Bay rivers are extremely variable. Up to 40 years of flow records and 100 years of rainfall records show no significant trends at either regional or sub-regional level. The variability in river flows is attributable to variability in climate patterns rather than increasing use, or climate-driven changes in trends.

Groundwater



Generally sufficient to meet irrigation and domestic demands. However in some localised areas pressure on the resource may occur. Water levels in 51% of monitored wells are declining by less than 1 metre/10 years. 11% of wells are declining by between 1 and 2 metres/10 years. Water levels in 17% of wells are increasing.

Surface water quality

Microbiological

Microbiological water quality across the region is generally good and compares favourably with River Environment Classification standards. Data suggests that water quality in the region is decreasing over time. However, HBRC attributes this primarily to flow levels rather than human-induced changes.

Inorganic

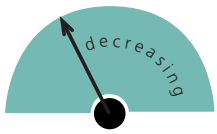
Inorganic water quality across the region is generally good, although there are some areas with elevated nitrate-nitrogen concentrations. Data suggests that water quality in the region is decreasing over time, however, HBRC attributes this primarily to flow levels rather than human-induced changes.

Groundwater quality

Microbiological

Currently water in monitored wells is generally good across the region. Only one of the monitored wells exceeded the drinking water standards for faecal coliforms. No trend for microbiological determinants

Inorganic



Currently water in a number of monitored wells exceeds drinking water standards. Median manganese concentrations exceed health standards at 7 wells (of 48 monitored). Aesthetic manganese and iron standards are commonly exceeded across Hawke's Bay. Generally there have been increasing trends in pH, ammoniacal nitrogen, nitrate, manganese, iron, chloride and soluble reactive phosphorus in wells.

Future demand

Proposed irrigation schemes

There is interest in developing irrigation schemes but no firm proposals. Individual users are increasingly aware of the greater certainty provided by groundwater

Regulatory framework

- Proposed Regional Resource Management Plan 1998 sets cap on amount of surface water for irrigation
- Minimum flow set for all streams and rivers
- Plan provides for what exists but does not provide for future demands, pressures and uncertainties.

Source: Hawke's Bay Regional Council; Hawke's Bay Regional Council, 2004

Water trends in the Southland Region

Water allocation and abstraction

Surface water

The volume of surface water allocated for abstraction has remained largely unchanged over the last decade.

Groundwater

Regional groundwater allocation has increased significantly (+100%) since 2000. Much of this increase has been for pasture irrigation.

Water quantity

Surface water

Since 1998, average surface water flows were almost all below their long-term means. Environment Southland attributes this trend entirely to climatic conditions.

Groundwater

Current levels of groundwater allocation have had limited effect on the magnitude of seasonal groundwater level variation

Surface water quality

Microbiological

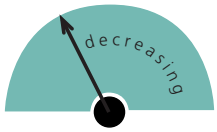
In the decade prior to 2001, contamination levels had increased in the Mataura River, but remained steady elsewhere. Recent trends uncertain.
In 2003, 10 bathing sites were routinely monitored. In terms of suitability for recreation, four were 'good' or 'very good', five were 'poor' and one was 'very poor'.

Inorganic

In 2000, concentration of nitrogen in streams draining developed catchments generally exceeded periphyton guidelines. Levels appear to have remained steady since then. Phosphorus levels within guidelines, but some increase is evident due to anthropogenic and/or climatic factors.

Groundwater quality

Microbiological



Microbial contaminants are found in a significant number of bores however their occurrence is strongly correlated with the standard of bore construction and adequacy of wellhead protection. Some decrease in levels of contamination is indicated.

Inorganic

Groundwater quality in many areas shows some impact resulting from agricultural land use. Overall groundwater quality remains well below maximum drinking water standards at the majority of locations. Trends uncertain due to short record.

Future demand

Proposed irrigation schemes

While the demand for pasture irrigation continues, especially in northern Southland, there are no apparent plans for large scale irrigation schemes.
The Southland Water Demand Study (2003) concluded that irrigation demand for water was likely to continue in a number of areas of Southland.

Regulatory framework

- Environment Southland notified a Proposed Regional Fresh Water Plan (PRFWP) in October 2000.
- A Variation to the PRFWP was notified in July 2004. The purpose of the Variation is to incorporate a new framework for allocating groundwater into the Water Plan to address the increased demand for groundwater that has occurred in recent years.
- Environment Southland is currently considering initiating a Variation to the PRFWP to update the existing water quantity provisions of the Plan.

Source: Environment Southland

Water trends in the Waikato Region

Water allocation and abstraction

Surface water

In 2002, 560,000 m^3/day of surface water was allocated for consumptive use such as irrigation and water supply.
Many waterways in the region are reaching their allocation limits. Much of the recent pressure has come from irrigation takes.

Groundwater

In 2002 there were 339 consents to take groundwater amounting to 547,000 m^3/day. 39% of the consents were for irrigation. However this amounted to only 9% of the groundwater allocated.
There has been a 61% increase in amount of groundwater allocated between 1987 and 2002.

Water quantity

Surface water

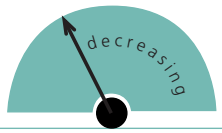
Changes in discharge are generally related to climate influences. There is natural variation from year to year in the range of plus or minus 40% of the long-term average discharge. The allocation limits in the Regional Plan limit the depletion effects due to surface water takes.

Groundwater

Most areas in the Waikato region have low stress from groundwater abstraction, with less than 10% of available groundwater being used. Thirteen areas are under high pressure, with more than 30% of available groundwater being used.

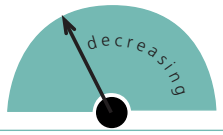
Surface water quality

Microbiological



Water quality for contact recreation in rivers is generally good in the Upper Waikato River and in rivers and streams in the Taupo and Coromandel areas. It is poorer in areas where land use is more intensive.
A 2002 study found that median *E. coli* concentrations in 53 of 73 stream and river sites sampled in the region, exceeded the guideline for freshwater recreation.
3 of 69 sites monitored across the region had increases in *E. coli* concentrations between 1998 and 2002. 62 sites showed no significant trends.

Inorganic



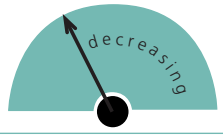
Water quality for ecological health is generally good across the region, however it is poorer in intensively farmed areas.
More than 90% of streams in intensively farmed catchments in the region have moderate to high levels of nitrogen.
Across the region as whole, monitoring between 1987 and 2002 indicates a general decline in water quality (increased total nitrogen, total phosphorus, decreased dissolved oxygen and pH).

Groundwater quality

Microbiological

Localised microbial contamination of groundwater is a problem in some coastal areas, due to septic tanks.
At present there is little information about microbial contamination of rural groundwater, however a study of 40 wells in Matangi found that 12.5% were contaminated with faecal coliforms.

Inorganic



Nitrate contamination levels in groundwater commonly exceed drinking water guidelines.
Nitrate concentrations are increasing in many areas.
Pesticide residues at generally low levels have been detected in areas of frequent use. They commonly relate to historic practices.

Future demand	Regulatory framework
Proposed irrigation schemes	
 There are currently no proposed irrigation schemes. Future demand will come from individual takes and not from irrigation schemes.	• Proposed Waikato Regional Plan is the main planning framework for managing water resources in the Waikato Region. • Environment Waikato proposes to address non-point source discharges through a combination of education and encouragement and conditions on permitted activities, to gradually change identified inappropriate farming practice. More stringent conditions and standards may be used in regulatory methods in the future if no improvement in water quality is detected. • The Clean Streams project aims to encourage and support farmer efforts to reduce the impacts of farming on waterways. Advice and financial support of up to 35 percent of farmers' costs for fencing and planting waterway margins is available. The project runs for 10 years and EW has committed up to $10 million. • The Protecting Lake Taupo Project proposes regulatory control of non-point source discharges to the lake supported by education, advice, research on low nitrogen farm systems and land use and public funds to reduce nitrogen discharges to the lake.

NB: Environment Waikato measures water quality for contact recreation by assessing water clarity and *E.coli* levels in rivers and streams. It measures water quality for ecological health by assessing dissolved oxygen, pH, turbidity, ammonia, temperature, nitrogen and phosphorus levels in rivers and streams.

Source: Environment Waikato

3.4.2 Soil

New Zealand loses between 200 and 300 million tonnes of soil to the oceans every year.[68] This rate is about 10 times faster than the rest of the world, and accounts for between 1.1 and 1.7 percent of the world's total soil loss to the oceans, despite a land area of only 0.1 percent of the world's total.[69]

Soil erosion is thus a significant issue across much of agricultural New Zealand – from extensive hill country grazing to more intensive types of farming such as horticulture.[70] This is partly because of the mountainous terrain and maritime climate. However, soil erosion can also be accelerated by land clearance and unsuitable land management practices (e.g. grazing on steep slopes, over-stocking). Farmed land in New Zealand has an average of only 15 centimetres of topsoil.[71] Moderate to slight erosion affects over half of the country, and almost 10 percent of the country has severe to extreme erosion.[72] The 1997 State of New Zealand's Environment report concluded that about 30 percent of New Zealand is able to sustain pastoral farming without significant erosion problems, and a further 28 percent can support limited livestock grazing provided it was accompanied by erosion management measures.[73]

The annual economic cost to New Zealand of soil erosion and sedimentation was *conservatively* estimated at $127 million in 1998.[74] However, it is unclear how much of this soil erosion can be attributed to farming given New Zealand's high background erosion rates reflecting tectonism and steep topography.

The loss of this precious, non-renewable resource is a major issue, and so too is the downstream effect that sediment has on waterways and estuaries. Sediment from farming activities can enter waterways and harm aquatic ecosystems by reducing light penetration and visual clarity, and by sedimentation. Chapter 5 discusses the effects of soil erosion on water quality and aquatic ecosystems in more detail.

3.4.3 Atmosphere

Certain gases present in the atmosphere trap heat from the sun and help to maintain the Earth's climate. This natural phenomenon is called the greenhouse effect. In the past 50 to 100 years, atmospheric concentrations of certain greenhouse gases such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) have been rising at an increasing rate. This is contributing to global warming, which is also affecting weather patterns and climatic conditions (i.e. it is leading to climate change).

In New Zealand, the farming sector contributes over half of the country's greenhouse gas emissions, compared to an average share of less than ten percent in other countries.[75] The main greenhouse gases emitted through farming are methane and nitrous oxide. Nearly all of New Zealand's methane emissions originate from the belching of ruminant animals (cattle, sheep, deer and goats).[76] Ruminants produce methane in their rumen (forestomach) as a by-product of digestion. Nitrous oxide emissions are produced by soil bacteria. The major source of nitrogen for these processes is animal waste (urine and dung). Nitrous oxide emissions are also associated with the use of nitrogen-based fertilisers.

The farming sector is responsible for around 90 percent of New Zealand's methane emissions and more than 90 percent of nitrous oxide emissions.[77] These two greenhouse gases are both more potent in terms of their global warming effect than carbon dioxide (methane is 21 times more potent and nitrous oxide 310 times).[78]

According to the latest estimates, greenhouse emissions from New Zealand's farming sector are currently about 15 percent above 1990 levels.[79] The most significant changes have been in the dairy sector, where methane emissions have increased by 65 percent since 1990 due to the increase in stock numbers.[80]

Greenhouse gases

Up over 15%
1990 – 2002

Source: New Zealand Climate Change Office, 2004a

3.5 Other trends

3.5.1 Social trends

Although the primary focus of this report is on natural capital, it is also important to consider some social trends in rural areas of New Zealand. There have been some substantial social shifts across rural New Zealand in recent decades. As a Ministry of Agriculture and Forestry report has commented:

> ***Until recently, at least, most rural communities have functioned as close-knit groups, frequently focused around the activities of sporting clubs, churches, schools and pubs. Today, the characteristics of many rural communities have changed. Rural depopulation and a drop in traditional employment opportunities have resulted in a decline in the importance of the agricultural population relative to other rural residents...These changes have occurred in combination with the closure of many rural churches, schools, banks and other traditional facilities. Together these changes have had a fundamental effect on community dynamics.***[81]

Some recent trends include:

- *schools* — rural schools often play a major role in holding the fabric of rural communities together. Many schools in rural areas are currently under threat of closure.[82]
- *health services* — there are ongoing challenges to recruit and retain health professionals and to maintain high quality health services in rural areas.[83]
- *population* — both depopulation and repopulation have occurred in rural areas over time. The rural population has decreased by about 12 percent over the last 50 years, but is now growing gradually (albeit much more slowly than the urban population).[84] It is often difficult to retain younger people in particular in rural areas.[85]
- *employment* — employment opportunities in rural communities often fluctuate, but there has been a general increase in employment in the farming sector in recent years. However, there have also been significant labour and skill shortages in this sector, sometimes co-existing with substantial levels of local unemployment.[86]

3.5.2 Human capital trends

The Ministry of Agriculture and Forestry commissioned a report in 2000 to examine student numbers in farming fields of study and to compare skill and knowledge requirements in the farming sector with the education opportunities available. The resulting report found that enrolments in farming and forestry courses declined overall during the 1990s — especially in universities. [87] If this trend continues, the development of human capital in the farming sector may be impeded.

3.5.3 Science and research trends

During interviews for this investigation, we found deep concerns about aspects of the contribution that science is making to the future of farming in New Zealand. For many farmers, processors, councils, investors and science teams, the concern is not so much about what *is* being done, which is generally regarded very highly. The concern is more about what is *not* being done and how what is being done is being communicated and implemented.

We conducted a review of Foundation for Research Science and Technology (FRST), Ministry of Agriculture (MAF), Marsden Fund and Ministry for the Environment (MfE) funding and research. Our initial analysis suggests that there is significantly less research into the natural resources necessary for farming (such as water and soil) than research into the manipulation of natural resources for farming and into farm management practices to improve production. It is important to acknowledge that some of the research into improving farm products will make a contribution to the understanding of the health and functioning of natural resources. There is some excellent work underway, such as research into land management practices and managing the environmental effects of those practices, supported by the MAF Sustainable Farming Fund.

Over the last year FRST has been revising its research investment portfolios to better reflect Government priorities for knowledge development and wealth creation. This is further discussed in Chapter 6.

3.6 Summary and key points

Farming in New Zealand has changed enormously over the past century. Trends during the last decade include:

- *dairy farming* — there is a general move away from traditional pasture-based systems towards systems that are highly dependent on external inputs. There has been a major increase in the use of urea fertiliser. Dairying is also expanding into relatively dry regions where significant irrigation is required.
- *sheep and beef farming* — although there has been an overall decrease in the number of sheep and beef cattle in New Zealand, stock numbers have increased on intensive sheep and beef farms. Lambing rates nationally have increased significantly. Livestock weights have also increased, partly due to improved animal nutrition. This has been enabled partly through the use of significantly more fertiliser to boost pasture growth.
- *deer farming* — deer numbers, hectares farmed and production volumes have all increased in recent years. Urea fertiliser use has also increased significantly in this sector.
- *horticulture and viticulture* — the overall size of these sectors, in terms of hectares farmed, is gradually increasing. The area of land under irrigation has also increased significantly. A positive trend in the horticulture and viticulture sectors is toward Environmental Management Systems that reduce pesticide use.