



Getting the balance right

The effect of water quality proposals on the New Zealand economy

NZIER report to the New Zealand Fish and Game Council, Forest and Bird and Greenpeace

September 2019

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice.

We undertake and make freely available economic research aimed at promoting a better understanding of New Zealand's important economic challenges.

Our long-established Quarterly Survey of Business Opinion (QSBO) and Quarterly Predictions are available to members of NZIER.

We pride ourselves on our reputation for independence and delivering quality analysis in the right form and at the right time. We ensure quality through teamwork on individual projects and critical review at internal seminars and by peer review.

NZIER was established in 1958.

Authorship

This paper was prepared at NZIER by Peter Wilson and Eugene Isack.

It was quality approved by Laurie Kubiak.

The assistance of Christina Leung, Derek Gill, Mary Bennett and Jessica Matthewson is gratefully acknowledged.

Registered office: Level 13, Willeston House, 22–28 Willeston St | PO Box 3479, Wellington 6140
Auckland office: Ground Floor, 70 Shortland St, Auckland
Tel 0800 220 090 +64 4 472 1880 | econ@nzier.org.nz | www.nzier.org.nz

© NZ Institute of Economic Research (Inc). Cover image © www.dreamstime.com
NZIER's standard terms of engagement for contract research can be found at www.nzier.org.nz.

While NZIER will use all reasonable endeavours in undertaking contract research and producing reports to ensure the information is as accurate as practicable, the Institute, its contributors, employees and Board shall not be liable (whether in contract, tort (including negligence), equity or on any other basis) for any loss or damage sustained by any person relying on such work whatever the cause of such loss or damage.



Key points

Many of New Zealand's waterways are now degraded.

A major and growing source of this degradation is the leaching of nutrients – nitrogen and phosphorous – from intensive dairy farming.

The government is proposing regulations...

The government has released a discussion document that details proposals to address this situation. Some of these proposals will place restrictions on farming activity in the form of limits on the amount of nutrients that can leach into the soil.

...which will likely spur innovation

Experience here and overseas with environmental regulation is that often unimagined innovations result, reducing the costs and increasing the effectiveness of those regulations. But innovation is bigger than big inventions or new technology. At the farm level, it includes adopting advanced management practices already used on the best farms.

The dairy sector is one part of a growing economy

While output from the dairy sector has been increasing, looking below the top-line figures of gross export receipts reveals a nuanced picture of its direct contribution to the New Zealand economy.

Between 1991 and 2017, the average combined direct contribution of dairy farming and dairy manufacturing was 3.09% of GDP. It is now about the same size as the tourism sector.

Since 1945, the total number of people employed in the agriculture sector has stayed largely stable.

In 2013, farmers and farm managers represented 2.92% of the national workforce, while farm, forestry and garden workers represented a further 2.26%.

Likely impact on national GDP

Due to the relatively small size of the dairy industry, the impacts of the government reforms are unlikely to be major at the national level, and not felt for many years due to the long lead in times proposed.

A reduction in GDP from intensive dairy would, however, have uneven local effects, given the regional distribution of the sector.

The dairy sector has, however, been changing

There was been a marked shift in farming away from beef and sheep towards dairy, especially in the South Island. Irrigation and fertiliser use have also increased dramatically.

The combined result has been a steady increase in the amount of nitrogen from dairy farms leaching into waterways.



Getting the balance right

Tighter regulation of water quality will have costs as well as benefits.

New Zealand does not face stark choices between having a dairy sector versus having clean waterways. Experience shows that, by focusing on profits, not production, farms can increase their economic returns and reduce their impact on the environment.

New Zealand's best farms are already doing this.

There are, however, some places where even the most efficient dairy farming will have an adverse environmental impact.

The government should be providing more information

As it works through the reform process, the government should be focusing on further study of the following areas:

- The behavioural responses of farmers to regulation.
- How well good management practice is being taken up.
- The barriers to changing behaviour.
- The level of compliance to the new policies and regulations.
- The performance of Councils in implementing, monitoring and enforcing the new policies and regulations.
- The current distribution of farm profitability.
- The relationship between soil types and nutrient leaching.

The results of this work should be made readily available to farmers, councils and the general public.



Contents

- 1 Introduction1
 - 1.1 New Zealand’s waterways are degraded.....1
 - 1.2 The government proposes new actions3
 - 1.3 Outline3
- 2 What is the contribution of the agriculture sector to our economy?3
 - 2.1 The volume of dairy exports.....4
 - 2.2 The economy is changing.....8
 - 2.3 Employment in farming has remained at similar levels11
 - 2.4 Farming area is declining11
 - 2.5 Summary.....13
- 3 The changing face of the dairy sector14
- 4 What should the government be trying to achieve?18
 - 4.1 Aligning private and social incentives.....18
 - 4.2 The current system hides some costs.....18
 - 4.3 Look to current best practice.....19
- 5 What will be the effect of the government’s proposals?19
- 6 What needs to be measured?20
 - 6.1 Specific areas of focus.....21

Appendices

- Appendix A References 23

Figures

- Figure 1 Many New Zealand waterways are degraded.....1
- Figure 2 Nitrate leaching from dairy cattle is increasing.....2
- Figure 3 The quantity of dairy products exported has grown rapidly.....4
- Figure 4 The real value of dairy exports has grown rapidly5
- Figure 5 GDP from the dairy farming6
- Figure 6 GDP from the dairy sector is volatile.....7
- Figure 7 Dairy’s contribution to GDP is reasonably stable7
- Figure 8 The services sector is the real powerhouse of the New Zealand economy8
- Figure 9 International tourism and dairy are important exports.....9
- Figure 10 Domestic tourism expenditure is also an important source of national income.....10
- Figure 11 Tourism and dairy both contribute to the economy.....10
- Figure 12 Employment in the primary sector has been static for over 75 years11
- Figure 13 The number of farms is falling.....12
- Figure 14 Dairy cattle increases in the South Island14
- Figure 15 Nitrogen fertiliser use has also increased16
- Figure 16 Nitrate leaching from dairy cattle is increasing.....16
- Figure 17 Not all dairy farms are equally profitable17
- Figure 18 Underlying pay-out varies17

Tables

Table 1 Area of land used in dairy farming	12
Table 2 Numbers of farms	13
Table 3 Numbers of farmers and farm workers	13
Table 4 The great southward shift	14
Table 5 Land under irrigation has almost doubled in 15 years	15
Table 6 Dairy dominates irrigated land use	15

1 Introduction

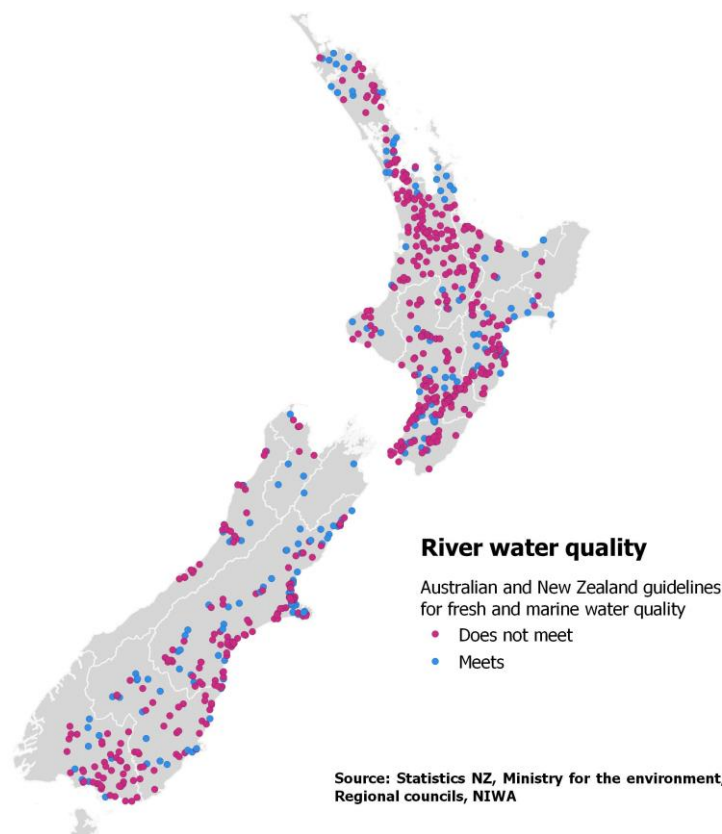
Water in New Zealand, in terms of location, time and quality, can be very scarce and, therefore, of considerable value.

Human activity across a wide range of sectors is having adverse impacts on the quality of the water in our lakes, rivers and streams. This is not just a rural issue. Supply of the ‘three waters’ – drinking water, wastewater and stormwater – to our large and growing cities is putting strains on the environment.

1.1 New Zealand’s waterways are degraded

The cumulative effect of human activity of our waterways is now becoming clear. Many of our waterways are degraded. (Ministry for the Environment and Statistics New Zealand 2019).

Figure 1 Many New Zealand waterways are degraded



Source: Statistics New Zealand 2019b

One of the principal causes of this degradation is entry of nutrients, principally nitrogen and phosphorous, into water catchments. As Statistics New Zealand explains:

Nitrogen is an essential nutrient for plant growth. It occurs naturally, but in agricultural systems more nitrogen is commonly added to soils as fertiliser or as

urine or dung from livestock. Not all the additional nitrogen can be used by plants and microorganisms, so some nitrate-nitrogen may leach (drain) from the soil.

Livestock urine is the dominant source of nitrate-nitrogen leached from soil. Leached nitrate-nitrogen can enter groundwater and waterways, potentially causing ecological harm. The amount of nitrate-nitrogen leaching from the soil varies around the country as a result of different land uses, climates, and soils. (Statistics New Zealand 2019b)

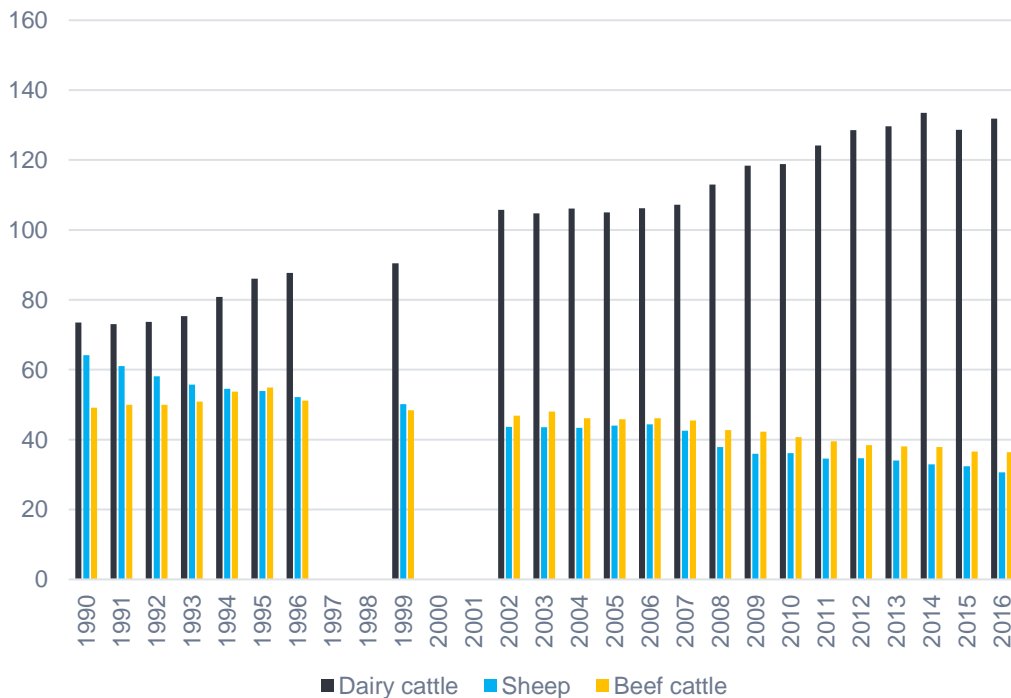
Over the past 25 years, there has been significant land use change in New Zealand in terms of pastoral farming in favour of dairying. This has resulted in a significant increase in the amount of nitrogen leaching into groundwater and eventually into our rivers and lakes, which has had a marked and measurable effect on water quality.

In the government’s view, the current regulation of land use in New Zealand allows too many nutrients to leach into our waterways, reducing water quality below desired levels. From an economic perspective, this represents an inefficient subsidy to polluting land users from mana whenua, the other users of those waterways (including those who receive amenity value from them and those who, while not necessarily users of waterways, gain value from their existence) and the people of New Zealand in general.

While nitrate leaching from beef and sheep farming has been falling, the rapid growth in dairy farming has led to a significant increase in leaching.

Figure 2 Nitrate leaching from dairy cattle is increasing

Thousands of tonnes of nitrates per year



Source: Statistics New Zealand 2019c – no data is available for some years

1.2 The government proposes new actions

The government has issued a discussion document – *Action for healthy waterways* – that contains a range of proposals to address the quality of water in New Zealand.¹ Some of these proposals will have effects on the current users of water, the farming sector especially.

In this report, we look at some of the costs and benefits of changing how human activity, particularly farming, affects the quality of water in New Zealand.

1.3 Outline

The major land use change in New Zealand which has led to the reduction in overall water quality has been the huge shift to dairy farming – either intensification of existing dairy farming and the conversion to dairy from other previous land-uses.

We begin with a description of the contribution the dairy sector makes to the New Zealand economy to put the costs and benefits into context.

We then go on to describe how the dairy sector has changed over the last 25 years and what effect these changes have had on the environment.

Standing back, we then look at what good regulation of the quality of water should be seeking to achieve. We focus on the need to balance the costs and benefits of human activity and emphasise that neither the government, society or farmers are facing choices between absolutes – dairy or clean water, but not both. Rather, the choices are about finding the right amount of human activity: what types of farming and what practices these use and finding at what level benefits are greater than the costs.

Next, we discuss in general terms, what economic effect the government's proposals might have and then provide some specific examples of what impact the proposals might have on farms.

We conclude the discussion with our outline of what issues the government and other stakeholders should be focusing on as they work towards implementing changes to regulation.

2 What is the contribution of the agriculture sector to our economy?

The primary sector, especially dairy processing, is commonly described as the backbone of the New Zealand economy. Where else in the world would the price of skim milk powder in global dairy auctions be the lead story on the news?

Looking deeper into the data, however, a more nuanced picture emerges.

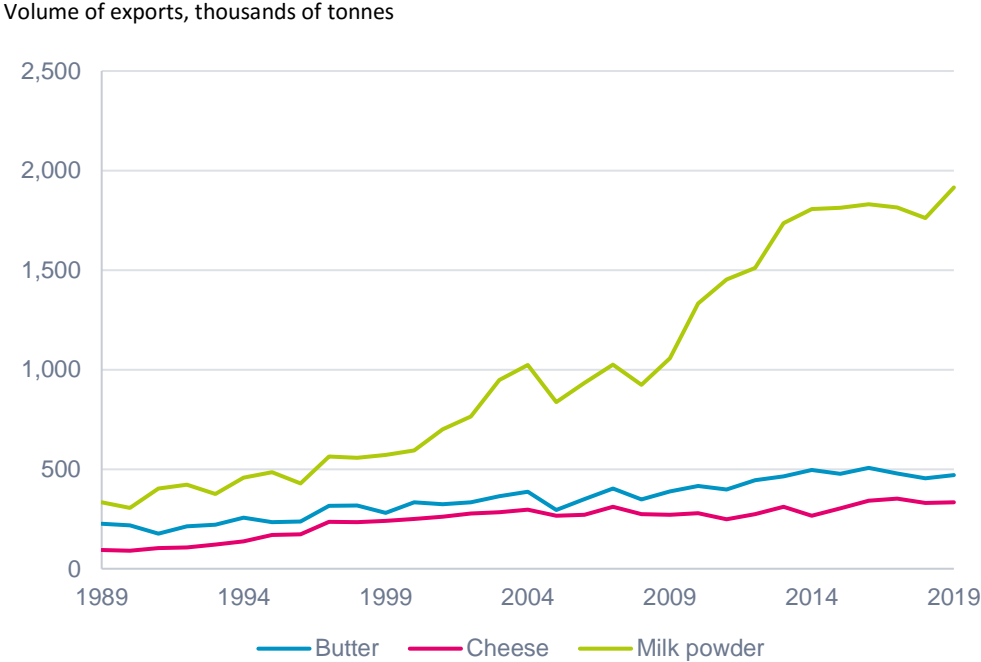
¹ These reforms are separate from but related to the issue of a **quantity** of water that is allocated to different uses. In October 2018, the government published the *Essential Freshwater: Healthy Water, Fairly Allocated* work programme, which outlines its overall policy programme. The work programme is available at <https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/essential-freshwater.pdf>



2.1 The volume of dairy exports

Certainly, the volume of exports of dairy products has risen rapidly in recent years. While growth in butter and cheese exports has been strong, it is the export of milk powder to a number of countries that has accelerated this century.²

Figure 3 The quantity of dairy products exported has grown rapidly



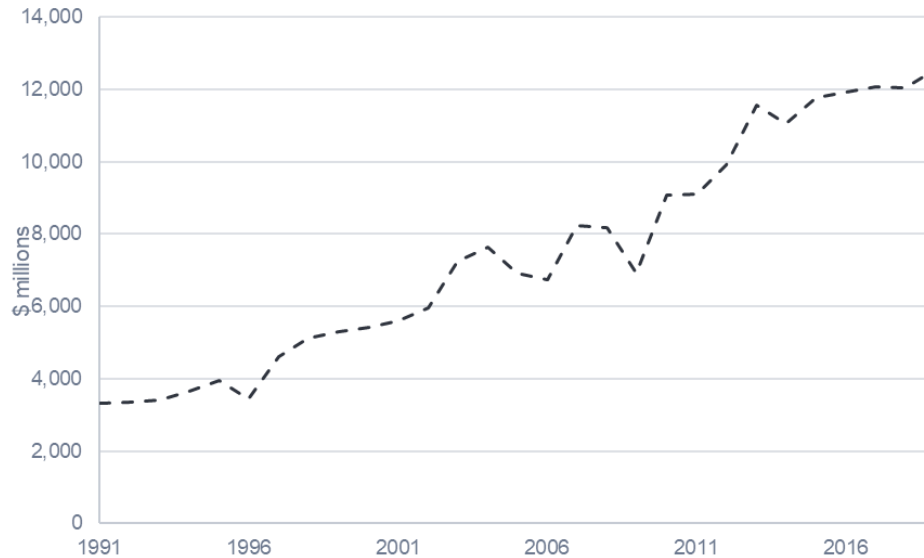
Source: Statistics New Zealand Infoshare Table EXP003AA

Accompanying this increase in volumes has been an increase in the **value** of exports, measured as quantity times price.

² While China is now the largest single destination of milk powder exports, growth in this trade alone has not been responsible for all the increase in total exports.

Figure 4 The real value of dairy exports has grown rapidly

Value of exports in 2009/10 prices



Source: Statistics New Zealand Infoshare Table SNE016AA

However, Figure 4 is a statistic about revenue. What this figure does not tell us anything about is the **costs** of producing this revenue. It is the net – revenue minus costs – that represent the benefit to New Zealand of this trade. Gross domestic product (GDP) statistics allow us to gain insights into those benefits.

Looking at GDP allows some economic costs and benefits to be compared.

While an imperfect measure of national welfare, GDP does measure the costs of production as well as the benefits. The idea behind GDP is to measure in a single number, and with no double counting, all the value of output or production carried out by all enterprises, government and non-profit institutions in an economy during a given period. GDP is conceptualised and measured in terms of the flows of payments that accompany all market-based economic activity.³

GDP is measured and presented in three different ways by Statistics New Zealand and other statistical agencies around the world:

- The *expenditure approach* identifies the final goods and services purchased by persons, businesses, governments and foreigners.⁴

³ Importantly in this context, one of the common criticisms of GDP is that it does not include the economic impacts of activity that is not traded in markets. Pollution is the prime example.

⁴ The mnemonic for GDP under this approach is $GDP = C+I+G+X-M$: Gross Domestic Product = Consumption + Investment + Government spending + eXports – iMports.



- The *income approach* measures all the incomes earned and costs incurred in production.
- The *production approach* measures either total sales less the value of intermediate inputs or the sum of the value added at each stage of the production process.

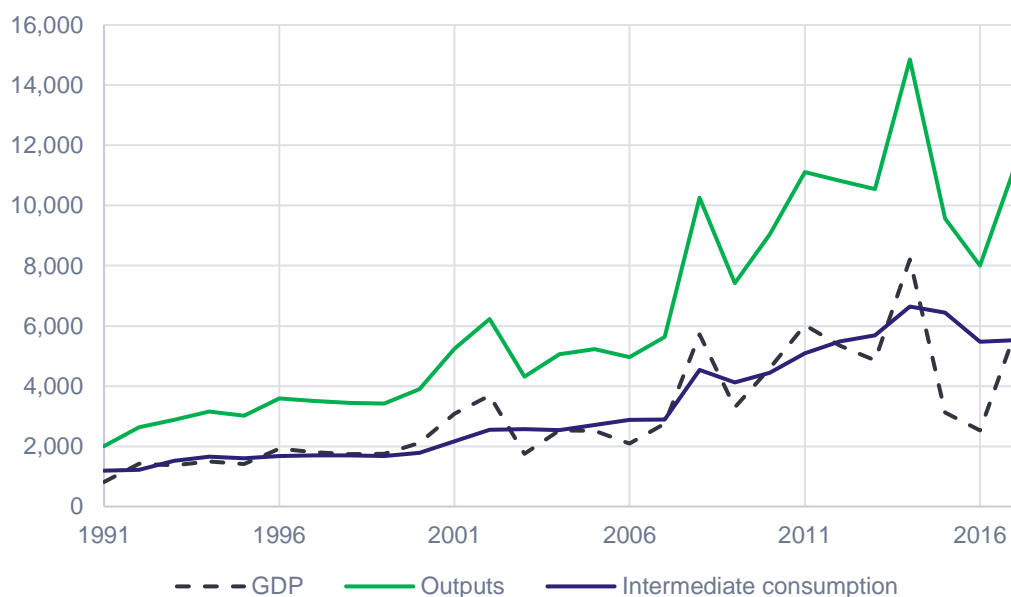
Using this last approach, statistical agencies collect data on the value of production (revenue from sales) and the cost of intermediate goods (the cost of inputs). The difference is GDP.

We illustrate this sort of calculation in Figure 5 in respect of dairy farming. The top solid line is output, while the bottom solid line is the cost of intermediate consumption: the goods and services purchased by farmers.⁵ The difference is GDP, shown by the dotted line.

Two points stand out: over the period studied, GDP is between 31% and 59% of sector output and, secondly, output is volatile. The difference between GDP and output is a good indicator of why it is important to look below ‘top line’ output and export figures and examine the underlying value added. The volatility mainly comes from variations in the price of outputs in New Zealand dollars rather than in the volume of production.

Figure 5 GDP from the dairy farming

Nominal GDP, \$ millions

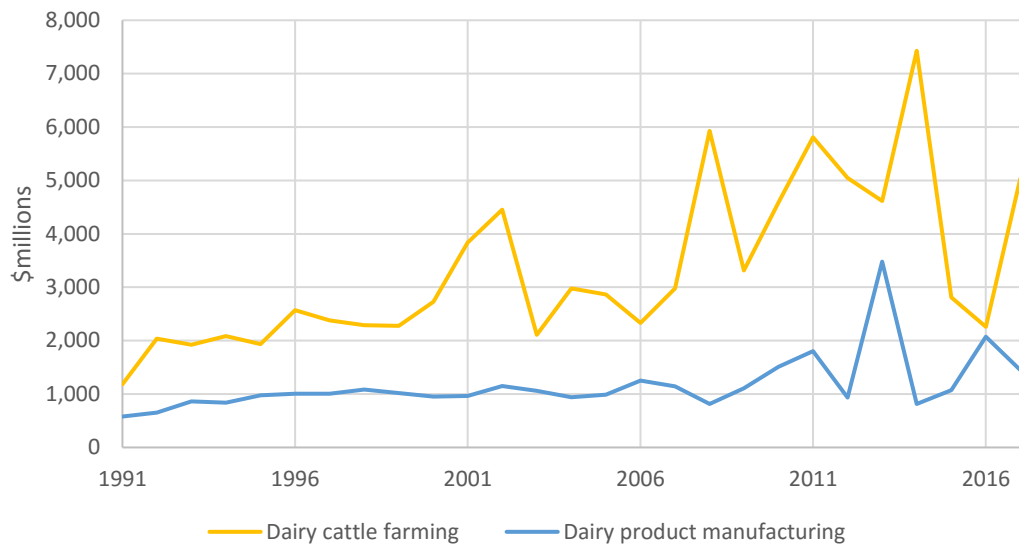


Source: Statistics New Zealand Infoshare Table SNE048AA

In Figure 6, we present the GDP figures for both dairy farming and dairy manufacturing. There are again two stand-out features: dairy manufacturing adds a small amount of GDP and has become volatile.

⁵ This is an example of the way in which GDP figures avoid double counting. The services that farmers purchase, like farm consultants, fertiliser, water, vets, banking and feed are not an **additional** benefit to the economy. Rather, they are the real resources used up in producing the output of farming. This needs to be kept in mind when discussing the benefits of farming. If you are using GDP, the inputs don't need to be added in.

Figure 6 GDP from the dairy sector is volatile



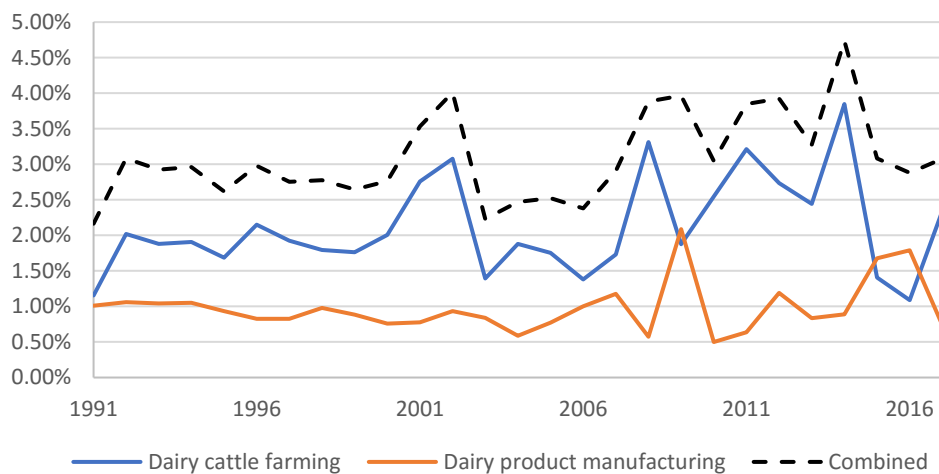
Real GDP Source: Statistics New Zealand Infoshare Table SNE048AA

When compared with the rest of the economy, the direct contribution of dairy to the economy can be seen to be reasonably small and stable.⁶

The dairy sector is growing, so too is the rest of the economy.

Figure 7 Dairy’s contribution to GDP is reasonably stable

Proportion of total GDP



Source: Statistics New Zealand Infoshare Table SNE048AA

⁶ Between 1991 and 2017, the average combined contribution was 3.09% of GDP, the maximum was 4.74% (in 2014) and the minimum was 2.16% (in 1991).

2.2 The economy is changing

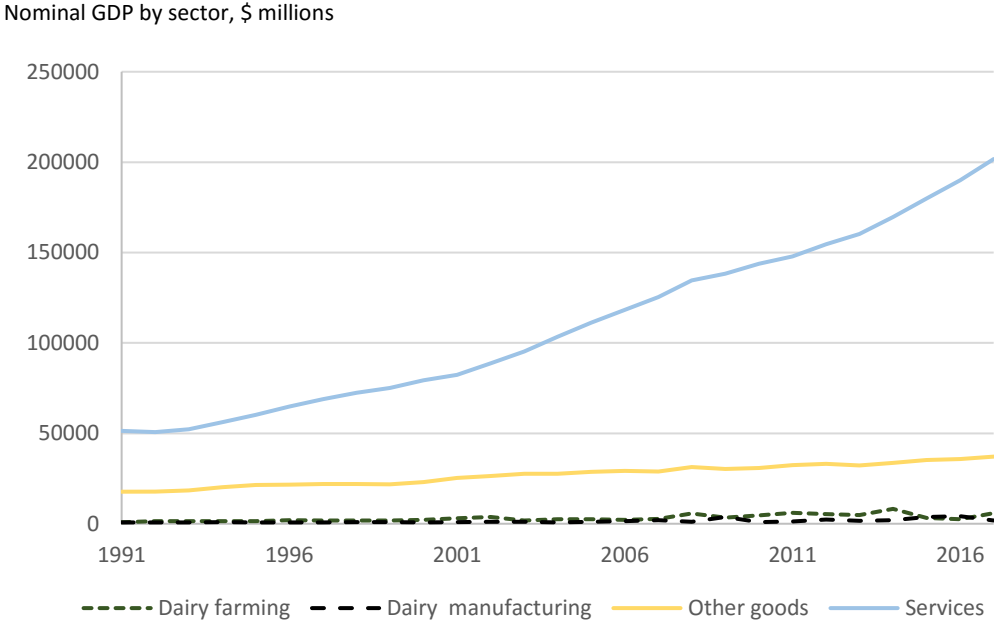
The make-up of the New Zealand economy, following worldwide trends, has been changing. The dominant part of developed economies is now services rather than goods, and most of those services are provided by domestic firms to domestic customers.

While international linkages can be a source of economic growth, what happens domestically is important for economic wellbeing at a single point of time.

As Figure 8 shows, the share of services in New Zealand’s GDP since 1987 has been steadily increasing. For comparison purposes, we have included figures for the GDP from dairy farming and dairy manufacturing, which are a much smaller share of GDP by comparison.

Modern economies produce more services than goods.

Figure 8 The services sector is the real powerhouse of the New Zealand economy



Source: Statistics New Zealand Infoshare Table SNE073AA

Not included separately in the GDP numbers is the economic contribution of the tourism sector, because large parts of tourism spending are recorded as domestic consumption on the grounds that it happens in New Zealand.⁷ To gain information about this sector, Statistics New Zealand publishes a special data series that estimates expenditure based on the normal place of residence of the consumer.⁸

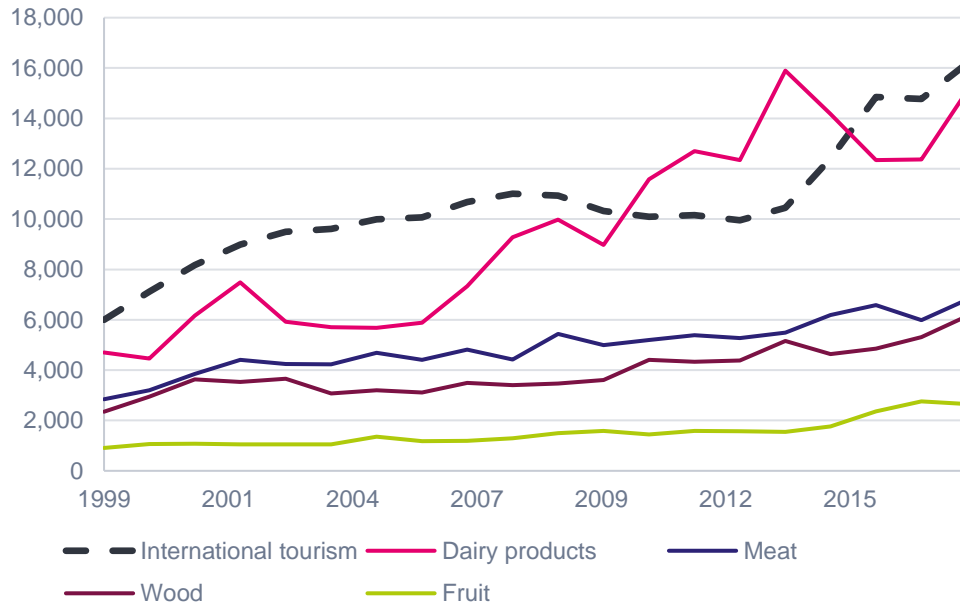
⁷ An important additional point about tourism expenditure is that spending in New Zealand by foreign tourists is subject to GST, while the export of dairy products is zero rated.

⁸ For details, see <https://www.stats.govt.nz/information-releases/tourism-satellite-account-2018>

This data is relevant in the context of water quality because of the role that New Zealand’s ‘clean and green’ image plays as an attractor of tourists. Lower water quality can distract from the tourism experience and harm New Zealand’s image.

Figure 9 International tourism and dairy are important exports

International tourism expenditure compared with selected primary exports, \$ millions



Note: The data used to generate this figure does not include any adjustment for inflation, unlike Figure 4.

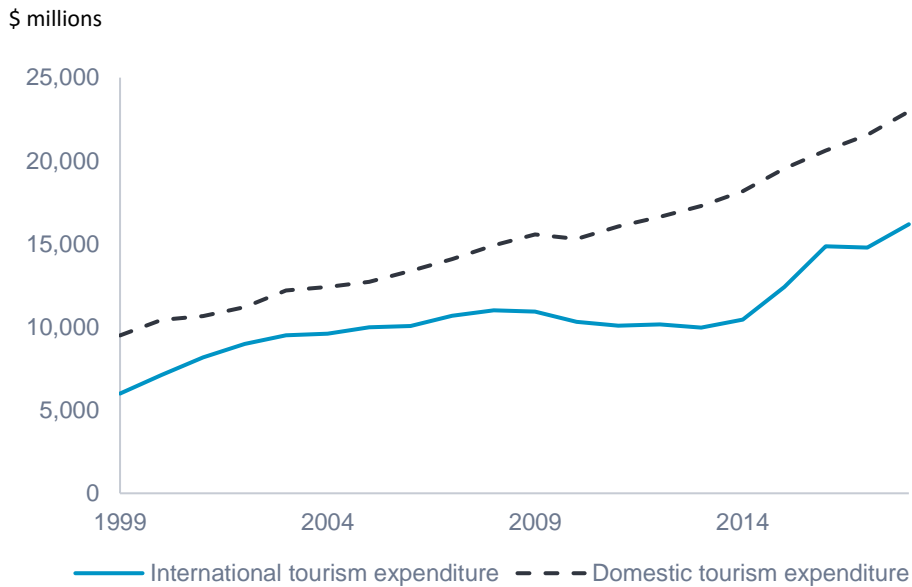
Source: Statistics New Zealand 2018

International tourism also has environmental consequences, not least the emissions of greenhouse gases from travel both getting to New Zealand and while touring here. This is another example of why the analysis of net effects needs to be undertaken.

It is not just international tourists who enjoy New Zealand’s environment. Domestic tourism expenditure is higher than that of foreign visitors. Within the context of the environment, domestic tourists value a ‘clean and green’ experience as much as international visitors.



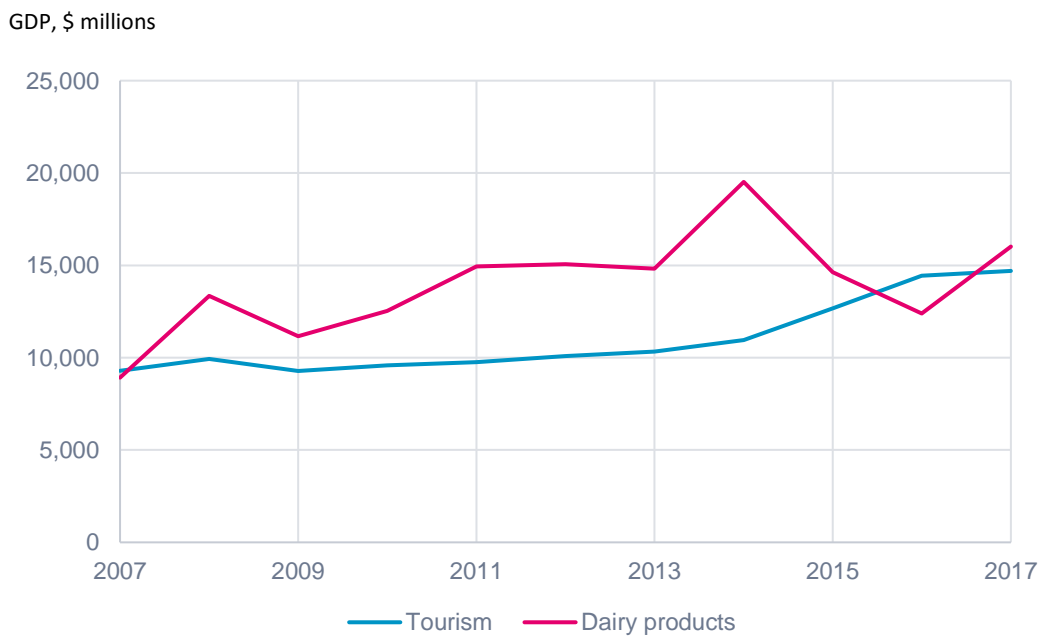
Figure 10 Domestic tourism expenditure is also an important source of national income



Source: Statistic New Zealand 2018

Comparing the GDP (which again deducts intermediate consumption from revenue to get a net figure) produced from all tourism (domestic and international) with the dairy sector shows that they both make similar direct contributions to the economy.

Figure 11 Tourism and dairy both contribute to the economy



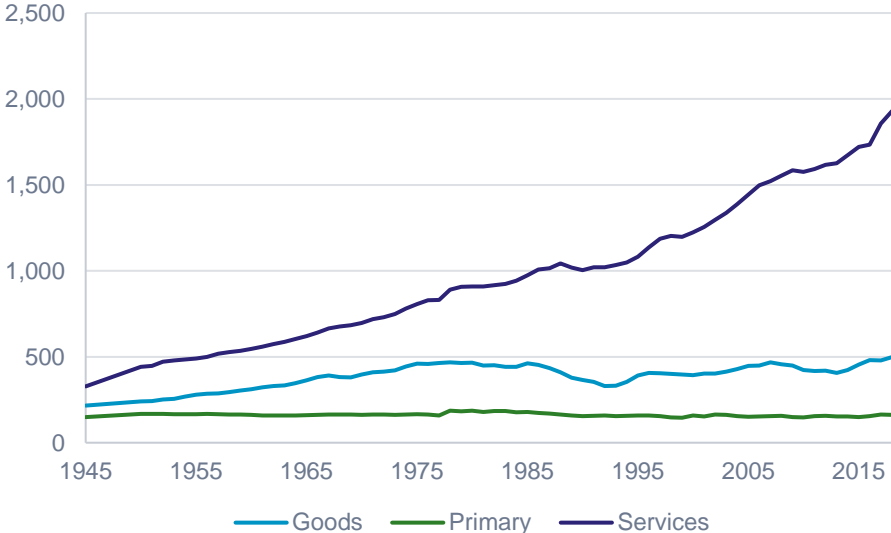
Source: Statistics New Zealand Infoshare Table TSA024AA

2.3 Employment in farming has remained at similar levels

Commensurate with the increase in output of the services sector, employment in service-producing industries now also dominates the labour market. Since 1945, the total number of people employed in the agriculture sector has stayed largely stable.

Figure 12 Employment in the primary sector has been static for over 75 years

Total employment by broad sector, thousands employed.



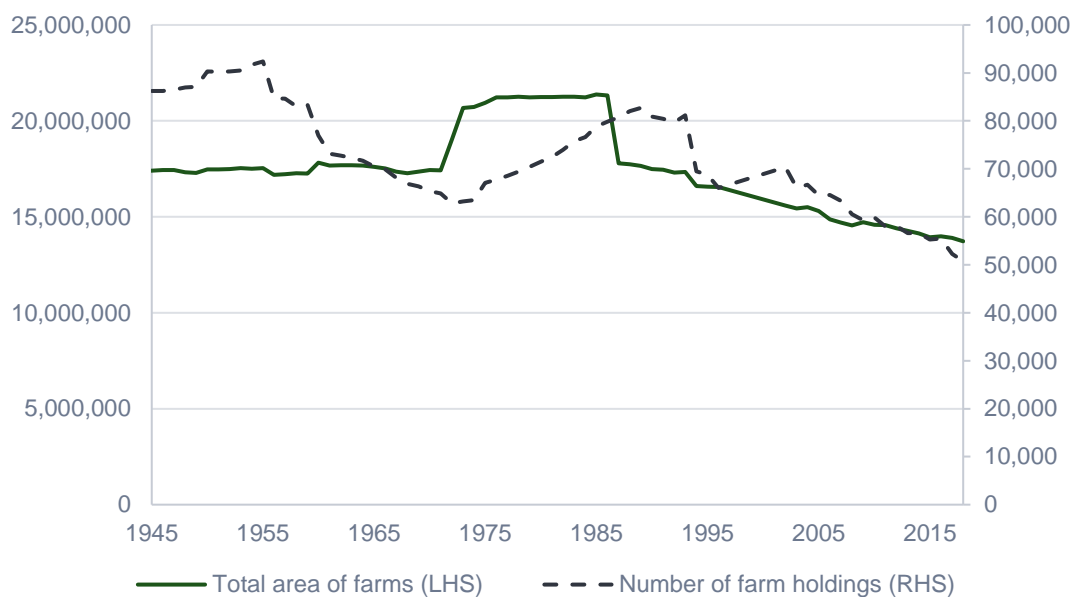
Source: www.Data1850.nz

2.4 Farming area is declining

The proportion of New Zealand’s land area given over to farming, and indeed the number of farms, has also been in decline for over 30 years. The effect of government policy in the 1970s with marginal land and stock retention subsidies saw a rapid increase in the area farmed, followed by a rapid reduction when these and other subsidies were removed in the mid to late 1980s

Figure 13 The number of farms is falling

Area in hectares



Source: Statistics New Zealand Infoshare Table AGR001AA

Note that, while the area of land used for farming has reduced overall, the area used for dairy farming, especially in the South Island, has increased.

Table 1 Area of land used in dairy farming

Hectares

Region	2002	2007	2012
Northland	291,885	267,204	303,934
Auckland	91,879	71,638	74,012
Waikato	762,705	796,453	881,379
Bay of Plenty	185,446	153,278	173,946
Gisborne	29,501	19,446	36,984
Hawke's Bay	98,971	85,482	103,906
Taranaki	321,619	281,549	293,373
Manawatu-Wanganui	303,180	285,042	355,884
Wellington	75,103	71,182	98,367
Tasman	53,981	59,274	60,421
Nelson	2,033	1,219	1,285
Marlborough	90,080	35,441	44,458
West Coast	93,170	113,377	122,439
Canterbury	345,076	497,622	673,141
Otago	150,363	198,758	321,703



Region	2002	2007	2012
Southland	218,717	295,143	444,558
New Zealand	3,113,903	3,232,107	3,991,027

Source: <https://data.mfe.govt.nz/table/52471-farm-size-area-of-large-commercial-agricultural-activities-2002-2007-and-2012/>

At the same time, the number of dairy farms has also fallen.

Table 2 Numbers of farms

By activity

Agricultural activity	2002	2007	2012
Dairy	42,015	38,622	33,759
Sheep/beef	19,659	16,581	17,157
Deer	4,335	3,015	2,097
Pigs	3,705	3,021	2,706
Other livestock	13,389	9,429	8,220
Arable crops	9,714	8,391	12,372
Horticultural crops	13,221	11,097	9,321
New Zealand	69,510	61,644	56,703

Source: <https://data.mfe.govt.nz/>

And finally, the number of people identifying their occupation as farmer and farm manager fell between the 2006 and 2013 Censuses. In 2013, farmers and farm managers represented 2.92% of the workforce, while farm, forestry and garden workers (the most granular occupation published by Statistics New Zealand), represented a further 2.26%.

Table 3 Numbers of farmers and farm workers

Occupation	2006	2013
Total	1,985,778	2,001,006
Farmers	62,034	58,377
Farm, forestry, and garden workers	46,959	45,291

Source: Statistics New Zealand: Occupation (ANZSCO sub-major group) by age group and sex, for the employed census usually resident population count aged 15 years and over, 2006 and 2013 Censuses (RC, TA).

2.5 Summary

The volume of dairy exports has been growing steadily over the last 25 years, but so too has the rest of the economy, especially the services sector.

The direct contribution that the dairy sector makes to GDP has been broadly stable over that same period, although the New Zealand dollar prices of exports is variable.

3 The changing face of the dairy sector

While dairy's direct contribution to the economy may not be as great as is often thought, the size of the sector, the farming practices applied and the location of farming have all been changing.

Much of the growth in dairy output has been the result of increases in the number of dairy cattle and the intensity of farming. The number of cows per hectare has increased as has the volume of irrigated water, fertiliser and imported feed supplements.

The most dramatic change in the dairy sector has been the increase in the number of dairy cattle in the South Island, especially in Canterbury, Otago and Southland.

Table 4 The great southward shift

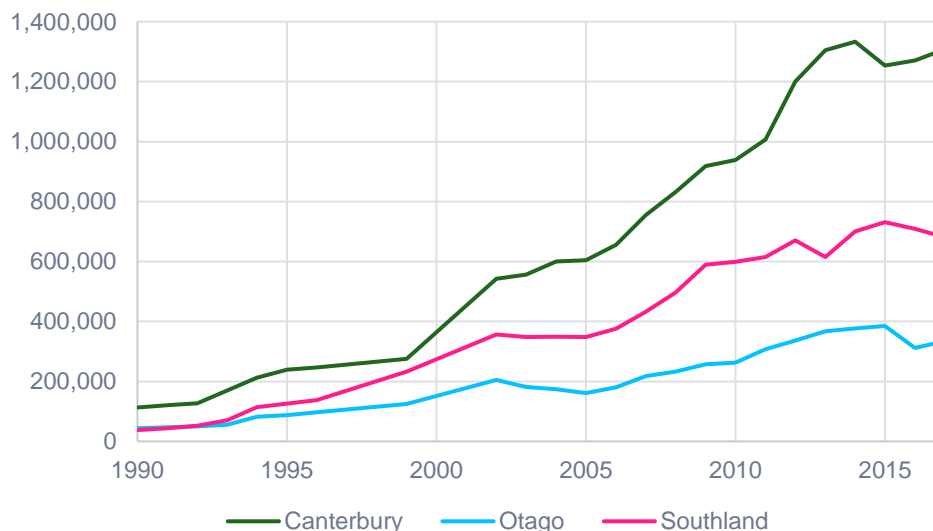
Total dairy cattle (including bobby calves)

	Waikato	Taranaki	Manawatu -Wanganui	Canterbury	Otago	Southland	Total
1990	1,276,689	563,115	255,205	112,999	43,775	37,772	3,440,815
2017	1,871,594	590,846	463,057	1,308,058	333,850	681,011	6,529,811

Source: Statistics New Zealand

Figure 14 Dairy cattle increases in the South Island

Total dairy cattle (including bobby calves)



Source: Statistics New Zealand Infoshare Table AGR003AA

Accompanying this shift in the distribution of dairy farming has been a shift to irrigation, mainly for dairy farming.

Table 5 Land under irrigation has almost doubled in 15 years

Hectares

	2002	2017	Percentage increase
New Zealand	384,152	746,739	94%
North Island	53,950	121,408	125%
South Island	330,201	625,331	89%
Canterbury	240,778	478,143	99%
Otago	60,678	94,151	55%
Marlborough	17,363	26,613	53%
Hawke's Bay	11,902	21,945	84%
Waikato	10,453	26,077	149%
Tasman	7,389	9,679	31%
Wellington	7,019	14,283	103%
Bay of Plenty	6,960	12,955	86%
Northland	5,150	7,582	47%
Manawatu-Wanganui	5,092	19,176	277%
Auckland	3,791	9,343	146%
Southland	2,922	13,799	372%
Taranaki	2,645	6,803	157%
West Coast	955	2,779	191%
Gisborne	935	3,240	247%

Source: Statistics New Zealand 2019a

Table 6 Dairy dominates irrigated land use

Hectares under irrigation by land use 2017

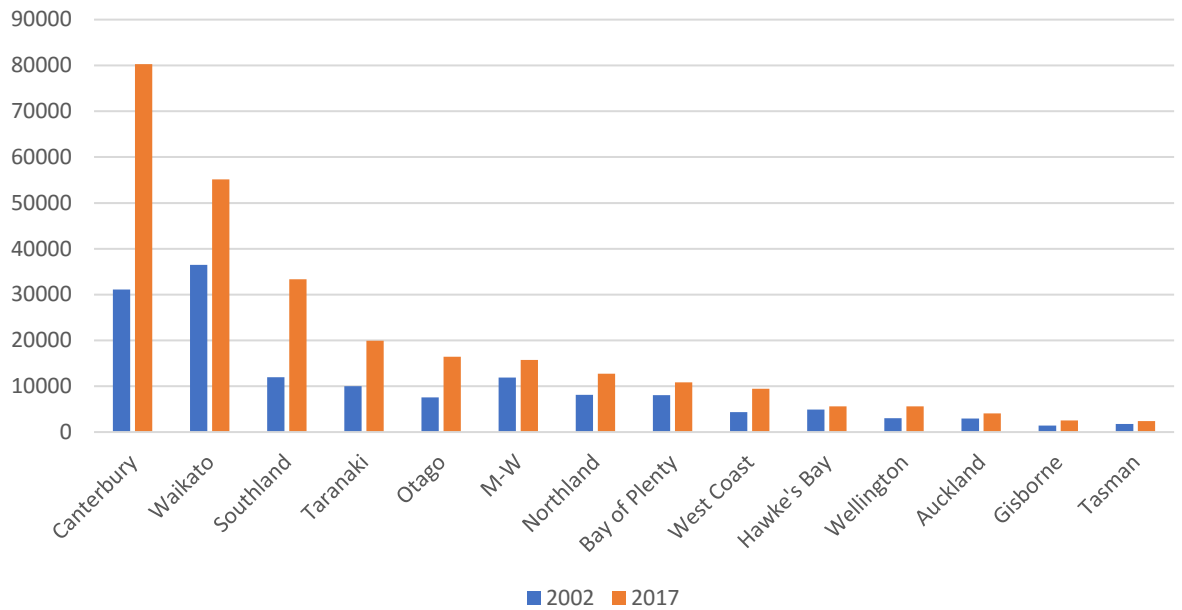
Dairy	Other livestock	Grain	Vegetables	Fruit	Other horticulture
451,905	127,170	98,165	31,732	40,248	12,134

Source: Statistics New Zealand 2019a

Associated with the increase in use of irrigation has been an increase in the use of nitrogen-based and other fertilisers used to promote grass growth.

Figure 15 Nitrogen fertiliser use has also increased

Tonnes of nitrogen in urea

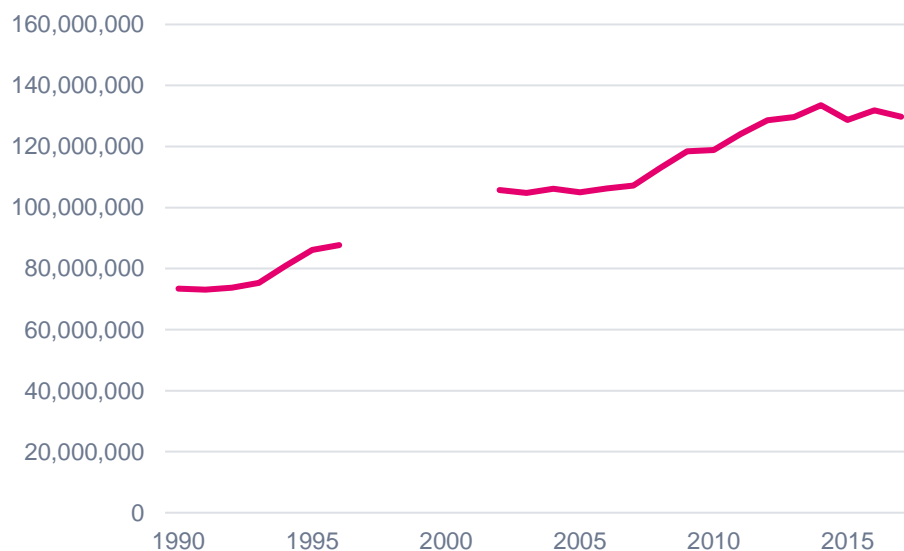


Source: Statistics New Zealand 2019a

Putting this all together, the result has been an increase in the amount of nitrates leaching into waterways from dairy cattle.

Figure 16 Nitrate leaching from dairy cattle is increasing

Kilograms of nitrates per year



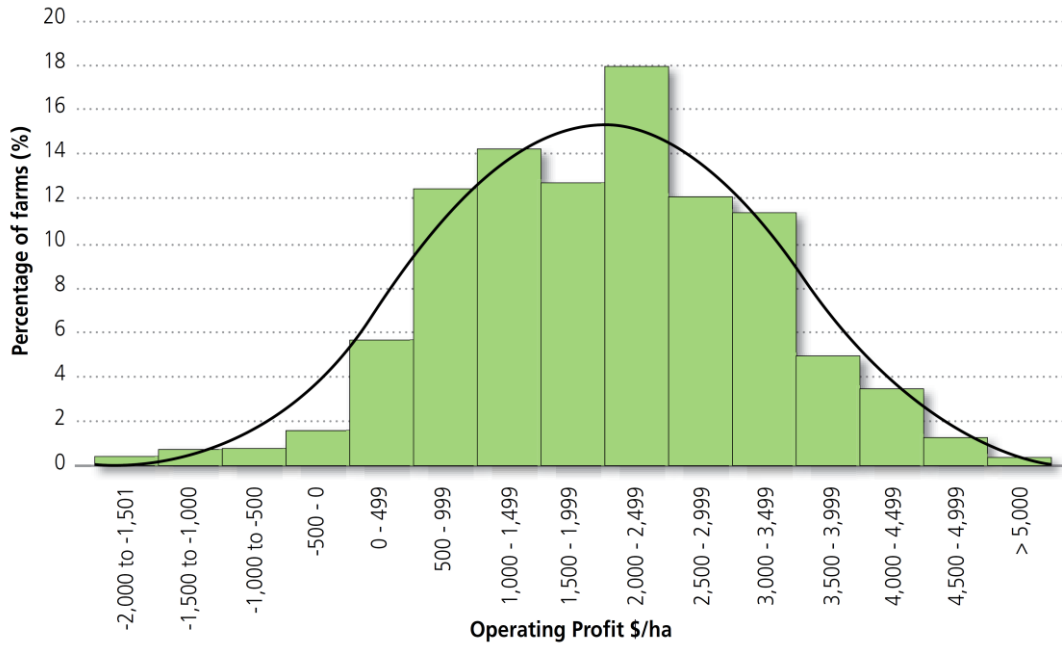
Source: Statistics New Zealand 2019c – no data is available for some years

Dairy farm profitability on an area basis (per hectare) is not uniform across the country, with some farms making losses. Importantly, the distribution of profits is not closely related

to the variation in dairy pay-outs received by farmers. This implies that efficiency of farming is not uniform.

Figure 17 Not all dairy farms are equally profitable

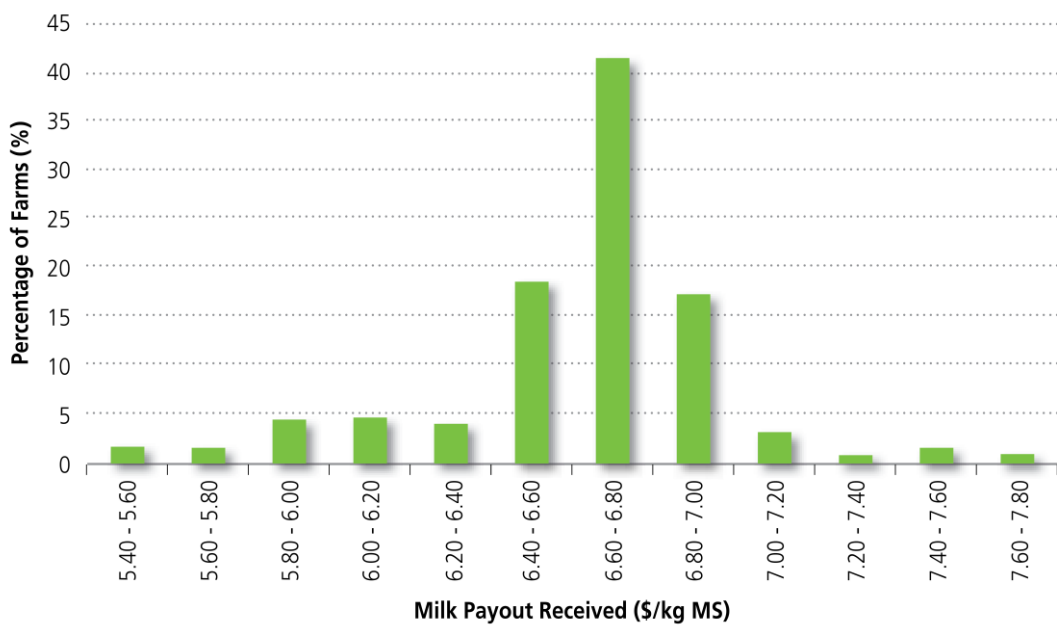
2017/18 dairy season



Source: DairyNZ 2019

Figure 18 Underlying pay-out varies

2017/18 dairy season



Source: DairyNZ 2019

4 What should the government be trying to achieve?

The government has come to the view, which is well supported by scientific evidence, that water quality has deteriorated due to human activities. Its view is that the benefits of improving water quality are greater than the costs. However, we are not aware of any economic modelling that has been done at a national scale that confirms this presumption.⁹

4.1 Aligning private and social incentives

In our opinion, from a qualitative perspective, what regulation should be seeking to achieve is the alignment of the private incentives of resource users with the incentives of society.

The usual way that this alignment takes place is where all the costs of undertaking an activity are borne by those who reap the benefits of that activity. When this happens, the right balance in activity is more likely to occur and individuals seek to maximise the benefits they receive after taking into account the cost they incur. If private and social incentives are aligned, this will mean that the net differences between social costs (all the resources used to produce output, including the quality of the environment) and social benefits will simultaneously be maximised.

New Zealand is not facing choices between absolutes – dairy versus clean water, but not both.

Rather, the choices are about finding the right balance of human activity: what type of farming, using what practices and at what level will create social, cultural and environmental benefits that are greater than the social, cultural and environmental costs.

The imposition of new rules, even those designed to address externalities and lead to a higher level of total wellbeing, can have impacts on the wellbeing of individuals. Transitional rules are often used to address these equity issues. In environmental settings, new standards have often been portrayed as being impossible for incumbents to meet. The result is often overly generous transitional assistance, which means that, in practice, the new standards never apply or at least are deferred.

4.2 The current system hides some costs

From an economic perspective, the current system for regulating the effects of land use within New Zealand creates an externality whereby some of the costs of using land in particular ways are not borne by the land user.

The economic principles of efficiency and equity should guide development of the nutrient management rules in New Zealand to make best use of scarce resources, including the

⁹ As part of the package of material released with the discussion document, the Ministry for the Environment made available two studies of the impact of the proposals on farms (Macfarlane Rural Business Ltd 2019; Journeaux 2019).

quality of the waterbodies, land use in catchments and the ability to leach nitrogen from that land.

4.3 Look to current best practice

A previous study by NZIER on the effect of nutrient regulation of dairy farming in Southland showed significant differences between traditional and modern dairying practices. It concluded that dairy intensification need not lead to reduced environmental quality – indeed, it could be associated with improved quality, provided the farming is taking place on the right soils (Kaye-Blake et al. 2013).

There are already many examples of farms that are using farm management practices to increase profitability while reducing their environmental footprints.

Perhaps the most famous is the Lincoln University Dairy Farm, which is in the top 2% of farms by profitability while having a low-level nutrient output.¹⁰ One notable feature of the Lincoln University Dairy Farm is that its objective is to maximise profitability, not output.

Successive winners of the Ballance Farm Environment Awards demonstrate repeatedly that low input, low footprint, high animal welfare values are achievable on New Zealand farms.¹¹

The kaitiakitanga approach to farming adopted by Pāmu Farms provides another example of environmentally sound farming practice creating high-quality natural products profitably.¹²

The Landcare Trust currently provides considerable free guidance material on how farm management practices can increase profits while reducing environmental impacts.¹³ DairyNZ also has guidance material available (DairyNZ 2014).

5 What will be the effect of the government's proposals?

Determining the effect of the government's proposals on the farming sector or individual farms is difficult.

What is being proposed is essentially that some of the costs of production that are currently not a financial charge to farms – water pollution and freshwater habitat loss or 'externalities' in the jargon of economics – will in the future be borne directly by farmers.

If nothing else changes, this might seem to imply that farm profitability must fall.

But things will change. The considerable New Zealand and international experience with moving to remove subsidies (in this case for pollution) shows that we can expect considerable behavioural change on the part of farmers.

Creativity and innovation have always been central to economic growth, allowing more or better things that people have reason to value to be made more efficiently (Aghion and Howitt 1992).

¹⁰ See <http://www.sidc.org.nz/lu-dairy-farm/>.

¹¹ See <https://www.nzfeatrust.org.nz/ballance-farm-environment-awards>.

¹² See <https://pamunewzealand.com/>.

¹³ See <https://www.landcare.org.nz/>.

Innovation is widely recognised to be the source of much, if not most economic growth (Feinstein 2009).

Innovation is not just something that happens in research and development departments of large firms. Innovation is ubiquitous. Innovation does not always mean discovering something new. It can be about applying an existing process or technique in a firm or on a farm, resulting in iterative improvements (Gill 2015).

The next big innovative idea in farming is to encourage more-traditional farmers to adopt advanced management practices. Innovation in this approach is not about big breakthroughs: it is a series of incremental adjustments.

The question for farmers will be how to maximise the return to farming once they are required to account for all the environmental costs of their operations. That is, the choices open to farmers are greater than just the number of cattle they farm. They will have choice around how they farm as well.

Some of these changes might include the following:

-
- Changing farm practices to reduce the environmental impact of farming by adopting good management practices. We already observe a marked distribution of practices across farmers. Note that, in the last 15 years, we have seen considerable shifts in the type of farming in the South Island.
- Changing the animals or crops farmed to those that have a lower impact on the environment.
- Increasing focus on profitability by moving investment and farm management away from the margins (both production from marginal land and for marginal volume).

The government is proposing a significant lead time for the introduction of new rules. Regional councils will have till 2025 to incorporate the new rules into their land and water plans and even then, farmers will have time to adjust as those plans will establish the timeframes for achieving the water quality targets.

Time brings the opportunity to experiment and learn. The New Zealand farming community is proud of its tradition of innovation, and there is no reason to suppose that they will not rise to the challenges of the new environmental rules.

While it is not possible without considerable economic modelling to estimate these effects, we do have some data from farm profit calculations that can give us a guide to the range of effects.

6 What needs to be measured?

Determining the effect of the government's proposals at the farm, community and national levels is a potentially large and contentious task. While there are some examples internationally on which to draw, the specific nature of farming in New Zealand needs to be

considered. For example, the degree of leaching from any one farm depends on the location of the farm and its soil type, slope, farm practices and so on. Broad averages can mask both high-cost and low-cost effects.

The government should commission further, detailed and independent analysis of the effects of its proposals, outlining the benefits and costs at all levels.

On the benefits side, including the amenity, cultural, environmental and health values that accrue to users and others from healthy freshwater, is an important part of the calculation. Placing a monetary value on these benefits is certainly possible but needs to be undertaken carefully and transparently.

Some individual land owners will be made worse off (from their private point of view) if the subsidy they currently receive (the ability to leach nutrients at no additional cost to them) is removed through changes in land use regulation. That this is true is not, on its own, a reason not to proceed with reforms. The frame of reference should be a national one.

6.1 Specific areas of focus

The following matters should be studied in detail.

6.1.1 The behavioural responses of farmers (marginal abatement cost curves)

As we discussed above, farmers will have options as to how they respond to any new regulations. The financial effects of these options are captured in marginal abatement curves (MACs), which measure the private costs to users of various approaches to reducing (abating) leaching.

Independent, objective research, based on what is achieved on the best performing farms, should be commissioned and made public.

6.1.2 The barriers to changing behaviour

Reduced environmental damage will only come about if behaviour changes. While the government's focus is on increasing regulation, we consider that it should also focus on the barriers to behavioural change, both monetary and non-monetary.

In a review of the literature on market-based nutrient regulation in the United States, Peterson and Smith (2012) identify four types of potential barriers to successful outcomes that are relevant to New Zealand:

- Non-monetary costs may be high.¹⁴
- Transaction costs, which can be especially high for farmers.
- Risk-averse regulators.

¹⁴ The study was of regulation in the United States, where farmers' political attitudes, especially a general distrust of government and ideological resistance to regulation, may be different from those in New Zealand.

- Information levels, noting that unfamiliarity is always a barrier to action.

Peterson and Smith note that these barriers can all be influenced and indeed overcome by regulatory scheme design.

6.1.3 The uptake of good management practice through farm advisory services

One of the government's proposals is to increase the public provision of advisory services to farmers to assist them to identify profitable changes in farm practice that reduce environmental footprints.

This proposal should be subject to careful evaluation using experienced, independent external evaluators to monitor its effectiveness.

6.1.4 The relationship between soil types and nutrient leaching

As we noted above, the amount of nitrate-nitrogen leaching from the soil varies around the country as a result of different land uses, climates and soils (Statistics New Zealand 2019b).

Thus, the location of farming, in terms of the type of soil upon which stock graze, is an important determinant of the environmental impact of that farm. Farming on highly permeable soils is likely to have higher environmental impacts.

We consider that the government and regional councils should identify and make public those locations where the type of farming in place is not suitable given the type of soil and put in place appropriate land use rules.



Appendix A References

- Aghion, Philippe, and Peter Howitt. 1992. "A Model of Growth through Creative Destruction." *Econometrica* 60 (2): 323–51.
- Baumol, William J., and Wallace E. Oates. 1971. "The Use of Standards and Prices for Protection of the Environment." *The Swedish Journal of Economics* 73 (1): 42–54.
<https://doi.org/10.2307/3439132>.
- Bohi, Douglas R., and Dallas Burtraw. 1997. "SO₂ Allowance Trading: How Do Expectations and Experience Measure Up?" *The Electricity Journal* 10 (7): 67–75.
[https://doi.org/10.1016/S1040-6190\(97\)80473-3](https://doi.org/10.1016/S1040-6190(97)80473-3).
- Calel, Raphael. 2018. "Adopt or Innovate: Understanding Technological Responses to Cap-and-Trade." SSRN Scholarly Paper ID 3138407. Rochester, NY: Social Science Research Network.
<https://papers.ssrn.com/abstract=3138407>.
- DairyNZ. 2014. "Reducing Nitrogen Loss." Hamilton, New Zealand: Dairy NZ.
- . 2019. "DairyNZ Economic Survey 2017-18." DairyNZ.
<https://www.dairynz.co.nz/publications/dairy-industry/dairynz-economic-survey-2017-18/>.
- Dewes, Mary. 2018. "Statement of Evidence of Alston Mary Dewes on Behalf of Wellington Fish and Game before the Hearings Panel in the Matter of Proposed Natural Resources Plan for the Wellington Region (Hearing Stream 4: Water Quality and Stormwater)."
- Feinstien, Jonathan. 2009. "Creativity & The Economic System." In *Encyclopedia of Giftedness, Creativity, and Talent*. Sage Publications.
- Fraser, Peter. 2018. "Statement of Evidence of Peter James Fraser on Behalf of the Natural Capital Group before the Environment Court in the Matter of Appeals under Clause 14(1) of Schedule 1 of the Resource Management Act (Bay of Plenty Regional Council Proposed Plan Change 10)."
- Gill, Derek. 2015. "The Role of Structural Policies in Innovation." Ministry of Business, Innovation and Employment.
https://nzier.sharepoint.com/:w:/r/_layouts/15/Doc.aspx?sourcedoc=%7B07356B18-58F7-4505-A3F4-84EA0A7D2596%7D&file=Final%20AEPR%202015%20framework%20including%20revised%20questionnaire%209%20March.docx&action=default&mobileredirect=true.
- Horan, Richard D., and James S. Shortle. 2011. "Economic and Ecological Rules for Water Quality Trading." *Journal of the American Water Resources Association* 47 (1): 59–69.
<https://doi.org/10.1111/j.1752-1688.2010.00463.x>.
- Journeaux, Phil. 2019. "Modelling of Mitigation Strategies on Farm Profitability: Testing Ag Package Regulations on-Farm." Wellington: Ministry for the Environment.
- Kaye-Blake, Bill, Chris Schilling, Ross Monaghan, Ronaldo Vibart, Samuel Dennis, and ElizabethW Post. 2013. "Potential Impacts of Water Related Policies in Southland on the Agricultural Economy and Nutrient Discharges |." Wellington: Ministry for the Environment.
<https://www.mfe.govt.nz/publications/fresh-water/potential-impacts-water-related-policies-southland-agricultural-economy-and>.
- Libecap, Gary D. 2009. "The Tragedy of the Commons: Property Rights and Markets as Solutions to Resource and Environmental Problems." *Australian Journal of Agricultural and Resource Economics* 53 (1): 129–44. <https://doi.org/10.1111/j.1467-8489.2007.00425.x>.
- Macfarlane Rural Business Ltd. 2019. "Impact of Possible Environmental Policy Interventions on Case Study Farms." Wellington: Ministry for the Environment.
<https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/impact-of-possible-environmental-policy-interventions-on-case-study-farms.pdf>.



- McCall, David. 2012. "Statement of Evidence of David Graeme McCall of 12 October 2012 before Hearing Commissioners at Christchurch on the Proposed Hurunui and Waiiau River Regional Plan."
- Ministry for the Environment, and Statistics New Zealand. 2019. "Environment Aotearoa 2019." New Zealand's Environmental Reporting Series. MfE, Stats NZ. <https://secure.livechatinc.com/>.
- Pannell, D. J., G. R. Marshall, N. Barr, A. Curtis, F. Vanclay, and R. Wilkinson. 2006. "Understanding and Promoting Adoption of Conservation Practices by Rural Landholders." *Australian Journal of Experimental Agriculture* 46 (11): 1407–24. <https://doi.org/10.1071/EA05037>.
- Pannell, David J., Rick S. Llewellyn, and Marc Corbeels. 2014. "The Farm-Level Economics of Conservation Agriculture for Resource-Poor Farmers." *Agriculture, Ecosystems & Environment* 187 (April): 52–64. <https://doi.org/10.1016/j.agee.2013.10.014>.
- Schmalensee, Richard, and Robert N. Stavins. 2013. "The SO₂ Allowance Trading System: The Ironic History of a Grand Policy Experiment." *Journal of Economic Perspectives* 27 (1): 103–22. <https://doi.org/10.1257/jep.27.1.103>.
- Statistics New Zealand. 2019a. "River Water Quality: Nitrogen." 2019. <https://www.stats.govt.nz/indicators/river-water-quality-nitrogencom/>.
- . 2019b. "Nitrate Leaching from Livestock." April 18, 2019. <https://www.stats.govt.nz/indicators/nitrate-leaching-from-livestock>.
- Stavins, Robert N. 2001. "Experience with Market-Based Environmental Policy Instruments." 01–58. Discussion Paper. Resources for the Future.
- Tietenberg, Tom. 2003. "The Tradable-Permits Approach to Protecting the Commons: Lessons for Climate Change." *Oxford Review of Economic Policy* 19 (3): 400–419. <https://doi.org/10.1093/oxrep/19.3.400>.

