



**economics**

Report to:

**Pasture Renewal Charitable Trust**

# **ECONOMIC ANALYSIS OF THE VALUE OF PASTURE TO THE NEW ZEALAND ECONOMY**

Prepared by

**Kel Sanderson**

**Michael Webster**

September 2009

Copyright© BERL

# Economic Analysis of the Value of Pasture to the New Zealand Economy

<b>1</b>	<b>Executive summary .....</b>	<b>4</b>
<b>2</b>	<b>Introduction.....</b>	<b>6</b>
2.1	Background .....	6
2.2	Definitions .....	6
2.3	Timing of data .....	8
2.4	Format of report.....	9
<b>3</b>	<b>Part one – the value of pasture .....</b>	<b>10</b>
3.1	National summary of the value of pasture.....	10
3.2	Gross output value of pasture-based products .....	11
3.3	GDP value of pasture-based products .....	11
3.4	Estimated employment in pasture-based industries .....	12
3.5	The value of pasture by region .....	13
3.6	Supplementary feed .....	13
3.7	Method.....	14
<b>4</b>	<b>Part two - a model of pasture response .....</b>	<b>19</b>
4.1	Summary of results- first year of renewal.....	19
4.2	Multiple years of sustained pasture renewal .....	20
4.3	Method.....	22
<b>5</b>	<b>Pasture response.....</b>	<b>35</b>
5.1	Sheep and beef farms .....	35
5.2	Dairy farms .....	35
<b>6</b>	<b>Appendix A – multiplier analysis .....</b>	<b>37</b>
6.1	Measures .....	37
6.2	Direct, indirect and induced effects .....	38
6.3	Leakages .....	38
6.4	Limitations of multiplier analysis.....	38
<b>7</b>	<b>Appendix B - pasture renewal 30% response .....</b>	<b>41</b>

## Tables

Table 1.1	Value of pasture products to the New Zealand economy, June 2007 year.....	4
Table 1.2	Summary of model results- farm gate value .....	5
Table 2.1	Region and farm type breakdowns .....	7
Table 3.1	Summary of pasture products.....	10
Table 3.2	Gross output of pasture based products, 2007 .....	11
Table 3.3	GDP of pasture based products, 2007.....	12
Table 3.4	FTEs in pasture-based industries, 2007 .....	13

Table 3.5 Regional farm gate values by product type, 2006/07 season .....	13
Table 3.6 Breakdown of Fonterra operating revenue .....	15
Table 3.7 List of HS codes for export values .....	17
Table 4.1 Summary of model results- farm gate value .....	19
Table 4.2 Summary of model results- GDP .....	20
Table 4.3 Multiple year analysis, method one.....	21
Table 4.4 Estimates of dairy farm hectares .....	22
Table 4.5 Estimates of pasture renewal, sheep and beef farms, farm type, 2006/07 .....	23
Table 4.6 Results of market research survey, 2008 .....	24
Table 4.7 Estimates of pasture renewal for dairy farms by farm type, 2006/07 .....	25
Table 4.8 Existing regional dry matter growth and stock units.....	26
Table 4.9 Average dry matter production, unrenewed pasture dairy farm trials.....	27
Table 4.10 Pasture response levels .....	27
Table 4.11 AgResearch model ratios.....	28
Table 4.12 Revenue per stock unit, by farm type, 2006/07.....	29
Table 4.13 Change in farm gate value for a 10% pasture response, sheep and beef ....	29
Table 4.14 Change in farm gate value for a 30% pasture response, sheep and beef ....	30
Table 4.15 Change in farm gate value for 7% and 27% pasture response, dairy .....	31
Table 4.16 Change in GDP for a 10% pasture response, sheep and beef.....	31
Table 4.17 Change in GDP for a 30% pasture response, sheep and beef.....	31
Table 4.18 Change in GDP for 7% and 27% pasture response, dairy.....	32
Table 4.19 Change in FTEs for a 10% pasture response, sheep and beef .....	32
Table 4.20 Change in FTEs for a 30% pasture response, sheep and beef .....	32
Table 4.21 Change in FTEs for 7% and 27% pasture response, dairy .....	32
Table 7.1 Summary of model results- farm gate value .....	41
Table 7.2 Summary of model results- GDP .....	41
Table 7.3 Summary of model results- FTEs .....	41
Table 7.4 Multiple year analysis, method one, 30% response.....	41

## Figures

Figure 3.1 Valuations of dairy product components.....	15
Figure 4.1 Pasture renewal multiple years, 10% production decline .....	21
Figure 4.2 Pasture renewal multiple years, sheep and beef, 10% production decline....	33
Figure 4.3 Pasture renewal multiple years, dairy, 10% production decline.....	33
Figure 4.4 Pasture renewal multiple years, sheep and beef, 20% production decline....	34
Figure 4.5 Pasture renewal multiple years, dairy, 20% production decline.....	34
Figure 5.1 Cumulative pasture growth for renewed and unrenewed trials.....	36

# 1 Executive summary

The farm gate value of pasture-based products to the New Zealand economy was \$10.2 billion in the June 2007 year.

In the 2006/07 year, the level of pasture renewal was 2.0 percent for sheep and beef farms and 6.1 percent for dairy farms. We modelled various scenarios for increased pasture renewal and pasture response. Based on the midpoint of the results of these scenarios, total farm gate values could increase by 16 percent to \$11.8 billion.

For the June 2007 year, pasture-based products directly contributed \$5.2 billion to New Zealand's Gross Domestic Product (GDP). This amounts to around 3.1 percent of New Zealand's GDP. Pasture-based products are therefore a significant part of the New Zealand economy. The midpoint result of our scenarios would increase the direct GDP contribution to \$6.0 billion.

**Table 1.1 Value of pasture products to the New Zealand economy, June 2007 year**

Measure	2007 estimate	With increased pasture renewal
Value at farm gate	\$10.2 billion	\$11.8 billion
Direct GDP	\$5.2 billion	\$6.0 billion
Total GDP, incl. upstream and downstream effects	\$20.5 billion	\$23.7 billion
Direct employment (FTEs)	35,400	41,100
Total FTEs, incl. upstream and downstream effects	277,300	321,600

Source: BERL.

Looking at pasture-based products, the largest contributor to farm gate values was the dairy industry. The dairy industry in the June 2007 year was worth \$6.6 billion, or 65 percent of the total value of pasture-based products. Sheep products (including lamb, mutton and wool) were worth \$2.2 billion, while beef pasture-based products were worth \$1.2 billion.

Pasture renewal has the potential to greatly increase the productivity of these pasture-based products. However, the magnitude of this increase would depend on the level of pasture response and whether the increase in pasture renewal is one-off, for one year, or sustained continuously.

We modelled scenarios with:

- target pasture renewal in sheep and beef farms of 8 percent, with the level of pasture response ranging between 10 and 30 percent.

- target pasture renewal in dairy farms of 12 percent, with level of pasture response ranging between 7 and 27 percent.

A summary of our model results for changes in farm gate value under different scenarios are shown in Table 1.2.

**Table 1.2 Summary of model results- farm gate value**

Farm type	Existing pasture renewal level	Current farm gate value (\$m)	Target pasture renewal level	Level of pasture response	New farm gate value due to renewal			Percent increase in farm gate value		
					Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Sheep and Beef	2.04%	\$3,538	8%	10%	\$3,567	\$3,567	\$3,592	0.8%	0.8%	1.5%
				30%	\$3,626	\$3,623	\$3,701	2.5%	2.4%	4.6%
Dairy	6.11%	\$6,630	12%	7%	\$6,657			0.4%		
				27%	\$6,734			1.6%		

Source: BERL.

Depending on the level of pasture renewal response, farm gate values for sheep and beef farms could increase from 8 to 27 percent and from 6 to 25 percent for dairy farms. In our modelling we have used the midpoints of these ranges. This means farm gate values for sheep and beef farms could increase by 18 percent and by 15 percent for dairy farms. Direct GDP would also increase from \$5.2 billion to \$6.0 billion.

When considering the effect that the pastoral sector has on related industries, such as agricultural services and the food processing industry, as well as the additional spending generated by salaries and wages paid by farmers, the GDP of pasture-based products is much higher. Total GDP, a measure including these impacts, equals around \$20.5 billion for pasture-based products. This is approximately 12 percent of total New Zealand GDP for the June 2007 year. Of this figure, \$2.4 billion is contributed by beef, \$4.3 billion by sheep, \$13.6 billion by dairy, and around a quarter of a billion by deer products.

To put this in context, it would require approximately 460,000 international tourists additional to the present 2.4 million to generate this level of additional expenditure for the tourism sector.

## 2 Introduction

This project was commissioned by the Pasture Renewal Charitable Trust (PRCT) to determine the size of pasture-based farming in New Zealand, and the impact that pasture renewal has on the national economy.

### 2.1 Background

The primary objectives of the PRCT are:

- To educate the participants in the agricultural sector of the benefits of pasture renewal to individual farmers, communities and the NZ economy as a whole.
- To undertake research into current farming practices, dissemination of information through the media, publications and field days to broaden the industry knowledge of the benefits of pasture renewal.
- To support and assist other NZ entities which have a similar focus.

A significant part of New Zealand's economy is based on pastoral farming. PRCT believes that renewing pasture more frequently is the key to New Zealand's farming future and will benefit the whole economy.

### 2.2 Definitions

#### 2.2.1 Products

This project provides an estimate of the value of the main products produced from pasture in New Zealand: beef, sheep (meat and wool), dairy, and deer products. For our estimates of pasture renewal in part two, we exclude deer products, due to their small size and the lack of information available.

We exclude cropping and other forms of farming (e.g. pigs, chickens, horses, emus).

#### 2.2.2 Regions and farm types

The regional breakdowns analysed in this report are as follows:

**Table 2.1 Region and farm type breakdowns**

<b>Region</b>	<b>Product type</b>	<b>Farm type</b>
Northland-Waikato-BoP	Sheep and Beef	3 N.I. Hard Hill Country
Northland-Waikato-BoP	Sheep and Beef	4 N.I. Hill Country
Northland-Waikato-BoP	Sheep and Beef	5 N.I. Intensive Finishing
East Coast	Sheep and Beef	3 N.I. Hard Hill Country
East Coast	Sheep and Beef	4 N.I. Hill Country
East Coast	Sheep and Beef	5 N.I. Intensive Finishing
Taranaki-Manawatu	Sheep and Beef	3 N.I. Hard Hill Country
Taranaki-Manawatu	Sheep and Beef	4 N.I. Hill Country
Taranaki-Manawatu	Sheep and Beef	5 N.I. Intensive Finishing
Marlborough-Canterbury	Sheep and Beef	1 S.I. High Country
Marlborough-Canterbury	Sheep and Beef	2 S.I. Hill Country
Marlborough-Canterbury	Sheep and Beef	6 S.I. Finishing Breeding
Marlborough-Canterbury	Sheep and Beef	8 S.I. Mixed Finishing
Otago/Southland	Sheep and Beef	1 S.I. High Country
Otago/Southland	Sheep and Beef	2 S.I. Hill Country
Otago/Southland	Sheep and Beef	6 S.I. Finishing Breeding
Otago/Southland	Sheep and Beef	7 S.I. Intensive Finishing
<b>NZ Total</b>	<b>Sheep and Beef</b>	<b>9 All Classes N.Z.</b>
Northland-Waikato-BoP	Dairy	Dairy
East Coast	Dairy	Dairy
Taranaki-Manawatu	Dairy	Dairy
Marlborough-Canterbury	Dairy	Dairy
Otago/Southland	Dairy	Dairy
<b>NZ Total</b>	<b>Dairy</b>	<b>Dairy</b>

Sheep and beef farm type breakdowns are based on Meat and Wool New Zealand classifications. Dairy regions have significant variations between regions, so do not require further breakdowns.

### **2.2.3 Farm gate value**

Farm gate value is the value of products as sold at the farm gate. It is the raw returns to farmers for the sale of their products, and excludes processing or transportation costs.

### **2.2.4 Gross output**

Gross output is the total value of the sale of a product before the cost of producing goods from that product is subtracted. For example, the gross output of a processing plant will include the farm gate value of the products and any added value created from the production process.

### **2.2.5 Direct and Total GDP**

GDP, or Gross Domestic Product, is a measure of economic performance equal to the sum of the value added at every stage of production (the intermediate stages) by all the industries in an economy, plus taxes less subsidies, over a year. We look at two estimates of GDP in this report, total and direct.

Each industry will contribute directly to GDP as well as being a source for indirect and induced effects.

In the case of the pasture-based products industry, GDP is created directly by advanced animal husbandry including breeding animals for meat and milking cows. GDP is also created through the processing of these products, in either a meat or dairy processing plant. This is also part of the direct GDP contributed by the pasture-based products industry. Indirect contributions to GDP would for example come from the transport industry when transporting milk from the farm gate to the processing plant.

The total contribution includes direct, indirect and induced effects. These are as follows:

- The industry purchases materials and services from supplier firms, who in turn make further purchases from their suppliers. This generates an **indirect** effect.
- Persons employed in the industry and in firms supplying related services earn income (mostly from wages and salaries, but also from profits) which, after tax is deducted, is then spent on consumption. There is also an allowance for some savings. These are the **induced** effects.

## **2.3 Timing of data**

### **2.3.1 Years**

Data in this report is presented in June years where possible.

In the instance of export values, we assume a three month lag between farm gate sales and the export of product. This allows for manufacturing, storage and transportation for export. Therefore export values are taken on September years.

### **2.3.2 2006/07 season**

The 2006/07 season was used in calculations in this report. This season was used rather than 2007/08 due to irregularities identified in that season. 2007/08 had historically high dairy prices, which caused some issues in our modelling.



While a better representation of the relative value of pastoral products, the 2006/07 season was not without its problems - there was a drought, which affected levels of beef and sheep stocks in some areas of the country. This should be considered when examining the data.

## **2.4 Format of report**

Section 3 outlines the value of pasture-based products to the New Zealand economy, in terms of farm gate value, exports and domestic sales, gross output, and GDP. It goes on to describe the methods used to obtain these values.

Section 4 provides an estimate of the effect (in terms of farm gate value and GDP) of increasing the level of pasture renewal in New Zealand. It goes on to describe the model that was used to develop this estimate.

Section 5 describes in more detail the sources of information in regards to pasture response, that is, the expected increase in dry matter caused by pasture renewal.

The Appendix provides information on the multiplier analysis that was used in deriving our estimates of GDP and gross output.

## 3 Part one – the value of pasture

### 3.1 National summary of the value of pasture

The farm gate value of pasture-based products to the New Zealand economy was \$10.2 billion in the June 2007 year.

Looking at pasture-based products, the largest contributor to this value was the dairy industry. The dairy industry in the June 2007 year was worth \$6.6 billion, or 65 percent of the total value of pasture-based products. Sheep products (including lamb, mutton and wool) were worth \$2.2 billion, while beef pasture-based products were worth \$1.2 billion.

Table 3.1 shows the value of pasture-related products for the 2007 year, for the four major product types, beef, sheep, dairy and deer.

**Table 3.1 Summary of pasture products**

Farm Types	Jun-07	Sep-07	Jun-07	Jun-07
	Farm gate value (\$000)	Export FOB value (\$000)	Domestic Retail Value (\$000)	Total of Retail + Export Value
Beef	1,232,830	1,924,732	533,000	2,457,732
Sheep	2,180,285	3,387,755	149,000	3,536,755
Dairy	6,629,749	10,685,000	986,000	11,671,000
Deer	126,927	262,740		262,740
<b>Total</b>	<b>10,169,791</b>	<b>16,260,226</b>	<b>1,668,000</b>	<b>17,928,226</b>

*Source: Various, BERL*

The export value of pasture-based products was \$16.3 billion in the September 2007 year. Again, the dairy industry was the largest contributor with \$10.7 billion in export sales, followed by sheep pastoral products with \$3.4 billion and beef with \$1.9 billion in export sales.

Pasture-based products consumed domestically were worth \$1.7 billion in the June 2007 year. Around 60 percent of this consumption was dairy products, at just under \$1 billion in sales. The domestic retail value of beef products in the June 2007 year was just over \$530 million, while sheep products had domestic sales of approximately \$150 million. No information was available on the domestic consumption of deer products, but we expect this was minimal.

### 3.2 Gross output value of pasture-based products

Taking these farm gate values, we have estimated the contribution to New Zealand's gross output from each product type.<sup>1</sup> We have also applied a multiplier to these numbers to determine the total effect (including direct, indirect and induced effects) on the economy of this gross output.<sup>2</sup> Table 3.2 shows our estimates of gross output.

In the June 2007 year, the direct contribution to New Zealand's gross output of pasture-based products was \$24.3 billion. Accounting for indirect and induced effects from the sale of pasture-based products, the total gross output totalled \$72.3 billion.

**Table 3.2 Gross output of pasture based products, 2007**

Farm type	Gross output ex processing plant (\$000)	Gross output multiplier	Gross output including direct, indirect and induced effects (\$000)
Beef	2,912,013	3.16	9,203,649
Sheep	5,149,954	3.16	16,276,841
Dairy	15,962,603	2.88	45,918,038
Deer	299,809	3.16	947,569
<b>Total</b>	<b>24,324,379</b>		<b>72,346,097</b>

*Source: Various, BERL*

For the products analysed, the gross output after processing was \$2.9 billion for beef; \$5.1 billion for sheep; \$16.0 billion for dairy; and \$0.3 billion for deer. Total gross output, including direct, indirect and induced effects, increased these figures to \$9.2 billion for beef; \$16.3 billion for sheep; \$45.9 billion for dairy; and \$0.9 billion for deer.

Figures for the beef, sheep and deer industries were estimated using input-output tables. Dairy figures were estimated from ratios along the chain as measured using Fonterra data (See section 3.7.1 below).<sup>3</sup>

### 3.3 GDP value of pasture-based products

Using our estimates of direct gross output excluding processing, we applied GDP to gross output ratios from our input/output table for the relevant industries. This provided us with an estimate of GDP generated from pasture-based products. We then applied an appropriate multiplier to these numbers, to derive the total GDP effect (including direct, indirect and

<sup>1</sup> Gross output is essentially the total value of sales of products, before subtracting the cost of the goods used in the production of the products.

<sup>2</sup> More information on multipliers is located in the Appendix.

<sup>3</sup> Input/output tables are described in more detail in the Appendix.

induced effects).<sup>4</sup> Table 3.3 shows the estimated GDP contribution of pasture-based products to the New Zealand economy.

In the June 2007 year, the direct contribution to New Zealand's GDP of pasture-based products was \$5.2 billion. Accounting for indirect and induced effects, the total contribution to GDP was \$20.5 billion.

**Table 3.3 GDP of pasture based products, 2007**

Farm type	Gross output ex processing plant (\$000)	GDP to gross output ratio	GDP ex processing plant (\$000)	GDP Multiplier	GDP including direct, indirect and induced effects (\$000)
Beef	2,912,013	0.197	573,667	4.195	2,406,505
Sheep	5,149,954	0.197	1,014,541	4.195	4,255,954
Dairy	15,962,603	0.225	3,591,586	3.779	13,574,039
Deer	299,809	0.197	59,062	4.195	247,764
<b>Total</b>	<b>24,324,379</b>		<b>5,238,856</b>		<b>20,484,262</b>

Source: BERL

For the products analysed, the direct GDP after processing was for beef \$0.6 billion; for sheep \$1.0 billion; and for dairy \$3.6 billion. This equates to around 3.1 percent of New Zealand's GDP. This can be compared with the direct contribution of New Zealand's tourism industry of \$7.8 billion, or around 5.1 percent of New Zealand's GDP.

We estimate the contribution of pasture-based products to the New Zealand economy was approximately 12.1 percent of total GDP in the June 2007 year. Of this figure, \$2.4 billion was contributed by beef; \$4.3 billion by sheep; \$13.6 billion by dairy; and around a quarter of a billion by deer products.

### 3.4 Estimated employment in pasture-based industries

Using our estimates of direct gross output excluding processing plant, we applied FTE to gross output ratios from our input/output table for the relevant industries. This provided us with an estimate of the number of Full Time Equivalents (FTEs) generated from pasture-based products. We then applied an appropriate multiplier to these numbers, to derive the total number of FTEs generated by pasture-based products (including direct, indirect and induced effects).<sup>5</sup>

As shown in Table 3.4 below, over 35,400 FTEs were directly employed in industries that produced pasture-based products in 2007. The total number employed, after considering indirect and induced employment, rose to almost 277,300 FTEs.

<sup>4</sup> More information on multipliers is located in the Appendix.

<sup>5</sup> More information on multipliers is located in the Appendix.

**Table 3.4 FTEs in pasture-based industries, 2007**

Farm type	Gross output ex processing plant (\$000)	Output to FTE ratio	Direct FTEs	FTE Multiplier	Total FTEs, including direct, indirect and induced
Beef	2,912,013	2.80	8,163	5.05	41,254
Sheep	5,149,954	2.80	14,436	5.05	72,958
Dairy	15,962,603	0.75	11,983	13.25	158,827
Deer	299,809	2.80	840	5.05	4,247
<b>Total</b>	<b>24,324,379</b>		<b>35,423</b>		<b>277,286</b>

Source: Various, BERL.

### 3.5 The value of pasture by region

Table 3.5 shows the value of pasture production for a range of regions.

**Table 3.5 Regional farm gate values by product type, 2006/07 season**

Season	Regions	Product type (\$000)				
		Sheep	Beef	Deer	Dairy	Total
2006/07	Northland-Waikato-BoP	284,279	488,298	19,267	3,340,270	4,132,114
	East Coast	474,424	283,564	2,602	354,578	1,115,168
	Taranaki/Manawatu	224,637	135,402	9,365	1,118,656	1,488,060
	Canterbury/Westland	492,974	211,538	43,269	1,166,660	1,914,441
	Otago	311,665	58,634	12,023	178,260	560,582
	Southland	392,306	55,394	40,401	471,325	959,426
	<b>Total</b>	<b>2,180,285</b>	<b>1,232,830</b>	<b>126,927</b>	<b>6,629,749</b>	<b>10,169,791</b>

Source: Meat and Wool NZ

The production is valued at the farm gate level. We used these regional values as an input into our model of pasture renewal.

### 3.6 Supplementary feed

When measuring the value of pasture, we need to consider the use of supplementary feed. The assumption is that supplementary feed is not pasture-based, so animal production based on this feed should be excluded from our calculation.

The reality is, however, that no animals in New Zealand survive purely on supplementary feed. Supplementary feed is given to support animal growth or milk production over months with low pasture growth. It is therefore difficult to estimate how much production is due to supplementary feed.

In addition, a large proportion of supplementary feed is actually pasture based. Producing hay and silage (including green maize silage) is a normal part of the pasture rotation cycle for sheep, beef and dairy farms. As such, it should be included as part of pasture-based production.

Supplementary feed that is not pasture-based is generally imported, and includes palm kernels and dry maize grains. Dry maize grains are fed to sheep and cattle, but also to chicken and pigs. Determining the breakdown between pasture and non-pasture based production is difficult.

However, palm kernels are increasingly used in the dairy industry as a supplement in the winter months. The cost of palm kernels imports (including insurance and freight) can be readily obtained, and were valued at \$53.2 million in 2007, up from \$27.0 million in 2006. In 2008, the cost of palm kernel imports reached \$211.5 million. Even the latter high figure is only 1.3 percent of the FOB value of exports, or 1 percent of pasture contribution to GDP, so it is not a significant component for inclusion in the model.

### **3.7 Method**

This section provides an overview of the estimation of the main values used in this report.

#### **3.7.1 *Measuring the value of dairy products***

In analysing dairy product value, our main concern has been with the discrepancies between dairy farm gate price and export value for the 2007/08 year. Both have a similar value, which is strange considering the significant levels of processing and transportation costs between farm gate and exports. Part of this will be due to domestic consumption. However, we expected a much larger margin in terms of value added. Hence the numbers appeared counter-intuitive.

According to the Customs department, exporters are relied upon to provide estimates of export value. This is because Customs are primarily focussed on imports, where duties and taxes may apply. In large companies such as Fonterra, it may be difficult to estimate the value of a product, especially if production is vertically integrated. In this case, the company will rely on transfer pricing to estimate export value. Often this transfer price is a nominal value, not reflecting the actual sale value of the product. This means that export value for dairy products could be estimated based on farm gate value, given the lack of alternative valuations. This means export values will not include the manufacturing and transportation costs within the value.

A more accurate estimate of dairy value has therefore been derived directly from Fonterra accounts. This does not include the value of the farm gate payout and value added from the independent companies, but does provide ratios of these numbers that can be applied to total production. The data from 2003 to 2008 indicates that the farm gate payout apart from Fonterra would have been about \$520 million in 2006/07.

We have analysed the Fonterra accounts from 2002 to 2008 and estimated the major components of Fonterra's operating revenue.

**Table 3.6 Breakdown of Fonterra operating revenue**

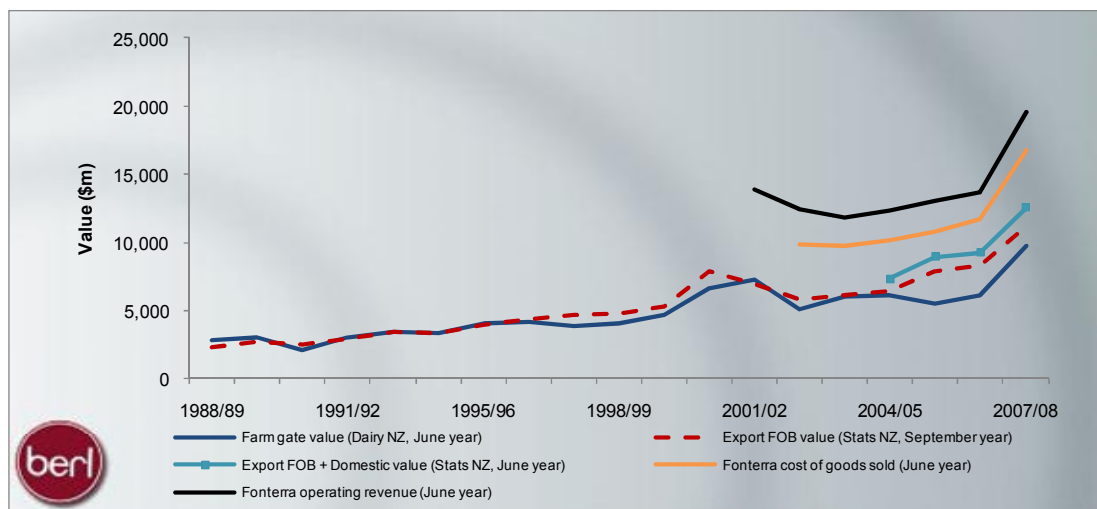
Item	Value 2006-07	
	\$m	%
Fonterra payout	\$5,612	41%
Processing costs	\$6,022	44%
<i>Cost of goods sold</i>	<i>\$11,634</i>	<i>85%</i>
Administration; other expenses	\$1,044	8%
<i>NZ Gross Output</i>	<i>\$12,678</i>	<i>93%</i>
Distribution; selling and marketing	\$1,009	7%
Fonterra operating revenue	\$13,687	100%

Note: the percentage breakdown is derived from data for 2002-2008.

We have assumed that the distribution expenses and selling and marketing expenses are mainly incurred overseas. We have also assumed that administration and other expenses are mainly incurred in New Zealand. Given that these assumptions are relatively accurate (or conversely that the divergences balance out), this shows that the value added or GDP contribution in 2006-07 from Fonterra's dairy operation was about \$12.7 billion. This was 2.26 times the farm gate payout by Fonterra in 2006-07.

Figure 3.1 plots total farm gate value (as estimated by multiplying milksolids processed by payout using Dairy NZ figures), export value (from Statistics New Zealand customs data), and domestic value (from Statistics New Zealand CPI expenditure weights). It relates these figures to Fonterra's cost of goods sold and total operating revenue. This shows a fairly steady relationship since the formation of Fonterra in 2002.

**Figure 3.1 Valuations of dairy product components**



### **3.7.2      *Farm gate value***

Farm gate value was calculated using Meat and Wool New Zealand data. The farm gate value is the value of the product when it leaves the farm. This is in effect the value for which the farmer sells his product.

### **3.7.3      *Export FOB value***

Export FOB value is the value of the product “free on board” i.e. the value of the product once it has been loaded on a ship for export. The value should approximate the processed end product value, plus transportation costs (by rail or truck) to the port of export. The numbers do not include the added value returned once the products have been sold overseas. Therefore, the actual value of exports will be higher.

We have used a lagged period to reflect the time taken to process and ship the products. Therefore, while we use the June 2007 year for farm gate values, we use the September 2007 in measuring FOB export value.

Statistics New Zealand data of Customs trade data was used, with HS codes used to define the pastoral products. In some cases, such as processed and preserved food, it was difficult to separate out pastoral based products. We have excluded these cases from the analysis, though we expect any underestimation to be minor.

The HS descriptors and associated categories used are shown in the table below:



**Table 3.7 List of HS codes for export values<sup>6</sup>**

<b>Product</b>			
<b>Dairy</b>	<b>Sheep</b>	<b>Beef</b>	<b>Deer</b>
0401	020410	0201	0208900001
0402	020421	0202	0208900002
0403	020422	020610	0208900003
0404	020423	020621	0208900005
0405	020430	020622	0208900006
0406	020441	020629	0208900008
1702.11	020442	021020	0208900009
1702.19	020443	0504000011	0208900011
1806.2	0206800039	0504000051	0208900013
1806.9	0206800041	160250	0208900015
1901.1	0206800049	4101	0208900017
2105	0206800051	4104	0208900018
3501.1	0206800059	051110	0208901915
3502.9	0206800061		0208901917
1901.90.09.28	0206800069		0208901918
2106.90.90.19	0206800079		0208901919
2106.90.91.00	0206900001		0210901915
2106.90.92.00	0206900009		0210901917
2106.90.93.00	0206900011		0210901918
2106.90.94.00	0206900019		0210901929
2106.90.95.00	0206900021		
2106.90.96.00	0206900029		
2106.90.97.00	0206900039		
2106.90.99.01	0206900041		
2106.90.99.19	0206900049		
3501.90.00.01	0206900051		
3501.90.00.09	0206900059		
3501.90.00.19	0206900061		
3502.20.00.00	0206900069		
	0206900079		
	0210901901		
	0504000019		
	0504000021		
	0504000031		
	0504000039		
	0504000059		
	4102		
	4105		

*Source: Statistics NZ*

<sup>6</sup> HS codes and their definitions are available from the Statistics New Zealand website [www.stats.govt.nz](http://www.stats.govt.nz).

#### **3.7.4      *Domestic retail value***

Domestic retail values were derived from CPI expenditure weights for meat and dairy products in New Zealand. This represents the expenditure made on pastoral products in the domestic market. The CPI expenditure categories used in this analysis were beef and veal; mutton, lamb and hogget; and dairy products. There was no category for deer, but we would expect this to be fairly minimal in New Zealand. Possibly more importantly, the figures do not include restaurant meals, which would include a large proportion of meat; processed and preserved meat such as sausages; and ready to eat meals. As we could not separate out the pastoral products from these categories, we have excluded them.

## 4 Part two - a model of pasture response

This section of the report discusses the model used to estimate the change in farm gate values given an ideal level of pasture renewal.

For the purposes of this study, the ideal level of pasture renewal is 12 percent of the area for dairy farms and 8 percent for sheep, beef and deer farms. This ideal was determined in a 2008 market research study by AgResearch.

Our model calculates the change in farm gate value for dairy farms, and sheep and beef farms. Deer is excluded, due to a lack of information. Broadly, we would expect a similar response for deer as for sheep and beef farms.

### 4.1 Summary of results- first year of renewal

Table 4.1 shows results from our model estimates. Note that these are estimates of the one-off response in the year following the pasture renewed. The magnitude of this increase would depend on the level of pasture response, and the method of calculation used.

**Table 4.1 Summary of model results- farm gate value**

Farm type	Existing pasture renewal level	Current farm gate value (\$m)	Target pasture renewal level	Level of pasture response	New farm gate value due to renewal			Percent increase in farm gate value		
					Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Sheep and Beef	2.04%	\$3,538	8%	10%	\$3,567	\$3,567	\$3,592	0.8%	0.8%	1.5%
				30%	\$3,626	\$3,623	\$3,701	2.5%	2.4%	4.6%
Dairy	6.11%	\$6,630	12%	7%	\$6,657			0.4%		
				27%	\$6,734			1.6%		

Source: BERL.

Sheep and beef farms had a level of pasture renewal of 2.0 percent in 2006/07. If this level of pasture renewal was increased to 8 percent, then the farm gate value of sheep and beef products would significantly increase.

We have modelled for a level of pasture response for sheep and beef farms of 10 and 30 percent. Assuming a 10 percent increase in pasture levels due to renewal, we would expect an increase in sheep and beef farm gate values of between 0.8 and 1.5 percent. Given an increase of 30 percent, we would expect an increase in farm gate values of between 2.4 and 4.6 percent.

Similarly, dairy farms had a level of pasture renewal of 6.1 percent in 2006/07. If this level of pasture renewal was increased to 12 percent, we would expect an increase in farm gate values of between 0.4 and 1.6 percent. This increase in value would depend on the level of pasture response due to renewal; we have modelled for a 7 and 27 percent response.

**Table 4.2 Summary of model results- GDP**

Farm type	Current GDP value (\$m)	Level of pasture response	New GDP due to renewal			Percent increase in GDP		
			Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Sheep and Beef	\$6,662	10%	\$6,718	\$6,772	\$6,876	0.8%	0.8%	1.5%
		30%	\$7,046	\$7,217	\$7,549	2.5%	2.4%	4.6%
Dairy	\$13,574	7%	\$13,630			0.4%		
		27%	\$13,786			1.6%		

Source: BERL.

For sheep and beef, pasture renewal could potentially increase the contribution to GDP of pasture-based products (including indirect and induced effects) from \$6.66 billion to a range of \$6.71 billion to \$7.55 billion, depending on the method used. The midpoint of this range is \$7.13 billion.

For dairy, pasture renewal could potentially increase the contribution to GDP of pasture-based products (including indirect and induced effects) from \$13.57 billion to a range of \$13.63 to \$13.78 billion. The midpoint of this range is \$13.71 billion.

Adding the GDP midpoints from sheep, beef and dairy gives a total of \$20.84 billion, a 3.0 percent increase from the June 2007 year GDP of \$20.24 billion.

More information on the methodology used to calculate these results is located in section 4.3.

#### **4.2 Multiple years of sustained pasture renewal**

To show the true value of pasture renewal, we modelled the level of response for several years. This is because each year farmers will renew different pasture, over time lifting the productivity of all pasture. As such, there is a cumulative effect, where each year includes added production that has been caused by pasture renewal occurring in previous years.

Countering this increase in production is the fall in production that occurs progressively in the years after a pasture is renewed. We have modelled this decline, assuming two scenarios where grass production reduces back to original levels at either 10 or 20 percent per year.

Figure 4.1 shows the effect of sustained, continuous pasture renewal on the value of dairy products, given a 10 percent production decline each year.

**Figure 4.1 Pasture renewal multiple years, 10% production decline**

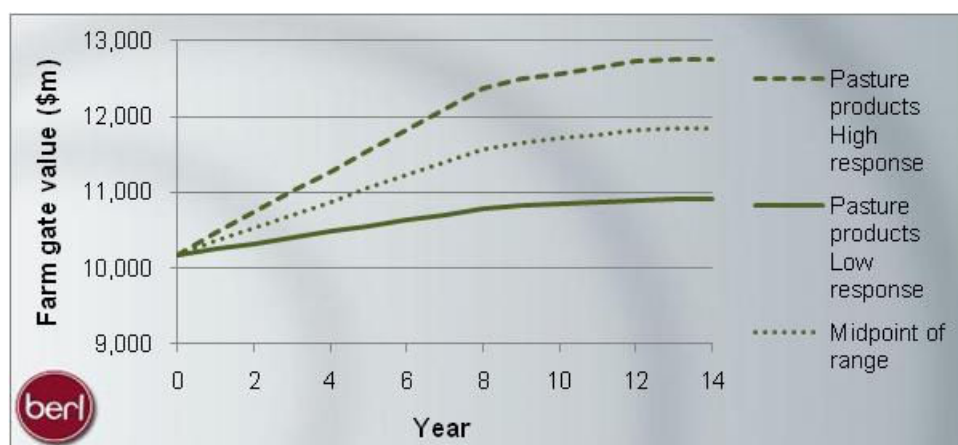


Table 4.3 shows the results of this analysis, using method one as a basis for the growth.

**Table 4.3 Multiple year analysis, method one**

Measure	Sheep and Beef		Dairy	
	Low (10% response)	High (30% response)	Low (7% response)	High (27% response)
Farm gate value (June-07 year)	\$3,538		\$6,630	
Highest production reached (10 percent prdn decline)	\$3,852	\$4,494	\$7,022	\$8,222
% increase	8.9%	27.0%	5.9%	24.0%
Highest production reached (20 percent prdn decline)	\$3,833	\$4,422	\$7,017	\$8,122
% increase	8.3%	25.0%	5.8%	22.5%

Source: BERL.

As can be seen in the table, total farm gate value could potentially increase by a larger amount than that modelled in a single year. Depending on the level of response, farm gate values could increase between 9 and 27 percent for sheep and beef farms, and between 6 and 25 percent for dairy farms. This response will be permanent if all pasture is renewed over the regular cycle.

Using the midpoints of these ranges, the farm gate value of continuous pasture renewal for sheep, beef and dairy farms is \$11.8 billion, 16.4 percent higher than current farm gate values. To put this in context, it would require an additional 460,000 international tourists to the current 2.4 million to generate this level of additional expenditure for the tourism sector.

Direct GDP would increase from \$5.2 billion to \$6.0 billion, an increase of \$850 million, if pasture renewal was increased to target levels (based on an average rate of pasture response).

### 4.3 Method

To estimate the impact an increase in pasture renewal will have on total farm gate values, we required several key inputs into our model.

- The total hectares for each farm type in New Zealand, by region.
- The existing level of pasture renewal occurring by region and farm type.
- The average annual existing pasture growth (in kilograms of dry matter per hectare) by region and farm type. An alternative method of measurement is the number of stock units per hectare.
- The level of pasture response due to pasture renewal, in kilograms of dry matter per hectare, or number of stock units per hectare.

The sections below indicate how we estimated these variables.

#### 4.3.1 *Hectares by farm type*

We obtained regional breakdowns of sheep and beef farms for the 2005/06 year from Meat and Wool New Zealand data. This data was derived from their annual survey.

It was difficult to obtain the area of dairy farm hectares. There were a range of estimates, which are shown in the table below.

**Table 4.4 Estimates of dairy farm hectares**

Publication	Source	Year	Hectares
Agricultural Production Census	Stats NZ	2007	1,962,724
Dairy Production Statistics	Dairy NZ	2006/07	1,412,925

Dairy NZ's Dairy Production Statistics provided a detailed breakdown of regional hectares. However, the numbers do not include the area for run-off pasture, only those hectares used specifically as a milking platform.

For the purposes of this study, we used the official Statistics New Zealand Agricultural Production Census figure of 2.0 million hectares. This census classifies blocks of land based on their main purpose. Therefore, land classified as dairy farms may include significant levels of sheep and beef farming, or possibly other land use such as forestry. Nonetheless, this estimate was the best available.

We therefore used the regional breakdowns provided by Dairy NZ and inflated them to reach the total Statistics New Zealand figure.

#### 4.3.2 Estimates of existing pasture renewal

To calculate the effect that increasing the level of pasture renewal will have on the New Zealand economy, we had to estimate existing levels of pasture renewal. This was done through several sources of information, including:

- the Meat and Wool New Zealand survey on sheep and beef farms
- AgResearch market survey on pasture renewal, commissioned by PRCT
- PRCT strategic focus brief
- seed production estimates.

#### Meat and Wool New Zealand annual survey

Estimates of pasture renewal levels for sheep and beef farms were taken from an annual survey by Meat and Wool New Zealand. This information was broken down into the nine Meat and Wool New Zealand farm classes by region for total hectares and level of pasture renewal, in terms of renewed and over sown hectares.

Table 4.5 summarises the pasture renewal levels from the survey,

**Table 4.5 Estimates of pasture renewal, sheep and beef farms, farm type, 2006/07**

Region	Farm type	Total Hectares	Existing new grass (ha)	Existing oversown (ha)	Existing pasture renewal (ha)	% of total
Northland-Waikato-BoP	3 N.I. Hard Hill Country	162,300	890	-	890	0.55%
Northland-Waikato-BoP	4 N.I. Hill Country	719,500	7,010	-	7,010	0.97%
Northland-Waikato-BoP	5 N.I. Intensive Finishing	114,200	2,520	1,010	3,530	3.09%
East Coast	3 N.I. Hard Hill Country	518,000	1,770	-	1,770	0.34%
East Coast	4 N.I. Hill Country	609,500	8,250	2,360	10,610	1.74%
East Coast	5 N.I. Intensive Finishing	291,500	9,300	-	9,300	3.19%
Taranaki-Manawatu	3 N.I. Hard Hill Country	311,800	3,360	-	3,360	1.08%
Taranaki-Manawatu	4 N.I. Hill Country	312,100	5,200	-	5,200	1.67%
Taranaki-Manawatu	5 N.I. Intensive Finishing	81,300	3,350	420	3,770	4.64%
Marlborough-Canterbury	1 S.I. High Country	981,200	4,040	-	4,040	0.41%
Marlborough-Canterbury	2 S.I. Hill Country	1,048,400	7,660	14,140	21,800	2.08%
Marlborough-Canterbury	6 S.I. Finishing Breeding	821,600	38,210	2,120	40,330	4.91%
Marlborough-Canterbury	8 S.I. Mixed Finishing	224,900	13,710	-	13,710	6.10%
Otago/Southland	1 S.I. High Country	1,240,500	1,260	-	1,260	0.10%
Otago/Southland	2 S.I. Hill Country	372,700	9,400	6,530	15,930	4.27%
Otago/Southland	6 S.I. Finishing Breeding	503,400	16,440	870	17,310	3.44%
Otago/Southland	7 S.I. Intensive Finishing	424,800	17,060	1,710	18,770	4.42%
<b>NZ Total</b>	<b>9 All Classes N.Z.</b>	<b>8,817,200</b>	<b>147,540</b>	<b>31,980</b>	<b>179,520</b>	<b>2.04%</b>

Source: Meat and Wool New Zealand

Nationally, we estimate around 2.0 percent or 180,000 hectares of pasture was renewed in the 2006/07 year at sheep and beef farms. The region with the largest proportion of pasture renewal was in Canterbury mixed finishing farms, at 6.10 percent, while the lowest proportion was in Otago-Southland high country, at 0.10 percent.

Excluding South Island high country, which had very low levels of pasture renewal, national pasture renewal for sheep and beef farms is estimated at 2.65 percent in the 2006/07 year.

### **AgResearch Market Research**

In May 2008, AgResearch completed a market research report for PRCT on pasture renewal in New Zealand. This report surveyed a number of farmers around New Zealand and estimated levels of pasture renewal.

Levels of pasture renewal in the AgResearch report were higher than other estimates, which may be due to statistical error or survey bias. Table 4.6 shows estimates of pasture renewal for the industry as at 2008.

**Table 4.6 Results of market research survey, 2008**

Region	Proportion of pasture renewal occurring (%)		
	Sheep, beef, deer	Dairy	Adjusted Dairy
North Island	3	8	5
South Island	7	12	8

*Source: AgResearch.*

Because we believe these figures are too high, we have adjusted the dairy figures by a factor of 0.66. This provided us with a total estimate of pasture renewal that broadly matches the estimate of total pasture renewal for dairy in the PRCT strategic focus brief. This brief estimated dairy pasture renewal at around 5 percent.

### **Seed production estimates**

We were provided an estimate of existing levels of pasture renewal by Murray Willocks of New Zealand Agriseeds Ltd.

This estimate was derived by taking the average production of seeds used for pasture renewal between 2003 and 2006, and removing exports, to estimate domestic sales. Assuming that pasture is sown at the recommended 20 kilograms per hectare, the average amount of pasture renewed during this period was approximately 300,000 hectares per annum.

Considering existing pasture renewal for sheep and beef farms is around 180,000 hectares, based on the Meat and Wool New Zealand figures, approximately 120,000 hectares of dairy farms must be renewed. This closely aligns with our estimates using the revised AgResearch figures.

Table 4.7 illustrates estimates of pasture renewal for dairy farms, based on the assumed proportions.



**Table 4.7 Estimates of pasture renewal for dairy farms by farm type, 2006/07**

<b>Farm type</b>	<b>Total Hectares</b>	<b>Existing pasture renewal (ha)</b>	<b>% of total</b>
Northland-Waikato-BoP	833,285	44,442	5.33%
East Coast	146,015	7,787	5.33%
Taranaki-Manawatu	413,302	22,043	5.33%
Marlborough-Canterbury	326,573	26,126	8.00%
Otago/Southland	243,549	19,484	8.00%
<b>NZ Total</b>	<b>1,962,724</b>	<b>119,882</b>	<b>6.11%</b>

*Source: AgResearch, Dairy NZ, Statistics NZ.*

The total estimated level of pasture renewal for dairy farms in 2006/07 was 119,900 hectares or 6.1 percent of the total hectares in the dairy industry.

#### **4.3.3      *Estimates of existing dry matter growth/stock units***

The level of current grass growth in terms of dry matter per hectare was hard to come by. Most striking was the lack of information or trials being run looking at pasture levels or response for sheep and beef farms.

We have gathered estimates from several sources: the outcomes from an AgResearch paper showing four separate regional models of sheep and beef farms; data from regional test dairy farms in Stratford, Ruakura, and Lincoln, and data from a range of trials measured between 1975 and 2003 by Dexcel.

Current stock units were available for sheep and beef farm models in the AgResearch models. We therefore used the AgResearch model data, supplemented with information from dairy farm trials in Stratford and Ruakura in our estimates of existing dry matter growth.

Table 4.8 provides a summary of average annual pasture levels, and stock units by product and farm type from the sources listed above. Mentioned in our interviews with industry stakeholders was the variability of pasture growth, even within the same farm, with some estimates suggesting a 100% difference in pasture growth between the lowest and highest performing pastures.

**Table 4.8 Existing regional dry matter growth and stock units**

Farm Type	Source	Existing pasture growth	Existing stock units
Sheep and beef	AgResearch Literature Review- Model CNI	8,900	12.3
Sheep and beef	AgResearch Literature Review- Model Manawatu	12,200	14.9
Sheep and beef	AgResearch Literature Review- Model Otago Hill	9,000	11.3
Sheep and beef	AgResearch Literature Review- Model Southland Fertile	12,900	18.3
Dairy	AgResearch Literature Review- Model Northland/BOP	9,825	
Dairy	AgResearch Literature Review- Model Waikato	11,558	
Dairy	AgResearch Literature Review- Model Canterbury	11,406	
Dairy	Northland Pastoral Development Group	12,197	
Dairy	Stratford Dairy Trials	13,500	
Dairy	Dexcel- NZ average of case studies 1975-2003	13,700	
Dairy	Dexcel case studies - Northland	14,549	
Dairy	Dexcel case studies - Bay of Plenty	14,699	
Dairy	Dexcel case studies - Waikato	14,256	
Dairy	Dexcel case studies - Taranaki	12,209	
Dairy	Dexcel case studies - Lower North Island	12,576	
Dairy	Dexcel case studies - South Island	13,323	

In our model of pasture renewal, we used a combination of AgResearch model data and dairy pasture trials to estimate existing levels of pasture growth in kilograms of dry matter per hectare. These estimates are applied to each of the regions we analyse, using the most appropriate estimate for each region.

#### **AgResearch modelling outcomes**

The AgResearch study *Benefit Analysis: Literature Review and Modelling Outcomes* prepared for PRCT used four farm models in its analysis of the outcomes of pasture renewal for sheep and beef farms. Each model provided an estimate of pasture growth for a base case. Similar information on stock units was available for each base case.

Further, the report modelled dairy pasture growth for three dairy farm models, which provided base pasture growth.

#### **Dexcel case studies**

Dexcel provided a comprehensive list of dairy pastures, measuring kilograms of dry matter per hectare over a range of years. This was our most comprehensive source of information, in terms of quantity of trials and geography. However, the limitations of this information was a lack of identification as to whether pasture was renewed or not, which could suggest that the estimates were high.

#### **Dairy farm pasture trials**

Data was available from pasture left deliberately unrenewed (as base cases) for Stratford and Ruakura dairy farm trials for kilograms of dry matter per hectare. Unfortunately,

Ruakura has only five months of data available at this stage, so may not be easily compared.

**Table 4.9 Average dry matter production, unrenewed pasture dairy farm trials**

Stratford	Ruakura
Average annual kgDM/ha	Average 5-month kgDM/ha
13,500	6,886

*Source: Stratford, Ruakura trials*

The Stratford number seems slightly high when compared with the Dexcel average for the Taranaki region or the base data from the AgResearch models.

#### 4.3.4 Estimates of pasture response

Pasture response is currently estimated using high and low bounds, based on the highest and lowest estimates of pasture response identified from the data. Table 4.10 summarises the levels of pasture response identified from the range of data sources available.

**Table 4.10 Pasture response levels**

Farm Type	Contact	Source	Renewed	
			Successful	Unsuccessful
Sheep and beef	Dave Stevens	AgResearch Literature Review- Model CNI	110% to 130% of average existing	
Sheep and beef	Dave Stevens	AgResearch Literature Review- Model Manawatu	110% to 130% of average existing	
Sheep and beef	Dave Stevens	AgResearch Literature Review- Model Otago Hill	110% to 130% of average existing	
Sheep and beef	Dave Stevens	AgResearch Literature Review- Model Southland Fertile	110% to 130% of average existing	
Dairy	Steve Lee	Lincoln University Dairy Farm	110% of average existing	
Dairy	Steve Lee	National estimate	120% of average existing	
Dairy	Warren King	Waikato - Ruakura Study- Warren's Model	180% of poorest pasture, or 16,000 kgDM/ha	
Dairy	Warren King	Waikato - Ruakura Study	127% of average existing	67% of successfully renewed
Dairy	Dave Stevens	AgResearch Literature Review- Model Northland/BOP	115% to 135% of average existing	
Dairy	Dave Stevens	AgResearch Literature Review- Model Waikato	115% to 135% of average existing	
Dairy	Dave Stevens	AgResearch Literature Review- Model Canterbury	115% to 135% of average existing	
Dairy	Graham Pitman	Stratford Dairy Trials	107% of average existing, or 14,400 kgDM/ha	

For sheep and beef farms, we used 10 percent and 30 percent for our lower and upper bounds of pasture response. For dairy farms, we used 7 percent and 27 percent as our bounds. Using the base pasture growth levels estimated in Section 4.3.3, we then applied this to produce a pasture-renewed level of kilograms of dry matter per hectare.

To provide rigor around the model estimates, we used stock units as an alternative measure of pasture renewal response in the sheep and beef analysis. That is, increased pasture renewal will allow a higher number of stock units to graze on the pasture. For this measure, we used the level of stock units from the AgResearch sheep and beef models, and compared this with the stock units for the base scenario to determine a ratio that could be applied.

We provide more in depth information on pasture response data gathered from other sources in chapter 5.

#### 4.3.5 Further calculations

Using the data gathered, we were able to derive estimates of the level of pasture production in millions of kilograms of dry matter for each region. We then estimated projected pasture growth (based on the pasture response assumptions) if the target levels of pasture renewal was reached.

Using data available from Meat and Wool New Zealand's annual survey for the 2006/07 season, broken down by geographical region and farm type, we calculated the farm gate value by kilograms of dry matter and by hectare.

We also built a failure rate into our model as pasture renewal, if improperly managed, can fail. Given some level of pasture renewal failure, and the result in terms of pasture response, we then modelled the resulting change in pasture growth. However, having no information on failure rates, we modelled the results based on a zero percent failure rate. This could potentially be an area of future research.

#### 4.3.6 Calculating new farm gate values

We approached our estimates of new farm gate values in two ways to improve the rigor of our model.

Firstly, we calculated the farm gate value assuming a constant farm gate value per kilogram of dry matter between existing levels and projected levels. This is identified as **method 1**, and could be derived for sheep and beef, and dairy farms.

Secondly, we calculated farm gate value based on the ratio between grass production and farm gate production from the AgResearch sheep and beef models. This is **method 2**.

The ratios used are in Table 4.11. We were only able to do this for the sheep and beef farms due to a lack of information.

**Table 4.11 AgResearch model ratios**

Model Name	Average ratio between revenue and dry matter production
Central North Island	1.10
Manawatu Flat	0.84
Otago Hill	1.46
Southland Fertile	0.98

*Source: AgResearch.*

A further method was to use stock units as a base for measuring pasture response. We found in the Meat and Wool New Zealand data that the value per stock unit was remarkably consistent on their main types of farms in different regions. These types were:

- High country
- Hard hill
- Hill
- Finishing/ Breeding
- Finishing/ Intensive finishing

The stock unit response generated by additional pasture growth is taken from the AgResearch models. We multiplied this by the value per stock unit according to farm type. This is **method 3**. The average value of revenue per stock unit for each farm type was as follows:

**Table 4.12 Revenue per stock unit, by farm type, 2006/07**

Region type	Value / stock unit (\$)
High	\$52.52
Hard hill	\$50.69
Hill	\$61.38
Finishing Breeding	\$72.24
Mixed finishing/Intensive finishing	\$79.74

Source: Meat and Wool NZ.

#### 4.3.7 Results – farm gate value

Table 4.13 shows the change in farm gate value of sheep and beef products, for an assumed 10 percent pasture response, for the three methods described above.

**Table 4.13 Change in farm gate value for a 10% pasture response, sheep and beef**

Region	Farm Type	Current	Farm gate value (\$m)			Increase in farm gate value (%)		
			10% pasture response			10% pasture response		
			Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Northland-Waikato-BoP	3 N.I. Hard Hill Country	80	80	80	80	0.1%	0.1%	0.2%
Northland-Waikato-BoP	4 N.I. Hill Country	556	557	558	559	0.3%	0.4%	0.6%
Northland-Waikato-BoP	5 N.I. Intensive Finishing	112	114	114	115	1.3%	1.0%	2.1%
East Coast	3 N.I. Hard Hill Country	196	196	196	196	0.1%	0.1%	0.1%
East Coast	4 N.I. Hill Country	345	346	346	348	0.4%	0.4%	0.8%
East Coast	5 N.I. Intensive Finishing	214	216	215	217	0.9%	0.7%	1.6%
Taranaki-Manawatu	3 N.I. Hard Hill Country	129	129	129	129	0.2%	0.2%	0.5%
Taranaki-Manawatu	4 N.I. Hill Country	177	178	178	179	0.4%	0.5%	0.9%
Taranaki-Manawatu	5 N.I. Intensive Finishing	61	62	62	63	1.4%	1.1%	2.5%
Marlborough-Canterbury	1 S.I. High Country	53	53	53	53	0.1%	0.1%	0.1%
Marlborough-Canterbury	2 S.I. Hill Country	179	180	180	180	0.5%	0.6%	0.7%
Marlborough-Canterbury	6 S.I. Finishing Breeding	487	494	494	501	1.6%	1.5%	3.0%
Marlborough-Canterbury	8 S.I. Mixed Finishing	89	91	91	92	2.4%	2.2%	4.3%
Otago/Southland	1 S.I. High Country	73	73	73	73	0.0%	0.0%	0.0%
Otago/Southland	2 S.I. Hill Country	118	119	119	119	0.9%	1.3%	1.5%
Otago/Southland	6 S.I. Finishing Breeding	278	281	281	283	1.0%	0.9%	1.9%
Otago/Southland	7 S.I. Intensive Finishing	392	398	398	403	1.6%	1.5%	3.0%
<b>NZ Total</b>	<b>9 All Classes N.Z.</b>	<b>3,538</b>	<b>3,567</b>	<b>3,567</b>	<b>3,592</b>	<b>0.8%</b>	<b>0.8%</b>	<b>1.5%</b>

Source: BERL

For the two methods based on dry matter response, results were fairly similar, at 0.8 percent at a national level. The farm types with the most increase in value using these methods were Marlborough-Canterbury mixed finishing (at a 2.2 to 2.4 percent increase in farm gate value) and Otago-Southland intensive finishing (at a 1.5 to 1.6 percent increase in farm gate value).

Looking at the method based on stock unit response, farm gate values grew 1.5 percent nationally. The strongest growth in farm gate values was recorded in Marlborough-Canterbury mixed finishing (4.3 percent), Marlborough-Canterbury finishing breeding (3.0 percent), and Otago-Southland intensive finishing.

Table 4.14 shows the change in farm gate value of sheep and beef products, for an assumed 30 percent pasture response, for the three methods described above.

**Table 4.14 Change in farm gate value for a 30% pasture response, sheep and beef**

Region	Farm Type	Current	Farm gate value (\$m)			Increase in farm gate value (%)		
			30% pasture response			30% pasture response		
			Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Northland-Waikato-BoP	3 N.I. Hard Hill Country	80	80	80	81	0.3%	0.4%	0.7%
Northland-Waikato-BoP	4 N.I. Hill Country	556	561	562	565	0.9%	1.1%	1.7%
Northland-Waikato-BoP	5 N.I. Intensive Finishing	112	117	116	120	3.8%	3.1%	6.4%
East Coast	3 N.I. Hard Hill Country	196	196	196	197	0.2%	0.2%	0.4%
East Coast	4 N.I. Hill Country	345	349	349	353	1.1%	1.3%	2.4%
East Coast	5 N.I. Intensive Finishing	214	220	218	224	2.6%	2.1%	4.9%
Taranaki-Manawatu	3 N.I. Hard Hill Country	129	129	130	130	0.6%	0.7%	1.4%
Taranaki-Manawatu	4 N.I. Hill Country	177	180	180	182	1.3%	1.5%	2.6%
Taranaki-Manawatu	5 N.I. Intensive Finishing	61	64	64	66	4.2%	3.4%	7.6%
Marlborough-Canterbury	1 S.I. High Country	53	53	53	53	0.3%	0.4%	0.4%
Marlborough-Canterbury	2 S.I. Hill Country	179	182	182	183	1.4%	1.8%	2.1%
Marlborough-Canterbury	6 S.I. Finishing Breeding	487	509	508	530	4.7%	4.4%	8.9%
Marlborough-Canterbury	8 S.I. Mixed Finishing	89	95	94	100	7.1%	6.7%	13.0%
Otago/Southland	1 S.I. High Country	73	73	73	73	0.1%	0.1%	0.1%
Otago/Southland	2 S.I. Hill Country	118	121	122	123	2.8%	3.8%	4.4%
Otago/Southland	6 S.I. Finishing Breeding	278	286	286	294	3.0%	2.8%	5.8%
Otago/Southland	7 S.I. Intensive Finishing	392	410	409	426	4.8%	4.5%	8.9%
<b>NZ Total</b>	<b>9 All Classes N.Z.</b>	<b>3,538</b>	<b>3,626</b>	<b>3,623</b>	<b>3,701</b>	<b>2.5%</b>	<b>2.4%</b>	<b>4.6%</b>

Source: BERL

For a 30 percent pasture response, the results for the first two methods were again similar, at 2.4 percent and 2.5 percent at a national level. The farm types with the most increase in farm gate value for these methods were in Marlborough-Canterbury mixed finishing (at a 6.7 to 7.1 percent increase in farm gate value), Otago-Southland intensive finishing (at a 4.5 to 4.8 percent increase in farm gate value), and Marlborough-Canterbury finishing breeding (at a 4.4 to 4.7 percent increase in farm gate value).

The method based on stock unit response resulted in a 4.6 percent increase in farm gate value nationally. The strongest growth was in Marlborough-Canterbury mixed finishing, with a 13 percent increase in farm gate value.

Table 4.15 shows the change in farm gate value of dairy products, for an assumed 7 percent and 27 percent pasture response, based on method 1.

**Table 4.15 Change in farm gate value for 7% and 27% pasture response, dairy**

Region	Farm gate value (\$m)			Increase in farm gate value (%)	
	Current	7% pasture response	27% pasture response	7% pasture response	27% pasture response
Northland-Waikato-BoP	3,340	3,356	3,400	0.5%	1.8%
East Coast	355	356	361	0.5%	1.8%
Taranaki-Manawatu	1,119	1,124	1,139	0.5%	1.8%
Marlborough-Canterbury	1,167	1,170	1,179	0.3%	1.1%
Otago/Southland	650	651	656	0.3%	1.1%
<b>Total</b>	<b>6,630</b>	<b>6,657</b>	<b>6,734</b>	<b>0.4%</b>	<b>1.6%</b>

Source: BERL.

Results for dairy farms were between 0.4 and 1.6 percent, given a 7 to 27 percent pasture response. Dairy farms in the North Island, which currently have a lower rate of pasture renewal than the South Island, were more affected by increasing their pasture renewal to the target level of 12 percent of total hectorage. North Island dairy farms increased their farm gate value in the range of 0.5 to 1.8 percent, while South Island dairy farms increased their farm gate value by 0.3 to 1.1 percent.

#### 4.3.8 Results – GDP

The contribution of pasture-based products to national GDP (including induced and indirect effects) was \$13.6 billion for dairy products and \$6.7 billion for sheep and beef products in the June 2007 year.

Using estimates of farm gate value, we can derive an increase in GDP due to pasture renewal for the different levels of pasture response.

**Table 4.16 Change in GDP for a 10% pasture response, sheep and beef**

Region	GDP (\$m)			Increase in GDP(%)			
	Current	10% pasture response			10% pasture response		
		Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
NZ Total	6.662	6.718	6.772	6.876	0.8%	0.8%	1.5%

Source: BERL.

**Table 4.17 Change in GDP for a 30% pasture response, sheep and beef**

Region	GDP (\$m)				Increase in GDP(%)		
	Current	30% pasture response			30% pasture response		
		Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
NZ Total	6.662	7.046	7.217	7.549	2.5%	2.4%	4.6%

Source: BERL.

Pasture renewal could potentially increase the contribution to GDP (including indirect and induced effects) of sheep and beef products from \$6.66 billion to between \$6.7 billion and \$7.5 billion.

**Table 4.18 Change in GDP for 7% and 27% pasture response, dairy**

Region	GDP (\$m)			Increase in GDP (%)	
	Current	7% pasture response	27% pasture response	7% pasture response	27% pasture response
<b>Total</b>	<b>13,574</b>	<b>13,630</b>	<b>13,786</b>	<b>0.4%</b>	<b>1.6%</b>

Source: BERL.

For dairy, pasture renewal could potentially increase the contribution to GDP (including indirect and induced effects) of dairy products from \$13.57 billion to between \$13.6 billion and \$13.8 billion.

#### 4.3.9 Results – Employment

Using estimates of farm gate value, we can derive the change in the number of FTEs employed due to pasture renewal for the different levels of pasture response.

**Table 4.19 Change in FTEs for a 10% pasture response, sheep and beef**

Region	Current	FTEs			Increase in FTEs(%)		
		10% pasture response			10% pasture response		
		Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
<b>NZ Total</b>	<b>114,211</b>	<b>115,161</b>	<b>116,095</b>	<b>117,877</b>	<b>0.8%</b>	<b>0.8%</b>	<b>1.5%</b>

Source: BERL.

Pasture renewal could potentially increase the number of FTEs employed in the sheep and beef industry by between 950 and 15,200 people.

**Table 4.20 Change in FTEs for a 30% pasture response, sheep and beef**

Region	Current	FTEs			Increase in FTEs(%)		
		30% pasture response			30% pasture response		
		Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
<b>NZ Total</b>	<b>114,211</b>	<b>120,794</b>	<b>123,713</b>	<b>129,408</b>	<b>2.5%</b>	<b>2.4%</b>	<b>4.6%</b>

Source: BERL.

For dairy, pasture renewal could potentially increase the number of FTEs employed in this industry from around 158,800 to 161,300, an increase of 2,500 people.

**Table 4.21 Change in FTEs for 7% and 27% pasture response, dairy**

Region	FTEs			Increase in FTEs (%)	
	Current	7% pasture response	27% pasture response	7% pasture response	27% pasture response
<b>Total</b>	<b>158,827</b>	<b>159,479</b>	<b>161,313</b>	<b>0.4%</b>	<b>1.6%</b>

Source: BERL.

#### 4.3.10 Modelling multiple years of pasture renewal

To show the true value of pasture renewal, we modelled the level of response sustained continuously in future years. This is because each year, farmers will renew different pasture until all pasture has been renewed. As such, there is a cumulative effect, where each year

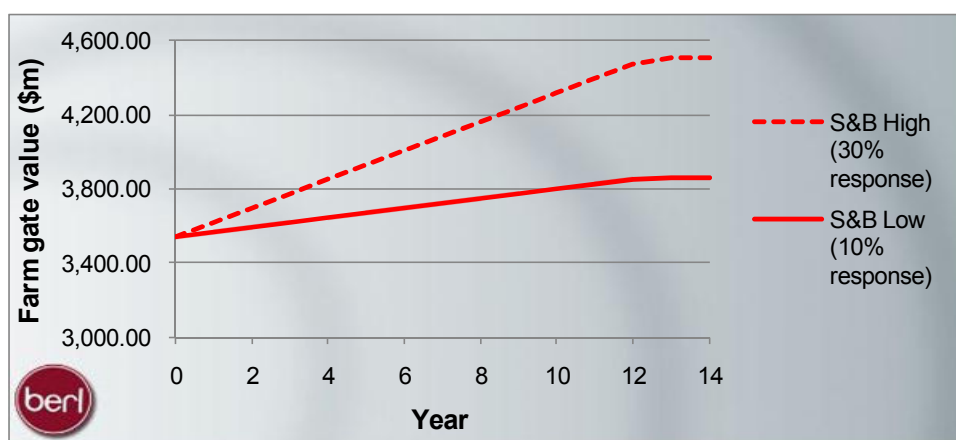


includes added production that has been caused by pasture renewal occurring in previous years.

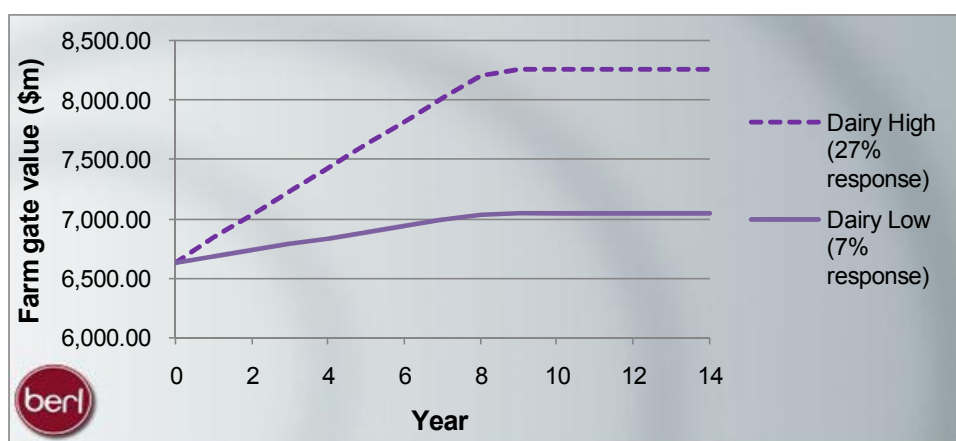
The initial effect on a paddock will be reduced as the effect of pasture renewal reduces over time, steadily lowering production levels on previously renewed pasture. We have not closely examined the levels of productivity decline that pasture renewal may face in this study.

As such, we have modelled two scenarios of productivity decline, one where the effect of pasture renewal falls by 10 percent each year, and one by 20 percent each year.

**Figure 4.2 Pasture renewal multiple years, sheep and beef, 10% production decline**

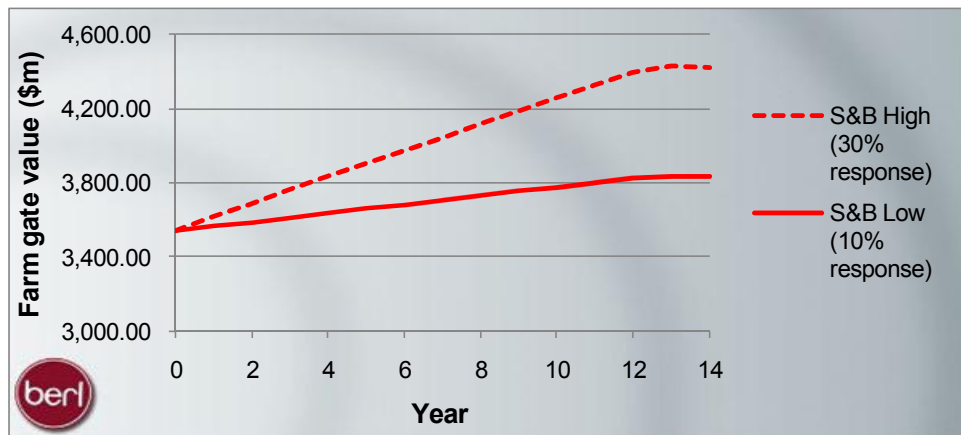


**Figure 4.3 Pasture renewal multiple years, dairy, 10% production decline**

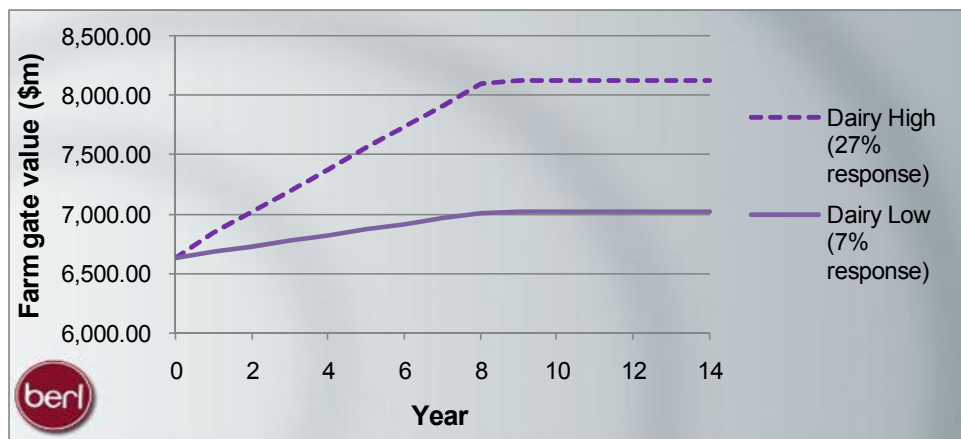


The model assumes that after a number of years, the cycle will be completed with all pasture renewed. At this point, the maximum level of added production created by pasture renewal is reached.

**Figure 4.4 Pasture renewal multiple years, sheep and beef, 20% production decline**



**Figure 4.5 Pasture renewal multiple years, dairy, 20% production decline**



## 5 Pasture response

### 5.1 Sheep and beef farms

#### 5.1.1 *AgResearch modelling outcomes*

For the AgResearch modelling outcomes paper, the results were modelled assuming dry matter production would increase by 10, 20 or 30 percent based on pasture renewal.

### 5.2 Dairy farms

#### 5.2.1 *AgResearch modelling outcomes*

The AgResearch report used data from Dexcel's Annual Economic Survey database, which was modelled using the UDDER program. Scenarios were run assuming 15, 25 and 35 percent pasture response due to pasture renewal.

#### 5.2.2 *Stratford trial dairy farm*

The Stratford trial farm based in Taranaki is funded through the MAF Sustainable Farming Fund.

The purpose of this trial is to *“trial and demonstrate the use of new pasture cultivars in improving dairy farm production and profit in central Taranaki.”* It compares existing pasture with newly renovated pasture over a three year period. Results from the third year have recently been published.

Results in terms of pasture response were not overwhelming in the Stratford trial. Estimated dry matter response was on average 13,500 kilograms of dry matter per hectare for the unrenewed pasture, and 14,500 kilograms of dry matter per hectare for the renewed pasture, an increase of 7.1 percent. This translated into an increased profit margin of around \$137 per hectare.

#### 5.2.3 *Lincoln University dairy farm*

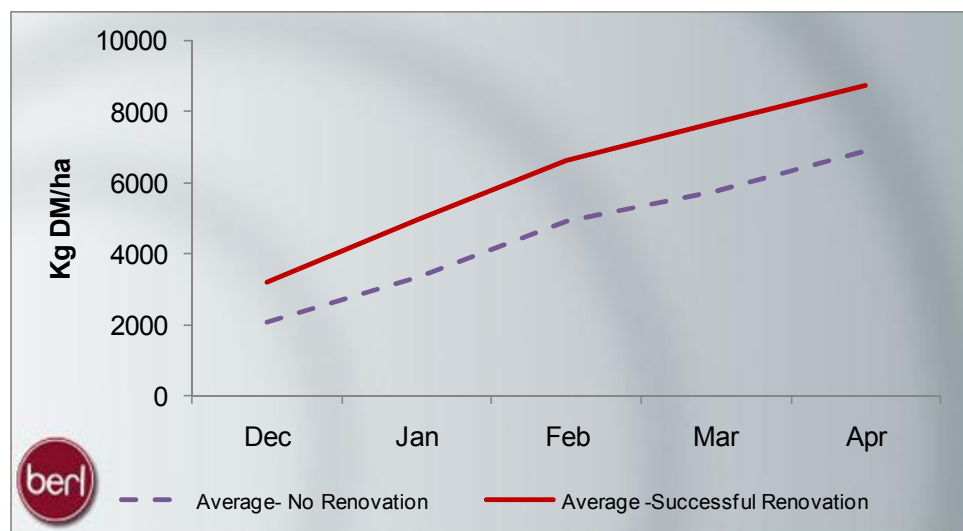
The current trial estimating pasture response at Lincoln University compares old and new pastures. This trial was incomplete at the time of this study, with results due at the end of August 2009. However, we were able to obtain an initial estimate of renewed pasture showing an estimated 10 percent higher growth in dry matter compared with unrenewed pasture.

#### 5.2.4 Ruakura test farms

Pasture at a number of farms is being studied as part of an AgResearch project based in Ruakura, outside of Hamilton. This project involves the measurement of kilograms of dry matter per hectare for a range of grasses, for unrenovated and renewed pasture. So far only data for the first five months of 2009 is available.

Figure 5.1 shows the average cumulative growth of pasture in kilograms of dry matter per hectare for successfully renovated pasture, compared with the average growth for unrenovated pasture.

**Figure 5.1 Cumulative pasture growth for renewed and unrenovated trials**



After five months, growth in pasture for the renovated trials was on average 27 percent higher than that of the unrenovated trials. Average cumulative grass growth was 8,742 kilograms of dry matter per hectare for successful renovations, compared with 6,886 kilograms of dry matter for pasture with no renovation.

Some modelling was done on the available data, providing an estimate of the expected total pasture growth for one year. This was estimated at 16,000 kilograms of dry matter per hectare. Pasture growth at the highest performing renewed paddocks were achieving approximately 80 percent higher growth than the poorest performing paddock.

## 6 Appendix A – multiplier analysis

This multiplier analysis uses multipliers derived from inter-industry national input-output tables.

Multipliers allowed us to identify the direct, indirect and induced effects in terms of output (GDP) and Full Time Equivalent (FTE) employment.

### 6.1 Measures

#### 6.1.1 Gross output multipliers

Gross output is the value of production, built up through the national accounts as a measure, in most industries, of gross sales or turnover. This is expressed in \$ million at constant prices. Gross output is made up of the sum of:

- compensation of employees (i.e. salaries and wages)
- income from self employment
- depreciation
- profits
- indirect taxes less subsidies
- intermediate purchases of goods (other than stock in trade)
- intermediate purchases of services.

#### 6.1.2 Value added (GDP) multipliers

Value added multipliers measure the increase in output generated along the production chain, which, in aggregate, totals Gross Domestic Product (GDP).<sup>7</sup>

Value added is made up of the sum of:

- compensation of employees (i.e. salaries and wages)
- income from self employment
- depreciation

---

<sup>7</sup> GDP is a basic measure of economic performance equal to the sum of the value added at every stage of production (the intermediate stages) by all the industries in an economy, plus taxes less subsidies, over a period (usually a year).

- profits
- indirect taxes less subsidies.

### **6.1.3      *Employment Impact multipliers***

Employment impact multipliers determine the number of FTE roles that are created for every \$1 million spent in an industry for one year. It provides a measure of total labour demand associated with Gross Output.

An FTE is the percentage of time an employee works represented as a decimal. A full-time position is 1.00; a part-time position is 0.50.

## **6.2          Direct, indirect and induced effects**

The underlying logic of multiplier analysis is relatively straightforward. An initial expenditure (**direct** effect) in an industry creates flows of expenditures that are magnified, or “multiplied”, as they flow on to the wider economy. This occurs in two ways:

- The industry purchases materials and services from supplier firms, who in turn make further purchases from their suppliers. This generates an **indirect** effect.
- Persons employed in the direct development and in firms supplying services earn income (mostly from wages and salaries, but also from profits) which, after tax is deducted, is then spent on consumption. There is also an allowance for some savings. These are the **induced** effects.

Hence, for any amount spent in an area (**direct** effect), the actual output generated from that spend is greater once the flow on activity generated (**indirect** and **induced** effects) is taken into account.

## **6.3          Leakages**

Generally the more developed, or self sufficient, an industry is, the higher the multiplier effects. Conversely, the more reliant an industry is on supply inputs from outside the country, the lower the multipliers. These outside factors can be referred to as “leakages”.

## **6.4          Limitations of multiplier analysis**

### **6.4.1      *Partial equilibrium analysis***

Multiplier analysis is only a “partial equilibrium” analysis, assessing the direct and indirect effects of the development being considered, without analysing the effects of the resources used on the wider national and regional economy.

In particular, it assumes that the supply of capital, productive inputs and labour can expand to meet the additional demand called forth by the initial injection and the flow on multiplier effects, without leading to resource constraints in other industries. These constraints would lead to price rises and resulting changes in overall patterns of production between industries.

To assess inter-industry impacts in full would require economic modelling within a “general equilibrium” framework. Applying such models becomes more relevant where the particular development is considered significant within the overall economy.

#### **6.4.2     *Additionality***

Related to partial equilibrium, using multipliers for economic impact assessments assumes that the event is something that would not have been undertaken anyway and that it will not displace existing activity. That is, the event is additional to existing activity. If it does either of the above, then the economic impact is less than that determined by the multiplier and it would be necessary to subtract both the activity that would have occurred anyway and the displacement effect.

#### **6.4.3     *Impact***

Again related to “partial equilibrium”, multiplier analysis assumes that an event will not have an impact on relative prices. However, in a dynamic environment, it can be assumed that a large event would have an impact on demand and supply and hence prices. Hence, the larger the event and the more concentrated it is in a single industry or region, the more likely it is that the multipliers would give an inaccurate analysis of impacts. For example, if multiplier analysis was used to determine the effect of residential building construction nationally it would likely be inaccurate as residential building construction accounts for over 6 percent of GDP.

#### **6.4.4     *Aggregation***

Industries outlined in input output tables are aggregates of smaller sub-industries. Each sub industry has unique inputs and outputs. The higher the level of aggregation the less accurate these inputs and outputs become. Thus, if determining the multiplier effect of a very specific event using highly aggregated data, there will be a lower level of accuracy. Similarly, if an event encompasses a range of industries and multipliers from a single industry are applied the accuracy levels will diminish.

#### **6.4.5     *Regions and boundaries***

The smaller or less defined a region and its boundaries, the less accurate the multiplier analysis will be. Similarly, the easier it is to move across boundaries, the less accurate the

analysis will be. For example, at the national level, the multipliers will be very accurate as it is easy to determine the inputs and outputs crossing through the New Zealand borders.

Similarly, it would also be more accurate to determine a north island/south island split. As smaller regions without obvious geographic boundaries are selected, a higher level of assumptions needs to be made and the multipliers become less accurate. For example, an individual could work in the Auckland Region but live in the Waikato Region and spend a large proportion of his/her recreation money in the Bay of Plenty Region.

For any regional analysis the level of accuracy will have to be accepted. As a rule of thumb, the larger and more defined the Region, the more accurate the analysis will be.



## 7 Appendix B - pasture renewal 30% response

This section illustrates our estimates of pasture renewal, based on a 30 percent pasture response rate for sheep and beef, and dairy farms.

**Table 7.1 Summary of model results- farm gate value**

Farm type	Existing pasture renewal level	Current farm gate value (\$m)	Target pasture renewal level	Level of pasture response	New farm gate value due to renewal			Percent increase in farm gate value		
					Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Sheep and Beef	2.04%	\$3,538	8%	30%	\$3,626	\$3,623	\$3,701	2.5%	2.4%	4.6%
Dairy	6.11%	\$6,630	12%	30%	\$6,745			1.7%		

Source: BERL.

**Table 7.2 Summary of model results- GDP**

Farm type	Current GDP value (\$m)	Level of pasture response	New GDP due to renewal			Percent increase in GDP		
			Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Sheep and Beef	\$6,662	30%	\$7,046	\$7,217	\$7,549	2.5%	2.4%	4.6%
Dairy	\$13,574	30%	\$13,810			1.7%		

Source: BERL.

**Table 7.3 Summary of model results- FTEs**

Farm type	Current FTEs	Level of pasture response	New FTEs due to renewal			Percent increase in FTEs		
			Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Sheep and Beef	114,211	30%	117,067	116,953	119,465	2.5%	2.4%	4.6%
Dairy	158,827	30%	161,368			1.6%		

Source: BERL.

**Table 7.4 Multiple year analysis, method one, 30% response**

Measure	Sheep and Beef	Dairy
	30% response	30% response
Farm gate value (June-07 year)	\$3,538	\$6,630
Highest production reached (10 percent prdn decline)	\$4,503	\$8,438
% increase	27.3%	27.3%
Highest production reached (20 percent prdn decline)	\$4,422	\$8,287
% increase	25.0%	25.0%

Source: BERL.

All work is done, and services rendered at the request of, and for the purposes of the client only. Neither BERL nor any of its employees accepts any responsibility on any grounds whatsoever, including negligence, to any other person.

While every effort is made by BERL to ensure that the information, opinions and forecasts provided to the client are accurate and reliable, BERL shall not be liable for any adverse consequences of the client's decisions made in reliance of any report provided by BERL, nor shall BERL be held to have given or implied any warranty as to whether any report provided by BERL will assist in the performance of the client's functions.