Orari-Temuka-Opihi-Pareora Zone

Current state economic assessment

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Authors: Kel Sanderson, Julian Williams and Natalia Fareti

The OTOP Zone economy – water's role

The purpose of this research and reporting is to provide a 'Current State Economic Assessment' that will provide a basis for the Limit-Setting Process for the Orari-Temuka-Opihi-Pareora (OTOP) sub-regional chapter of the ECAN Land and Water Regional Plan (LWRP).

This Limit-setting Process is contributing to the Healthy Catchments Project.

The current state of the OTOP economy is relatively strong, having grown at a similar rate since the year 2000 as the Canterbury and New Zealand economies. The current economy is strongly-based on primary production, related processing, manufacturing and upstream and downstream elements in the value chain through to export.

The underlying reason for the current strength of the OTOP / Timaru economy is that over the past thirty years there has been an increase in the value of primary production in the region. At the core of the primary production increase has been the addition of irrigation to large areas of pastoral land, and the conversion of production from sheep, beef and cropping, to dairy farm 'production platforms', and the associated dairy support activity.

There has been some retention of arable cropping production on the remaining sheep and cropping farms, and the addition of horticulture production. The horticulture is mainly outdoor vegetables, including potatoes and carrots for processing, and fruit production, especially berries for processing. These are high value land uses and benefit from specific irrigation inputs.

The dairy production increase began in the late 1980s, and by 1996 there were about 19,000 cows in milk, producing under 5,000 tonnes of milk solids (MS). By 2014-15 there were over 130,000 cows, a seven-fold increase, producing over 51,000 tonnes of MS, which is more than a ten-fold increase. This has been achieved by more-intensive, more-costly production under irrigation.

This rapid increase in dairy production has been the main driver of employment growth between 2000 and 2015. The directly-affected employment over this period includes employment increases in: dairy farming from 160 to 730; agriculture and fishing support services from 250 to 400; and in dairy product manufacturing from 360 to 820. These combine into direct increases from 770 in the year 2000 to 1,950 in 2015, an increase by about 1,200 or by two-and-a-half times. During this period, total employment in Timaru District including retail trade, social and business services and other industries increased from 17,270 to 22,840. This was an increase by 5,570, or an increase by about one-third.

The rapid increase in irrigated dairy production was initially supported by water from ground water sources, and then from about 2005 onwards surface water sources have provided the majority of the water. There are indications that current levels of ground water 'take' are depleting the ground water resource, resulting in reduced reliability and some imposed restrictions in the allowed level of take. There are also indications that the high level of irrigation and stocking rates are increasing effluent runoff and reducing water quality in the Zone.

The OTOP/Timaru economy has received a major boost from the widespread adoption of irrigated dairy production. The Zone and region is now moving emphasis to applying some of this increased income to invest in consolidating the gains. The aim is to maintain current production, while increasing the efficiency, the overall sustainability, and the contribution of the primary production value chain to the OTOP and Timaru economy, environment and community. The low dairy prices of the last two seasons put the higher-cost production systems at risk. However the current BERL assessment of market conditions are that the farmgate dairy payout can be expected to return to about $6 per kg MS within the next two years. At this level sound animal husbandry, nutrition, and farm management systems can be modelled into scenarios for fully sustainable production.

Continuing the Orari-Temuka-Opihi-Pareora Zone Healthy Catchments initiatives already underway including exploring potential needs for limit-setting in water quantity and quality are a crucial part of this process.

OTOP Zone at a glance

1.9%

annual GDP per capita growth over ten years compared to 0.9% nationally

1.2%

annual employment growth over ten years compared to 1.3% nationally

46,683

population 2013

Cereals

11% of national total

Blackcurrants

11% of national total

Potatoes, peas and carrots

top 3 vegetables grown

51,000 tonnes

milk solid production

800,000 m^3

annual irrigation consents

69%

of total land is irrigable compared to 54% nationally

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1 Introduction

Environment Canterbury (ECAN) commissioned an assessment of the economic current state of the Orari-Temuka-Opihi-Pareora Zone (OTOP Zone) from BERL. The project was part of ECAN's "Healthy Catchments" project to develop a package of solutions to water quality and quantity for the Orari, Temuka, Opihi and Pareora catchments. The project boundary spans an area south of the Rangitata River as far as Lyalldale Creek, which lies south of the Pareora River. The western boundary encompasses part of the Hunters Hills and Two Thumb Ranges in the Mackenzie District, and is bounded in the east by the Pacific Ocean. Timaru is the main population centre.

This report presents an economic current state assessment in terms of four groups of economic indicators, comparing where possible with Canterbury and New Zealand:

(i) Economic snapshot - being summary macro-variables

(ii) Labour market indicators - showing employment composition and trends by detailed industry level

(iii) Land-use indicators - showing trends in farmgate outputs and crops harvested

(iv) Water-use indicators – showing the reliance on water by land uses and industry.

In addition, the link between trends in land-uses and trends in employment highlight the reliance on industry of land-use. Labour market data are presented for pre- and post-Canterbury earthquake periods to provide insights of the impact on employment composition and trends of that tragedy.

The executive summary to this report presents a clear narrative that tells the economic story for the OTOP Zone referring to a selection of these indicators. The infographic provided with the executive summary presents key OTOP indicators at a glance.

The data used in the report are sourced from databases of ECAN, Statistics New Zealand, DairyNZ, and Beef and Lamb New Zealand.

BERL consulted with stakeholders throughout the study to bring a context to the analysis, including with (i) the OTOP Zone Committee; (ii) Timaru District Council; (iii) leading industry stakeholders; (iv) resource management and land-use consultants; and (v) representatives of farmers and community stakeholders.

In this report, the OTOP Zone and the Timaru District are seen as the same geographical entity and data for the Timaru District are taken to represent the OTOP Zone entirely. The population in 2013 of the OTOP Zone was 46,683 compared with 6.2% higher population of Timaru District at 43,932. On this basis, aggregate economic activity results reported here are generally expected to be 6.2% higher for the OTOP Zone.

The main conclusions from this study are presented as key findings at the beginning of each chapter.

2 Economic Snapshot

2.1 Key findings

In the ten years to 2015, Timaru's average annual growth in contribution to the nation's GDP outpaced the national growth rate and that for Canterbury. Together with its lower population growth rate over this period. Timaru showed an average annual growth rate of 1.9% pa compared with 0.9% pa for the nation and 1.4% pa for Canterbury. This result was supported by higher growth rates in both labour productivity and employment.

In this report, the OTOP Zone and the Timaru District are seen as the same geographical entity and data for the Timaru District are taken to represent the OTOP Zone entirely. The population in 2013 of the OTOP Zone was 46,683 compared with 6.2% higher population of Timaru District at 43,932. On this basis, aggregate economic activity results reported here are generally expected to be 6.2% higher for the OTOP Zone.

2.2 Key performance indicators, 2015

Resident population growth in the Timaru district, while positive, was lower than the national and regional rates of growth. With an estimated total population of 44,809, the slight increase of 0.9% in 2015 was equal to 396 people.

GDP growth was stronger, at 1.7%, but again this was two and a half times lower than that seen across the Canterbury region. The rebuilding of Christchurch has heavily influenced the regional growth across Canterbury since then, though is now showing signs of easing.

Table 1 Key performance indicators for Timaru, 2015

Key Performance Indicators	%pa for 2015 year		
	Timaru District	Canterbury	New Zealand
Resident population growth	0.9	2.2	1.9
GDP growth	1.7	4.4	3.2
GDP per capita growth	0.8	2.1	1.2
Employment growth	1.4	3.2	2.3
Labour productivity growth	0.5	1.4	1.2
Business units growth	3.5	3.6	2.7
Business size growth	-2.0	-0.4	-0.5

Source: BERL Regional Database, 2015

GDP per capita showed some modest growth of just under 1% over the year, and was fairly similar to the 1.2% growth seen nationally. The Canterbury region was significantly stronger at 2.1% for 2015, but again, this is largely due to the rebuild activity following the 2011 earthquake.

Employment growth was 1.4% for 2015, which was subdued when compared with the national rate of 2.3% and regional rate of 3.2%. Similarly, labour productivity growth was relatively small, at 0.5% for the year.

The number of businesses in the district showed healthy growth of 3.5% in 2015, which was higher than the national rate and nearly on par with the strong growth of 3.6% across the whole Canterbury region.

2.3 Growth and development of Timaru District and City 2005 - 2015

In the ten years to 2015, while Timaru performed better than the Canterbury region and New Zealand in terms of GDP growth, GDP per capita growth, and labour productivity growth, it was lower in terms of resident population growth, employment growth, and business unit growth.

Table 2 Key performance indicators for Timaru, 2005 to 2015

Key Performance Indicators	%pa for 2005 - 2015		
	Timaru District	Canterbury	New Zealand
Resident population growth	0.5	0.9	1.0
GDP growth	2.4	2.3	1.9
GDP per capita growth	1.9	1.4	0.9
Employment growth	1.7	1.8	1.3
Labour productivity growth	0.8	0.6	0.6
Business units growth	1.3	1.6	1.2
Business size growth	0.3	0.2	0.0

Source: BERL Regional Database, 2015

The growth appears to have been largely driven initially by increased agricultural and horticultural production, processing and manufacturing. There was also growth in tourism activity.

2.3.1 Population growth

Although the population growth from 2005 to 2015 was only 0.5% per annum compared with 0.9% for Canterbury and 1.0% for New Zealand, consultation with a number of stakeholders revealed that a lessening of population decline had emerged in a number of Timaru communities in such indicators as increasing school rolls.

2.3.2 Household income growth

Median household income for Timaru District was $53,700 in 2013. This compared with $65,000 for Canterbury and $63,800 for New Zealand. For Timaru, this represented a change of 33% from the $40,500 level in 2006. By comparison, median household income for Canterbury and New Zealand grew from 2006 levels by 36% and 24% respectively. At $53,700, Timaru ranks 41st of 67 territorial local authorities in terms of median household income.

2.3.3 GDP growth and GDP per capita

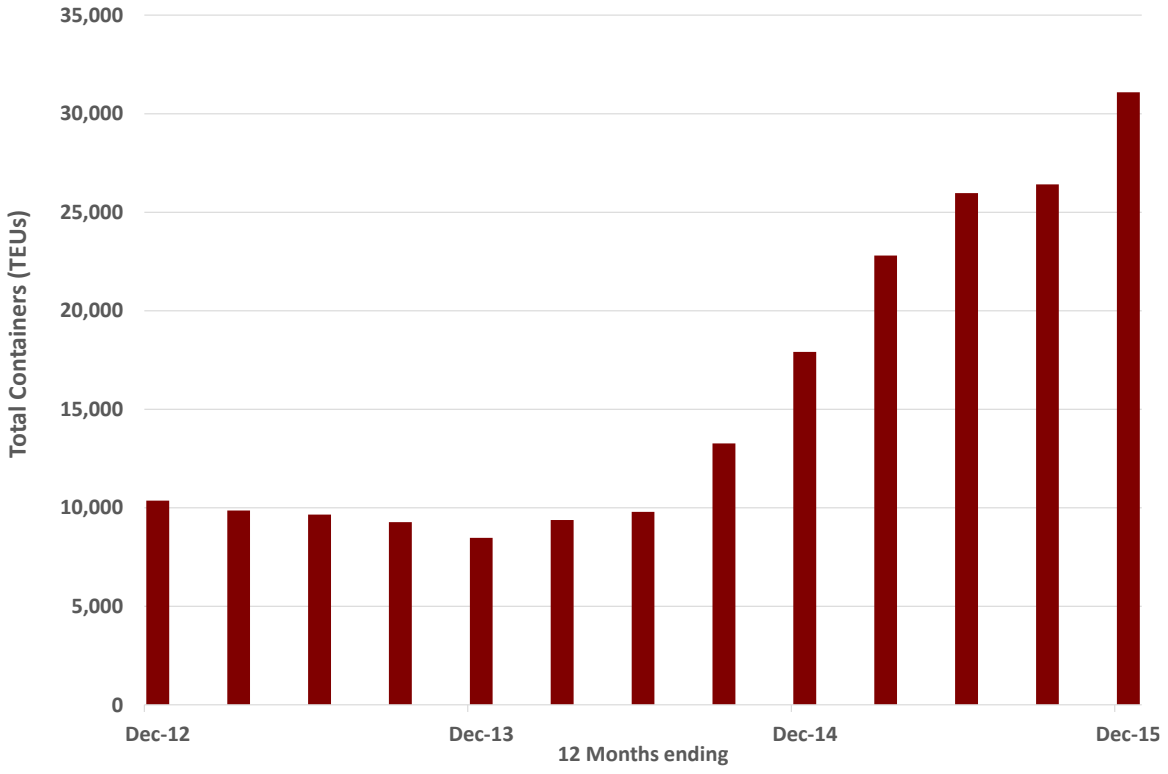
The GDP growth in Timaru District 2005 to 2015 was similar to that for Canterbury as a whole, and since the population growth was less, this showed an increase in GDP per capita. This is undoubtedly due to an expansion of business in Timaru, including more processing and manufacturing, which in turn increases demand for higher-value business services.

2.3.4 Strengthening the society and economy

These changes have seen a strengthening of the society, in education and other ways, and the economy. A very specific example of the latter is the expanded operation of Fonterra at Clandeboye, and thence greater participation of Fonterra, including co-operation with other businesses in such initiatives as the expansion of operation of PrimePort Timaru.

The increase in container throughput in the Port in recent years is very impressive, and is reflected in industrial and warehouse developments at Washdyke. Figure 1 shows the actual track of container growth from 2012 to 2015.

Figure 1 Container throughput PrimePort Timaru 2012 to 2015



Source: Ministry of Transport, FIGS

2.4 Composition of the economy 2015

The composition of the Timaru economy is dominated by the Processing and Manufacturing sector, in terms of GDP generated annually, and in terms of full time employment (FTEs)[1]. Underpinning much of this Manufacturing activity however, are land-intensive industries such as dairy farming and dairy support services, which are captured at an aggregate level in the Primary sector. The Business Services sector accounted for the largest

[1] Note that the FTE employment measure here differs from the employment count measure in chapter 3.

proportion of business units, with a third of all businesses in Timaru. Just over half of this is comprised of Property Operators, most of which are Non-Residential.

Table 3 Timaru economy breakdown by sector

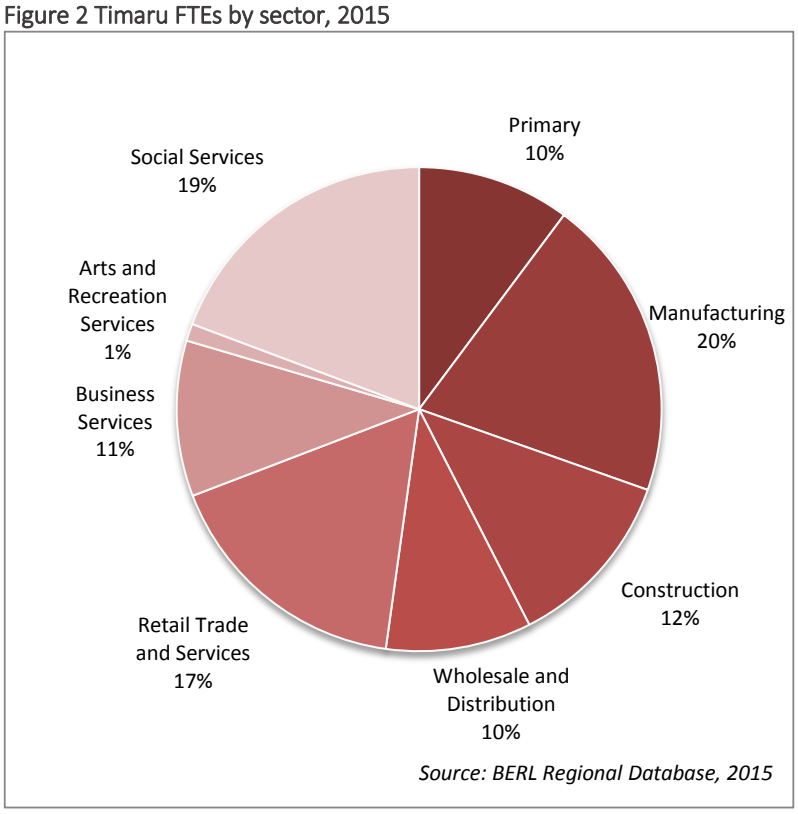
Sectors (2015)	FTEs	%	GDP (2015$m)	%	Business units	%
Primary	2,290	*10.2*	235	*10.0*	1,270	*22.7*
Processing, manufacturing	4,543	*20.2*	551	*23.5*	300	*5.4*
Construction	2,713	*12.1*	246	*10.5*	522	*9.3*
Wholesale and Distribution	2,181	*9.7*	278	*11.9*	359	*6.4*
Retail Trade and Services	3,814	*17.0*	233	*10.0*	834	*14.9*
Business Services	2,337	*10.4*	396	*16.9*	1,883	*33.6*
Arts and Recreation Services	258	*1.1*	27	*1.1*	101	*1.8*
Social Services	4,330	*19.3*	378	*16.1*	334	*6.0*
Sub-total (excluding O.O.D.)	22,465	100.0	2,343	100.0	5,603	100.0
*Owner-Occupied Dwellings (O.O.D)**			289			
Total	22,465		2,632		5,603	

Source: BERL Regional Database, 2015

* Imputed value, included in TOTAL GDP only.

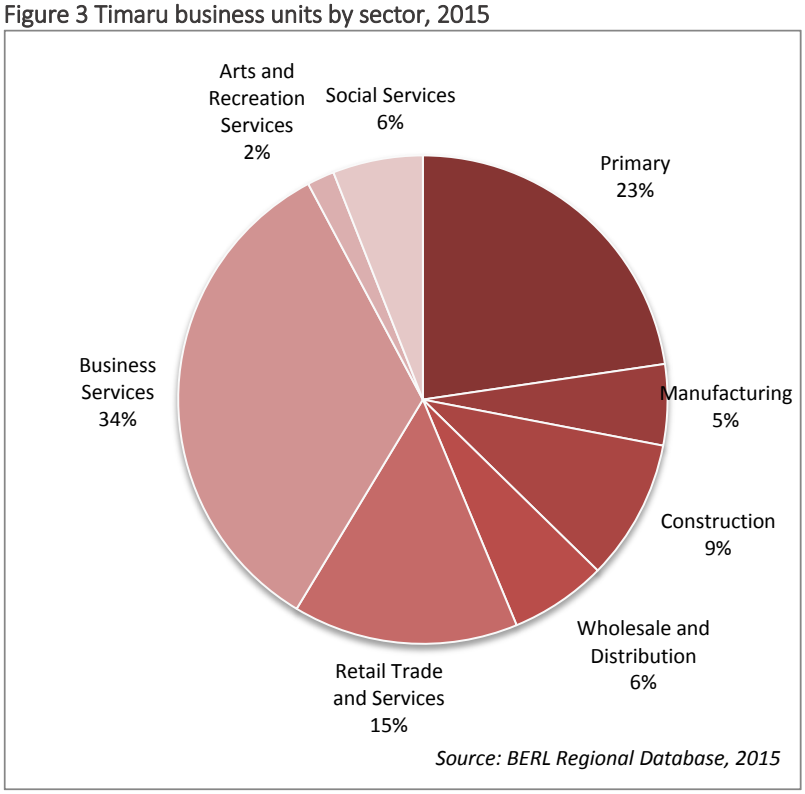
The breakdown of GDP, business units, and employment composition are shown in the pie graphs below.

Figure 2 Timaru FTEs by sector, 2015



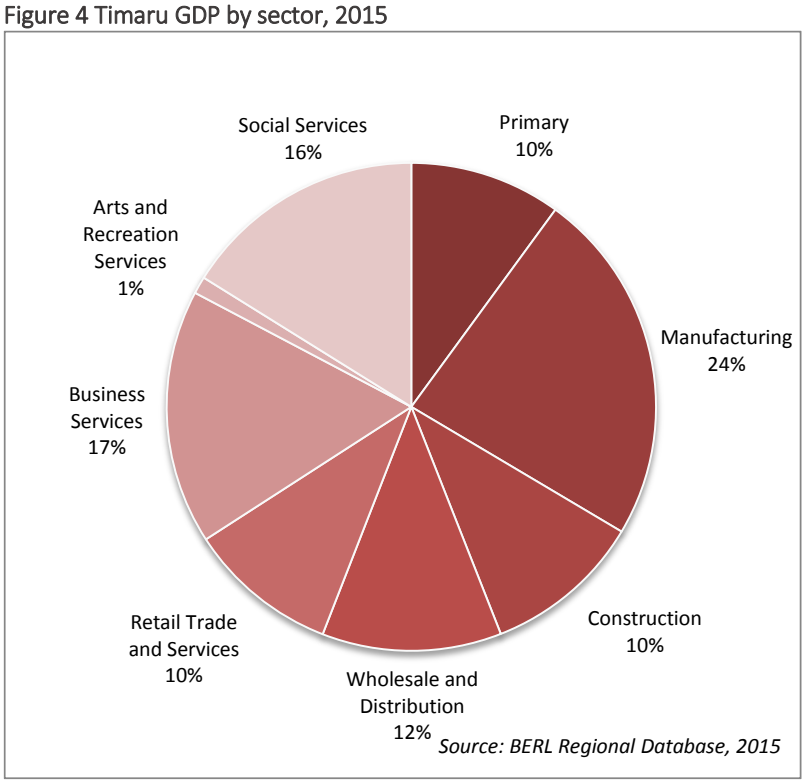
Source: BERL Regional Database, 2015

Figure 3 Timaru business units by sector, 2015



Source: BERL Regional Database, 2015

Figure 4 Timaru GDP by sector, 2015



3 Labour market indicators

3.1 Key findings

Employment is a useful indicator for economic activity at a detailed level because employment counts are accurate at detailed levels of industry classification. Similarly, employment growth is a useful indicator for economic growth at a detailed level of industry classification. These detailed levels of economic growth provide valuable insights into the types of industries driving overall economic growth.

Employment growth[2] in Timaru from 2000 to 2014 was characterised by average annual increases of 10.0% for dairy cattle farming, 5.6% for dairy product manufacturing, and 3.6% for agriculture and fishing support services. At the same time sheep, beef cattle and grain farming employment decreased at an average annual rate of 4.4%.

These results shed some light on the aggregate employment results showing that the Timaru District outpaced both Canterbury and all of New Zealand for employment growth in agriculture, forestry and fishing for the 2000 to 2014 period. In particular it is consistent with the substitution of dairy land use for sheep and beef land use.

In the period 2004 to 2014, rises of 171 employed in the heavy and civil engineering construction industry and 204 in the road freight transport industry are also consistent with the growth in dairy production because improved roads and increased transportation are required for increased dairy production.

Rises in residential building construction employment (189) and building installation services employment (171) for the same period are consistent with population growth from increased employment opportunities led by the growth in dairy output.

Tourism activity is usefully measured by the number of guest nights of accommodation in the hospitality industry. By this measure tourism activity increased by 21% from 2004 to 2014. This is consistent with the increase in employment of 315 in the tourism-related industries of cafes, restaurants and takeaway food services for the period from 2004 to 2014.

3.2 Labour Force Status

Job-matching has increased in recent years. Unemployment in Timaru has fallen in recent years relative to the country as a whole due to the uptake of jobs offered through the Canterbury rebuild and through the rising trend of employment for dairy and associated industries.

The number of people employed in Timaru as a proportion of those employed in the Canterbury was steady at about 8% for each of the 2001, 2006, and 2013 Censuses. Similarly the proportion that Timaru's unemployed made of the Canterbury total dropped from 8.4% to 7.4% to 7.1% for those years. For the same years, the share that Canterbury's employed make of the New Zealand total has been steady at 14%. By comparison, Canterbury's share of New Zealand's unemployed was 11%, 11% and 9% respectively for 2001, 2006 and 2013. These results combined mean that, using the Census data as a guide, Timaru's share of unemployed in 2013 had fallen to 0.6% of the New Zealand total from 0.9% in 2013 and 0.8% in 2006.

3.3 Employment by Occupation

The occupational composition of people employed in Timaru in 2013 (Table 4) is weighted more towards agriculture and fishery workers, trades workers, plant and machine operators, and elementary occupation

[2] The employment data in this chapter are annual LEED data and differ from the FTEs referred in chapter 2.Annual LEED data are not as up-to-date as FTE counts, but include self-employed workers.

workers, than the occupational compositions for Canterbury and New Zealand. Census data for 2001, 2006 and 2013 show that this weighting prevailed prior to 2001 and increased from 2001 to 2013. For example, while the increase in professionals for New Zealand was 3.0% from 2011 to 2013, the corresponding increases for Timaru and Canterbury were 1.1% and 2.3%. Similarly, while the increase in elementary occupations was 0.1% and 0.2% for New Zealand and Canterbury respectively for this period, it was 1.6% for Timaru.

Table 4 Employment percentage of total by occupation

	Timaru	Canterbury	New Zealand
Legislators, Administrators and Managers	13%	15%	16%
Professionals	12%	16%	18%
Technicians and Associate Professionals	11%	13%	14%
Clerks	10%	10%	11%
Service and Sales Workers	15%	14%	14%
Agriculture and Fishery Workers	9%	7%	6%
Trades Workers	8%	8%	7%
Plant and Machine Operators and Assemblers	11%	7%	6%
Elementary Occupations	12%	9%	9%
Total	100%	100%	100%

Source: 2013 Census Statistics NZ

3.4 Employment by Industry

Timaru's employment growth compared with that for Canterbury and New Zealand, is shown in Appendix A in a high-level comparison at a summary level[3]. Table 5 shows employment changes in Timaru for selected industries at a more detailed level[4], for the period 2000 to 2014 and for the six years prior to the Canterbury earthquakes and the four years following. These detailed-level industries account for the main changes in employment.

The employment trends are in line with the rapid increase in dairy production in this period. The Timaru District outpaced both Canterbury and all of New Zealand for employment growth in agriculture, forestry and fishing for the 2000 to 2014 period.

The data in Table 5 are consistent with Timaru's economic growth from 2000 to 2014 being:

- driven by expansion in dairy farming
- supported by expansion in dairy-related industries, including road freight, agricultural support and heavy engineering construction
- reduced by decline in the sheep, beef cattle and grain farming industry
- supported by expansion in population growth-related industries including residential construction
- supported by increases in tourism-related industries of cafes, restaurants and takeaway food services.

Employment in the seafood processing industry as a proportion of total New Zealand employment in this industry has declined from about 2.4% in 2002 and has been steady at about 1% since 2009.

Some relevant results for the 2004 to 2014 period on an average annual growth basis are:

[3] This summary level is the 1-digit level of the ANZSIC06 classification of industry
[4] The detailed 3- digit level of the ANZSIC06 classification

- agriculture, forestry and fishing employment for Timaru grew 2.3% pa, compared with 0.5% for Canterbury and 0.1% for New Zealand
- construction employment grew 4.4% pa for Timaru, compared with 7.4% for Canterbury and 2.6% for New Zealand. Tables 17 to 19 in the Appendix show that Timaru outpaced both pre-quake, but was itself strongly outpaced by Canterbury's post-quake growth rate of 14.0%. Table 5 shows that the key drivers of employment change for Timaru were rises in residential building construction, heavy and civil engineering construction, building installation services and other construction services.
- accommodation and food services employment grew 1.5% pa for Timaru. This compared with 0.9% for Canterbury and 2.2% for New Zealand. Table 5 shows that Timaru's rise was underpinned by cafes, restaurants and takeaway food services.
- transport, postal and warehousing employment grew 2.0% pa for Timaru. This compared with 0.9% for Canterbury and 0.7% for New Zealand. Table 5 shows that the rise was underpinned by road freight transport.
- healthcare and social assistance employment for Timaru grew 1.9% pa. This compared with 2.0% for Canterbury and 2.9% for New Zealand. Table 5 shows that hospitals and residential care services led the rise.

Table 5 Employment changes by selected industry 2004 to 2014

Industry	Change from 2004 to 2010	Change from 2010 to 2014	Change from 2004 to 2014
Dairy Cattle Farming	276	435	711
Cafes, Restaurants and Takeaway Food Services	252	63	315
Residential Care Services	225	9	234
Agriculture and Fishing Support Services	129	99	228
Road Freight Transport	138	66	204
Residential Building Construction	162	27	189
Heavy and Civil Engineering Construction	105	66	171
Building Installation Services	156	15	171
Preschool Education	102	18	120
Meat and Meat Product Manufacturing	-27	141	114
Specialised Industrial Machinery and Equipment Wholesaling	39	69	108
Hospitals	99	9	108
Other Construction Services	60	24	84
Fruit and Vegetable Processing	-72	-27	-99
Sheep, Beef Cattle and Grain Farming	-168	24	-144
Seafood Processing	-207	-6	-213

Source: Annual LEED Statistics NZ

The rise in employment in the dairy industry and related industries and the decline in sheep and beef industry employment is a characteristic feature of the Timaru, Canterbury and New Zealand economies. Table 6 shows

this using annual Business Demographic Statistics of Statistics New Zealand, which are updated to March 2015, but do not include counts of the number of self-employed.

Table 6 shows that in the 15 years to 2015, annual average growth rates were positive for wage and salary employment in Timaru for dairy cattle farming (10.0%), dairy product manufacturing (5.6%), and agriculture and fishing support services (3.6%). By contrast, for the same period the number of workers in sheep, beef cattle and grain farming declined at an annual average rate of 4.4%.

Table 6 Average annual growth in employment, 2000 to 2015, selected industries

Industry	Timaru	Canterbury	New Zealand
Dairy Cattle Farming	10.0%	8.2%	4.0%
Dairy Product Manufacturing	5.6%	5.0%	2.3%
Agriculture and Fishing Support Services	3.6%	2.3%	3.3%
Sheep, Beef Cattle and Grain Farming	-4.4%	-1.6%	-1.0%
All Industries	1.8%	1.9%	1.6%

Source: Annual Business Demography Statistics, Statistics NZ, BERL

The rise in employment of 315 in the cafes, restaurants and takeaway food services is consistent with the increase in Tourism activity for Timaru. This is measured by the change in guest night accommodation in the hospitality industry from 2004 to 2014. On a monthly average basis for the year to March, this change was a rise of 21% (18,734 to 22,666) for Timaru, a fall of 3% (381,417 to 371,250) for Canterbury reflecting the loss of accommodation in Christchurch caused by the earthquakes, and a rise of 12% (2,464,656 to 2,760,568) for New Zealand.

4 Land use indicators

4.1 Key findings

The OTOP Zone has a land use profile considerably different from that for Canterbury and New Zealand. In 2012, 85% of all land is used for economically productive, relatively intensive land uses. This compares with 54% for the Canterbury Region, and 70% for New Zealand as a whole.

South Canterbury has traditionally been a region with mixed sheep and cropping farms, together with beef or dairy beef production. Irrigation has assisted sheep farming and cropping, mostly with border-dyke irrigation or general flood irrigation.

Timaru experienced a pattern of change in pastoral agriculture similar to that in the rest of Canterbury. There has been conversion of production from one based on sheep with beef cattle and some cropping, assisted with some irrigation, to a high level of dairying production using irrigation. On the other mixed pastoral and cropping farms the pattern has moved towards dairy support providing grazing and feed crops to the dairy units as well as much of the beef production being based on dairy stock.

The most significant outdoor vegetable crop is potatoes, with 1,262 hectares harvested in 2012. There was a significant fall in the hectares harvested of peas, from 1,382 hectares in 2002, to 216 hectares in 2012. Carrots experienced a surge in growth over the 10 year period, growing from 86 hectares in 2002, to 348 hectares in 2012, an increase of 262 hectares. More recently South Canterbury and Canterbury have begun producing high value seed crops, mainly for seed export.

Blackcurrants dominate outdoor fruit production in Timaru and Timaru is a significant producer of blackcurrants in New Zealand.

4.2 Land use and farm size

At a high level in 2012, Timaru had a land use profile considerably different from that in Canterbury and New Zealand. In the economically productive, relatively intensive land uses of pasture, crops, horticulture and exotic plantations it had 85% of all land compared with 54% for the Canterbury Region, and 70% for New Zealand as a whole.

Table 7 Land use profile for Timaru, Canterbury, New Zealand 2012

Land use	Grassland	Tussock and danthonia used for grazing (whether oversown or not)	Grain, seed and fodder crop land, and land prepared for these crops	Horticultural land and land prepared for horticulture	Plantations and exotic forest land	Native bush and scrub	Other land	Total land
Hectares								
Timaru District	118,583	25,878	27,290	3,045	11,037	3,991	4,017	193,840
Canterbury region	1,135,043	1,098,819	233,429	15,841	102,292	124,424	66,279	2,777,783
New Zealand	7,888,314	2,740,919	467,916	127,937	1,684,210	1,074,549	409,958	14,393,802
Land Use Profile								
Timaru District	61%	13%	14%	2%	6%	2%	2%	100%
Canterbury region	41%	40%	8%	1%	4%	4%	2%	100%
New Zealand	55%	19%	3%	1%	12%	7%	3%	100%

Source: Statistics New Zealand, BERL

Table 8 Farm number by area

No. of farms	Under 20	20 - 59	60 - 99	100 - 399	400 - 999	1,000+	Total
			Farm size (hectares)				
Timaru district	321	189	69	285	87	27	978
Canterbury	3,681	1,455	474	2,553	903	474	9,540
NZ	20,724	9,297	5,286	15,705	4,791	2,268	58,071

Source: Statistics New Zealand

With nearly 1,000 farms in Timaru, the largest proportion were under 20 hectares each. There are also a sizeable proportion of farms which are sized between 100 and 399 hectares. This follows the same pattern as seen regionally and nationally. The adoption of more irrigation began in a small way in 1987 to 1990, but this increase plateaued, and sustained increase began in 1996.

4.3 Livestock carrying capacity

The livestock numbers from Beef + Lamb NZ are combined with the dairy cows in milk on dairy farm 'milking platforms' from DairyNZ to provide a profile of the changes in livestock carrying capacity in Timaru District since 2000-01.

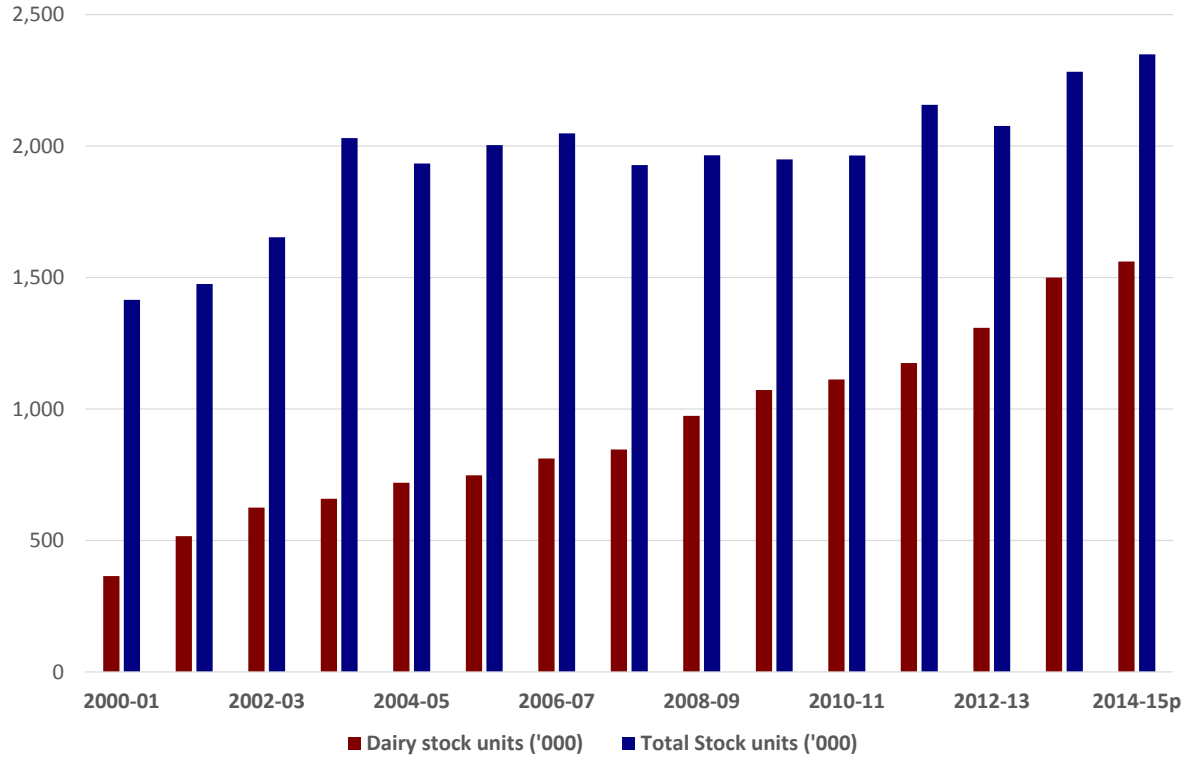
The estimate of livestock carrying capacity measured as ewe equivalents, increased from about 1.4 million in 2000-01 season to 2.35 million in 2014-15 season. This is an increase by about two-thirds in fifteen years.

Table 9 Timaru livestock carrying capacity (ewe equivalents) 2000 to 2015

Year	Sheep	Beef Cattle	Dairy Cows in Milk	Dairy grazing equivs.	Deer	Total Stock Units
	(000s)	(000s)	(000s)	(000s)	(000s)	(000s)
Source:	*B+L*	*B+L*	*DairyNZ*	*B+L/BERL*	*B+L*	
2000-01	859	41	31	21	79	1,415
2001-02	768	39	43	30	75	1,476
2002-03	766	51	53	37	80	1,653
2003-04	952	74	55	39	120	2,031
2004-05	867	62	60	42	105	1,933
2005-06	895	64	63	44	110	2,004
2006-07	878	64	68	48	107	2,048
2007-08	697	70	71	50	87	1,928
2008-09	635	65	82	57	79	1,965
2009-10	555	61	90	63	64	1,949
2010-11	530	56	93	65	74	1,965
2011-12	639	69	99	69	63	2,157
2012-13	472	52	110	77	65	2,076
2013-14	477	53	126	88	68	2,282
2014-15p	529	51	131	92	55	2,349
% chg 2000-01 to 2014-15	-38%	24%	328%	328%	-30%	66%

Source: DairyNZ, Beef + Lamb NZ, BERL

Figure 5 Timaru District dairy stock units and total stock units

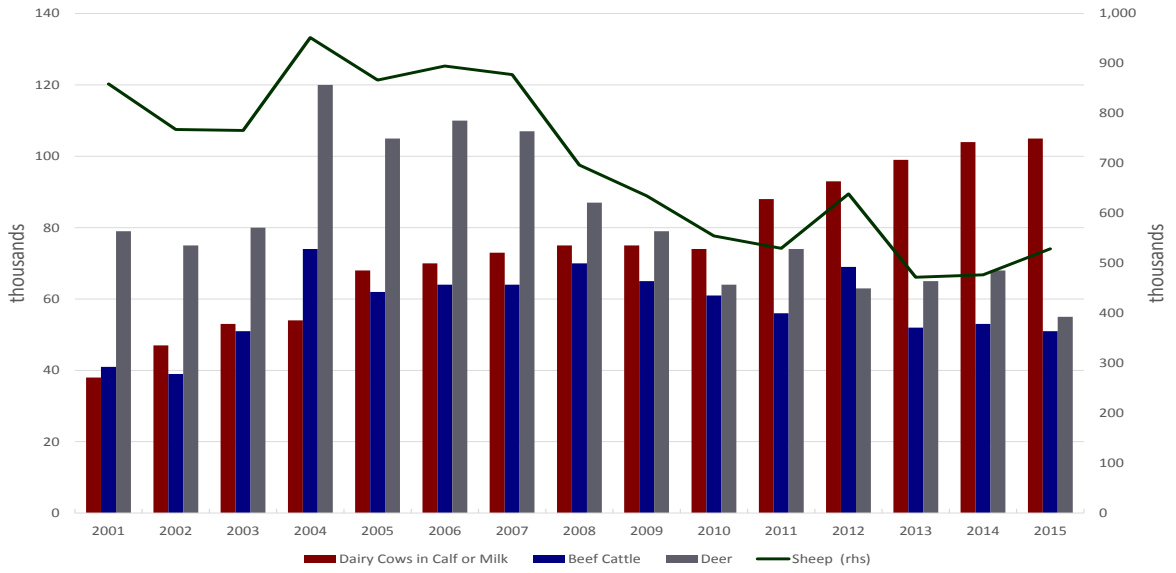


The substitution of dairying stock units for beef and lamb stock units underlying the ewe equivalent data in Figure 5 and Table 9 above are shown in Figure 6 where the number of Dairy Cows in Calf or Milk has risen from 38,000 in the 2001 year to 105,000 in the 2015 year (provisional numbers), while the number of Sheep has fallen from 859,000 to 529,000 over the same period.

The trend from the 2004 year is upwards for Dairy Cows in Calf or Milk and downwards for Beef Cattle, Sheep and Deer.

The main increase was in the number of Dairy Cows in Milk, and the dairy grazing to support that herd. The chart shows that the increase in total stock units mainly occurred at the beginning and end of the period, whereas the increase in dairy stock units continued steadily through the period.

Figure 6 Livestock changes in Timaru District 2001 to 2015



4.4 Cereals and field crops

The Canterbury region produces the majority of cereal grains in the country, with 77% of the national total harvested in 2012. Timaru's share of the Canterbury region was the third largest, behind Selwyn and Ashburton, the latter of which supplies the majority of wheat nation-wide.

For herbage and vegetable seed crops, the Canterbury region accounted for 93% of the total hectares harvested nation-wide in 2012, up from 89% in 2007. Timaru's share of the Canterbury herbage and vegetable seed crops is relatively minor, at 12% in the most recent census. Similar to the cereal grains, the predominant producer of these crops is the Ashburton district, followed by Selwyn.

The production profile over the last three agricultural Censuses are shown in Table 10.

Table 10 Cereal grains and herbage and vegetable seeds harvested[5]

Hectares harvested/planted	Cereal grains*			Herbage and Vege. seeds		
	2012	2007	2002	2012	2007	2002
Timaru	12,520	9,752	11,427	4,161	2,983	na
Canterbury	97,407	80,241	97,371	35,470	30,931	na
NZ	126,402	100,059	130,224	38,148	34,659	na
Timaru share of Canterbury	13%	12%	12%	12%	10%	na
Canterbury share of NZ	77%	80%	75%	93%	89%	na

* includes wheat, barley, oats and other cereal grains

Source: Statistics NZ, BERL

[5] Hectares are displayed as being harvested/planted, as the 2012 and 2007 agricultural censuses record the hectares harvested, while the 2002 census records hectares planted. This means that the hectares recorded in 2002 are not directly comparable with the later two censuses, as hectares planted will likely have been greater than the actual hectares harvested. However, the 2002 figures provide a useful order of magnitude for comparison, particularly when looking at the Timaru's share of Canterbury, and Canterbury's share of New Zealand.

The table shows that Canterbury had the most hectares in cereal grains and in herbage and vegetable seed crops. The hectares in cereal grains declined between 2002 and 2007, and then recovered to their previous level by 2012.

BERL research for the Arable Food Industry Council has found that over the period 2007 to 2012, and subsequently, there has been a large increase in sales of grains direct from farmer to farmer as stock feed. This has mainly been in support of increased dairy production, and dairy support livestock feed.

Cereal grains in the table above, include wheat, barley, oats, and other cereal grains. Wheat makes up the largest portion of the cereal grains harvest in Timaru, followed by barley. Wheat harvests have been increasing at each of the three censuses, while barley has fluctuated downwards then back up again. Oats meanwhile, have been steadily decreasing, while other cereal grains form a minor portion of the total cereal grain harvest in Timaru.

Table 11 shows the tonnages of cereal grains harvested, including the large increase between 2007 and 2012. Timaru's proportion of Canterbury did not increase significantly (only 2%), while Canterbury's share of New Zealand's total harvest of cereal grain harvest has dipped slightly.

Table 11 Cereal grains harvested by weight

Tonnes harvested	Cereal grains*		
	2012	2007	2002
Timaru	104,705	73,994	73,491
Canterbury	773,120	597,766	604,329
NZ	957,265	721,301	790,530
Timaru share of Canterbury	14%	12%	12%
Canterbury share of NZ	81%	83%	76%

* includes wheat, barley, oats and other cereal grains

Source: Statistics NZ, BERL

There was an increase by 42% in the tonnage of cereal grains produced in Timaru in 2012 compared with 2007. The same level of increase was seen in the ten years between 2002 and 2012. This is larger than the increase seen both regionally and nationally, and indicates that cereal grain planting and harvesting has intensified in Timaru. It also indicates that Timaru is becoming a more significant producer in the Canterbury region, with a rise from 12% to 14% of cereal grain harvest coming from the district.

Table 12 Change in cereal grains harvested by weight

Change in tonnage	2007-12	2002-07	2002-12
Timaru	42%	1%	42%
Canterbury	29%	-1%	28%
NZ	33%	-9%	21%

Source: Statistics NZ, BERL

4.5 Feed crops

The total hectares of maize silage (feed crop) harvested grew 56% between 2007 and 2012, or 159 hectares. There was an increase by 42% in the tonnage of cereal grains produced in Timaru in 2012 compared with 2007.

Data for 2002 are published in terms of hectares planted and are not comparable. There is a difference in classifications used between the censuses, with hectares planted used in 2002 as opposed to hectares harvested in the later censuses.

Cereal and pasture/lucerne feed crop hectares harvested have grown by over 5,500 hectares between the 2002 and 2012 censuses, with Timaru's share of the Canterbury's production remaining relatively steady. Canterbury's share of the total national harvest has been sitting at just over a quarter over the last two censuses. The total hectares harvested between 2007 and 2012 grew by nearly 120,000 hectares.

Table 13 Feed crops harvested or planted

Hectares harvested/planted	Maize silage			Cereal and pasture/lucerne (hay, silage and balage)		
	2012	2007	2002[6]	2012	2007	2002
Timaru district	443	284	2,763	27,595	26,824	22,082
Canterbury	3,795	2,413	31,847	236,326	215,946	175,555
New Zealand	47,514	32,459	266,986	888,504	769,261	426,792
Timaru share of Canterbury	12%	12%	9%	12%	12%	13%
Canterbury share of NZ	8%	7%	12%	27%	28%	41%

Source: Statistics NZ, BERL

4.6 Outdoor vegetable growing

Outdoor vegetable growing[7] in the Timaru district is dominated by three crops: potatoes, peas and carrots. Overall, the outdoor vegetable growing activity in the Timaru district has been falling over the 10 year period to 2012, most notably in fresh/processed peas. Potatoes have been on a gradual decline over the period, while carrots, while relatively smaller as a proportion of total outdoor vegetables harvested, have been growing strongly[8].

Table 14 Outdoor vegetables harvested in Timaru, 2002 to 2012

Timaru District Outdoor Vegetables	Carrots	Peas (fresh/ processed)	Potatoes	Sweet corn	Pumpkin	Other	Total
			Hectares harvested				
2002	86	1,382	1,539	426	14	29	3,476
2007	0	631	1,395	0	0	0	2,026
2012	348	216	1,262	0	0	2	1,828
Change 2002-2012	262	-1,166	-277	-426	-14	-27	-1,648

Source: Statistics NZ

[6] These data are for hectares planted.

[7] Indoor vegetable growing is relatively minor activity in the Timaru district, in that the only vegetable for which actual figures are supplied, are for cucumbers, and for the year 2012.

[8] While some data are suppressed by Statistics New Zealand and recorded as zero in the table this does not affect the results for the main crops.

Table 15 Outdoor vegetables harvested, Timaru and Canterbury

Tonnes harvested	Carrots			Peas (fresh/ processed)			Potatoes		
	2012	2007	2002	2012	2007	2002	2012	2007	2002
Timaru share of Canterbury	43%	0%	26%	6%	14%	29%	22%	33%	34%
Canterbury share of NZ	39%	19%	18%	52%	68%	61%	49%	42%	41%

Source: Statistics NZ, BERL

In the ten years between 2002 and 2012, the total recorded hectares harvested in the Timaru district have decreased by about 1,648 hectares.

Potatoes

The most significant outdoor vegetable crop is potatoes, with 1,262 hectares harvested as at the 2012 agricultural census. This was still some 277 hectares less than in 2002, and 133 less than in 2007. Potatoes accounted for 69% of the total hectares of outdoor vegetables harvested in 2012. This is compared to 2002 when potatoes accounted for just over 44% of outdoor vegetables harvested. However, this has largely been due to the decrease in hectares harvested in other outdoor vegetables over the 10 year period, rather than any substantial change in the hectares of potatoes harvested.

While potatoes have been gradually declining in the Timaru district, the hectares harvested elsewhere in the Canterbury region has been growing significantly. Between the 2007 and 2012 censuses, the total hectares harvested of potatoes in the region grew by a third, or 1,402 hectares. Nationwide it grew 15%, or 1,528 hectares.

Peas

There was a significant fall in the hectares harvested of peas, from 1,382 hectares in 2002, to 216 hectares in 2012. There was a steep decline between 2002 and 2007, when the hectares harvested nearly halved, to 631 hectares, followed by a decline of roughly a third again between 2007 and 2012. This mirrors the trend seen in the Canterbury region, which saw a drop from 4,717 hectares harvested in 2002, to 4,622 in 2007, and finally to 3,489 in 2012. This same trend was also seen nationwide, falling 13% over the 10 year period.

Carrots

Carrots on the other hand, experienced a surge in growth over the 10 year period, growing from 86 hectares in 2002, to 348 hectares in 2012, an increase of 262 hectares. This is highly likely be linked to the establishment in 2008 of the purpose built carrot juice production line of Juice Products NZ Ltd. The hectares harvested of carrots in the Canterbury region overall has also grown significantly, between the 2007 and 2012 censuses, from 249 to 803 hectares. Timaru accounted for 43% of the region's carrots in 2012, while the Canterbury region accounted for 39% of the country's carrot harvest.

Sweet corn

The hectares harvested of sweet corn and pumpkin have been suppressed in the 2007 and 2012 censuses, so it is inconclusive as to what their actual totals were. We expect the 2012 levels are similar to those of 2002.

4.7 Outdoor fruit growing

Blackcurrants dominate outdoor fruit production in Timaru and Timaru is a significant producer of blackcurrants in New Zealand. Statistics New Zealand data for 2012 are not reported due to their practice of withholding data where its release may allow identification of producers. Agricultural Census data for 2007 reveal that in terms of area planted, Timaru's proportion of the New Zealand total was 11% for blackcurrants, 4% for hazelnuts, 2% for peas and 1% for apples.

5 Water consented uses in OTOP zone

5.1 Key findings

The years from 1969 through until the mid-1980s showed little change in consented allocations. Demand for ground water and then surface water increased steadily from the mid-1980s onwards. Completion of the Opuha dam in 1998 led to a surge in allocation for surface water takes. From the mid-1980s irrigation consents accounted for nearly all of total ground water and surface water allocation. Annual irrigation consents account for about 800 million cubic metres, many multiples of the 100 to 150 million cubic metres for total consents for all other uses. Industrial use increased along with irrigation use, presumably due to expansion of the Fonterra plant at Clandeboye, coincident with the increase in dairy production, together with juice, jam and other food processing in Washdyke and Geraldine.

5.2 Water data

Detailed annual data was provided by Environment Canterbury (ECAN) for the consented allocation of ground water and surface water for the main uses in the OTOP zone from 1969 to the present. Data has also been provided for the metered allocation from 2001 onwards, and similarly for the metered use volume from 2001 onwards.

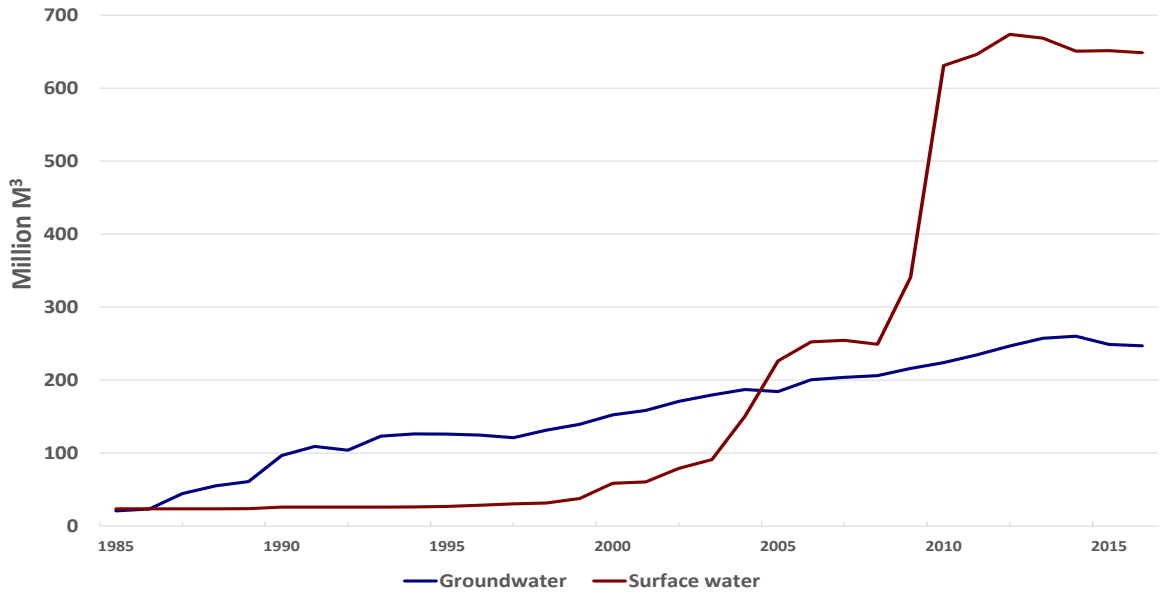
The years from 1969 through until the mid-1980s showed little change in the consented allocations. This section therefore traces the path of consented allocation of water for the main uses from the mid-1980s onwards. It also comments on apparent changes in consented allocation and uses in recent times.

Given the dominance of irrigation as a water use, and in turn its main use in dairying those aspects are covered in the following section 6.

5.3 The increase in consented allocation began in mid-1980s

The information provided by ECAN shows that there was a steady increase in the total consented demand for ground water takes from the mid-1980s onwards. As that demand increased further then demand for surface water consents began to increase from 2000 onwards. By 2010 the consents for surface water takes exceeded the consents for ground water takes.

Figure 7 Total consented allocation for ground water and surface water takes 1985 to 2015



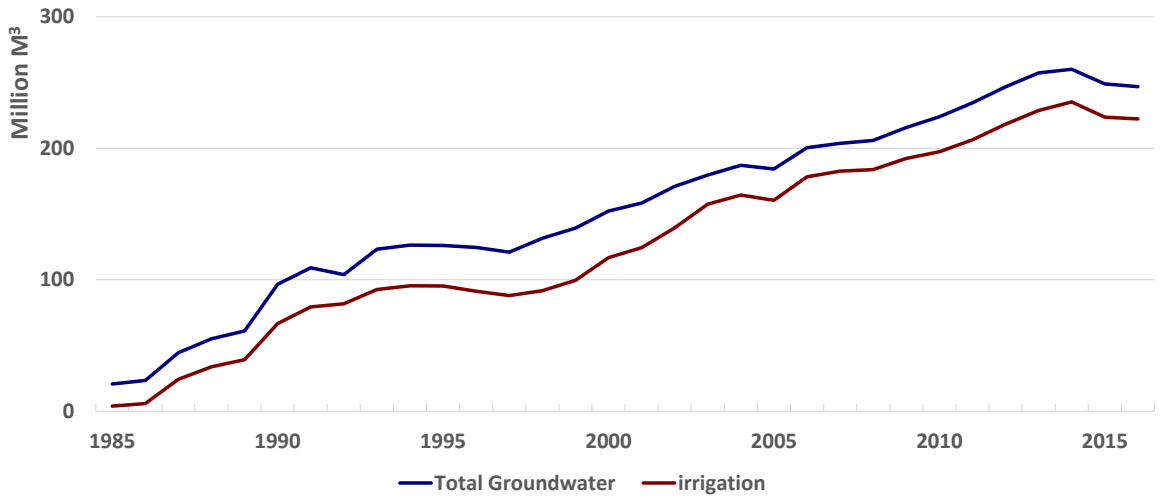
Source: Environment Canterbury

Note that the total take of ground water and surface water consented in 1985 was approximately 44 million cubic metres, and it increased thereafter, to peak in 2012 and 2013 at about 920 million cubic metres. The rapid increase in the consented allocations of surface water between 2008 and 2010, we understand from stakeholders, was facilitated by the entry into the zone through a large irrigation scheme of water from the Rangitata River, on the boundary of the Zone.

5.4 Irrigation water use

By far the largest allocation of consented water is that required for irrigation. The pattern of requirements for consented allocation for irrigation has generally set the pattern for expansion of total consents for all uses. These increases since 1985 are shown in Figures 8 and 9.

Figure 8 Ground water irrigation and total consented allocations

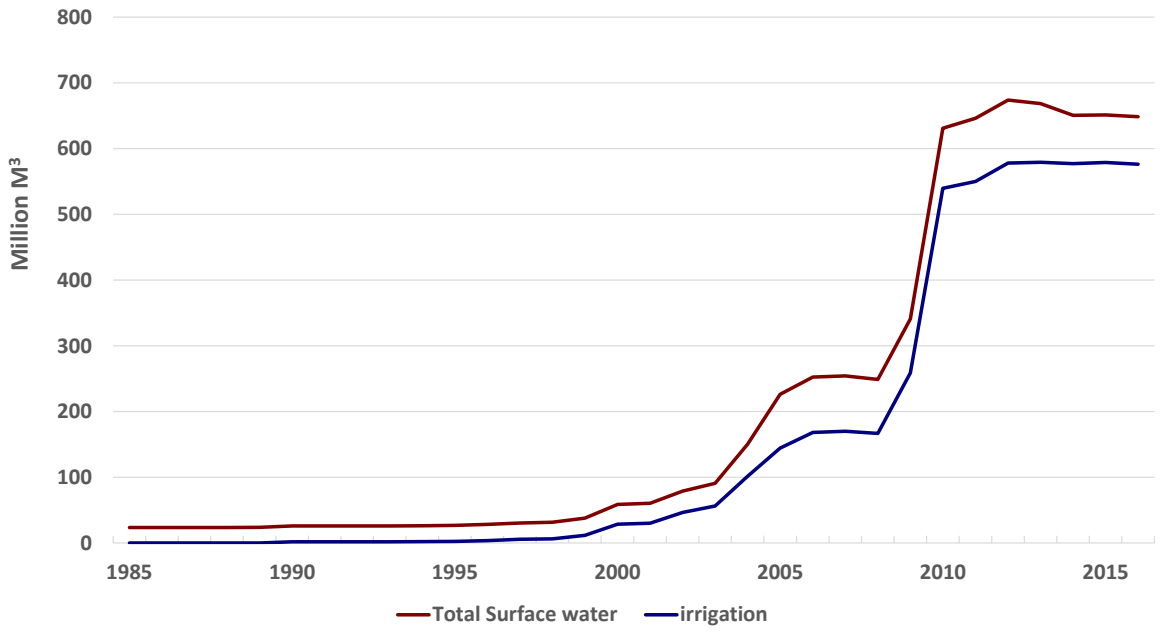


Source: Environment Canterbury

The chart indicates that from the beginning of the increase through to the present, the irrigation consents have accounted for all of the consented ground water allocations apart from 20 million to 30 million cubic metres.

The surface water consented allocations shows a similar picture from when the consents began increasing strongly in 2001. Note that the scale on this graph is twice that on the ground water graph. The difference between the irrigation consents and total consents has been a range up to 80 to 100 million cubic metres.

Figure 9 Surface water irrigation and total consented allocations



Source: Environment Canterbury

The actual utilisation of irrigation water is analysed and discussed in section 6.

5.5 Other water uses

The ECAN data was provided for water in the following other uses:

- Industry,
- Public supply,
- Stock water, and
- Other.

As we noted above, the total consented allocation in other uses is of a much smaller scale than the irrigation consents. Where the total consents for irrigation are of the order of 800 million cubic metres, the total of all other uses combined is of the order of 100 to 150 million cubic metres per year.

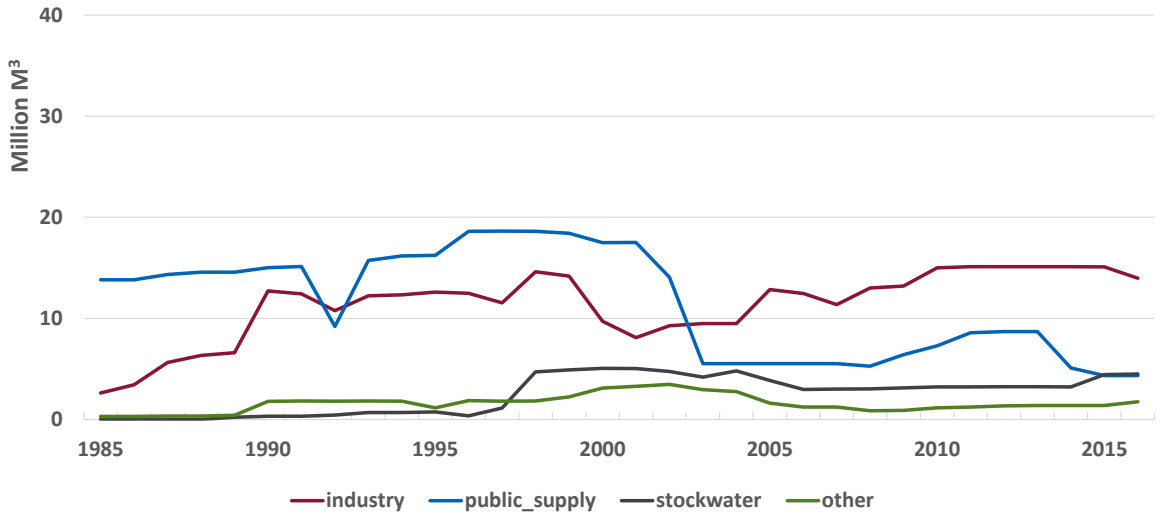
The following charts show the track of the consented allocations in these other uses over the period of expansion 1985 to 2015. Note that the ground water and the surface water charts each have the same vertical scale, so are directly, visually comparable as to volumes.

The two main uses of ground water are industry use and public supply, and an ongoing, relatively small amount for stock water.

The industry use increased in the second half of the 1980s and has stayed at about 10 million to 15 million cubic metres per year since. Presumably the increase was due to expansion of the Fonterra plant at Clandeboye when dairy production increased, and also juice and jam and other food processing in Washdyke and Geraldine. Fonterra reported that at times they had to restrict their ground water take due to the level of the aquifer. This can affect their level of processing.

The public supply take was earlier 14 million to 19 million cubic metres through until 2002 when it dropped to about 6 million cubic metres. There has been some fluctuation since, with an increase then decline.

Figure 10 Ground water consented allocations other uses 1985 to 2015

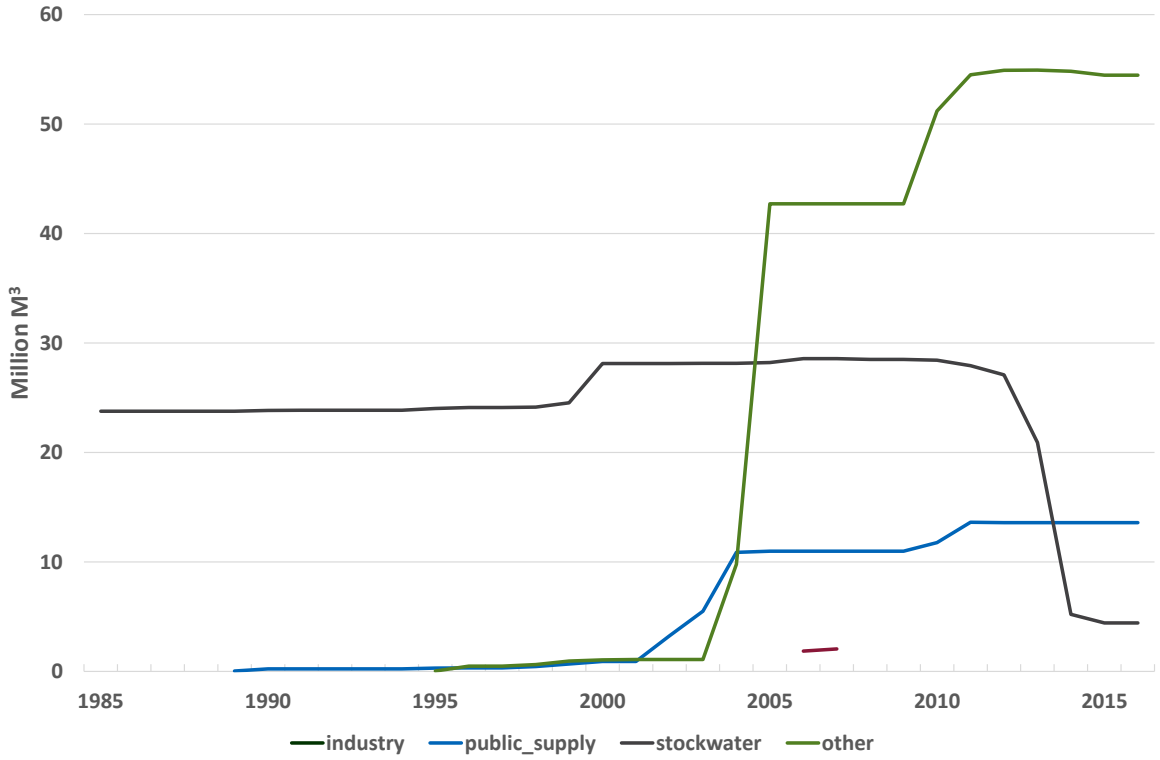


Source: Environment Canterbury

The surface water take for public supply increased from about 2002 when the ground water take reduced. We understand from stakeholders, but have been unable to verify that this is due to water becoming available from Opuha Dam. The take was above 10 million cubic metres until 2010 from when it has increased to about 13 million cubic metres.

Stock-water has apparently been traditionally from the surface water source, and was 24 to 29 million cubic metres per year from 1985 to 2012. Thereafter it has dropped to about 4 million cubic metres per year. Perhaps some farmer-irrigators obtain their stock water from their irrigation sources and do not record it as stock-water.

Figure 11 Surface water consented allocation other uses 1985 to 2015



Source: Environment Canterbury

The other main use for surface water is classified as 'Other'. That use increased in 2003 from negligible to 43 million cubic metres and increased further in 2010 to 54 million cubic metres. We understand that is probably the allocation consent for electricity generation from the Opuha Dam.

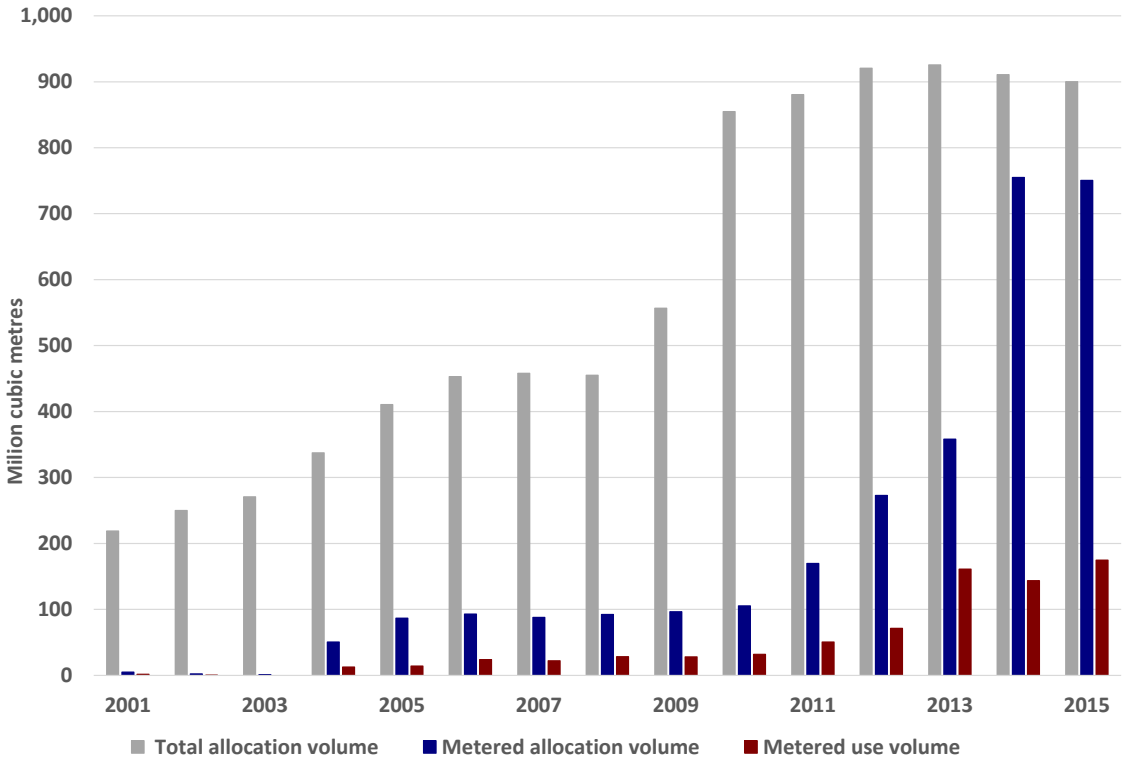
5.6 Recent changes

There has been steady increase in the requirements for allocation of water consents since about 1985, with this showing through initially in the ground water consents, especially for irrigation water. Then in about 2002 demand exceeded the availability of ground water, and surface water was required. By that stage the Opuha Dam had been constructed and was able to supply some of this water, and then by 2008 water entered the zone from the Rangitata River on the boundary of the zone, through a large irrigation scheme. The demand for water across New Zealand was increasing, and in order to better manage the allocation, regulations were introduced requiring the use of water metres on water takes.

5.6.1 Allocation and consent behaviour

Regulation requiring metering of water takes was signalled in 2010, and over the next four years the metered allocation volume increased strongly. By 2014 approximately 750 million cubic metres of allocation were metred, out of a total allocation of about 900 million cubic metres.

Figure 12 Total allocation volume and metered allocation volume and use 2001 to 2015



Source: Environment Canterbury

It is interesting to note that even though the water users felt it necessary to obtain a metered allocation of 750 million cubic metres, in the event in 2013 to 2015 their total usage as metered was only about 150 to 180 million cubic metres.

6 The Baseline economy, irrigation, dairying, the future

6.1 Key findings

The main purpose of this research report is to generate a description of the Baseline economy in the OTOP zone. The Baseline economy description is required to inform policy on water limits. We have therefore researched at a high level the apparent influences of water in developing the Baseline economy into the shape it is today. Knowledge of the place water has played in shaping the economy can assist in assessing changes likely due to any future changes in water availability and use.

In 2012 Timaru had 96% land irrigable by the more-efficient spray systems, compared with 87% and 80% for Canterbury and New Zealand respectively. Timaru, at 1%, has the lowest proportion of land irrigable by the most efficient micro irrigation systems most suitable for high value arborculture and horticulture.

The Baseline economy as it exists today has gained a lot of its strength from increased production by conversion of a broad range of land from other more or less intensive forms of agriculture into dairy production and support. This has been achieved with much dependence on increased feed produced under irrigation, and feed imported to the zone. This section will show that with expanded irrigation since 1996 the milking platforms on dairy farms have increased six-fold; the cows in milk have increased seven-fold; and the total milk solids production has increased ten-fold.

The relative importance of irrigation to Canterbury and Timaru District is shown by the fact that Canterbury has 65.6% of New Zealand's land area under irrigation. Within Canterbury, Timaru had a 10.5% share of the Canterbury land under irrigation. The extent of irrigable land in 2012 in Timaru was 12.6% of its total land area irrigable, which was higher than Canterbury at 9% and New Zealand at 3%. The types of irrigation in Timaru District are more concentrated on the relatively efficient spray irrigation systems rather than flood systems. There limited potential to increase efficiency by changing systems.

Now looking at the part irrigation has played, the previous section of the report has shown that irrigation consented allocation volume has trended strongly upwards since shortly after 1996.

Milk solids production has also trended upwards strongly over the period 1996 to 2015.

These related set of changes in production appear to have generated the strength in the economy to the extent that by 2015 the primary industries and the processing and manufacturing industries generated more than one-third of the GDP in the Baseline economy.

This indicates that the current level and type of irrigation and in particular dairy production and dairy support using irrigation are very important in the current shape of the Baseline OTOP economy.

The commercial and economic and environmental basis for the current model of dairy production with irrigation are all coming under scrutiny at present, especially in the last two years of low dairy farmgate payouts.

There will be changes to the Baseline economy from a number of directions, as the future fortunes of the dairy industry change. It will be important to understand the actual needs for dairy production in terms of Good Management Practice, the right level and type of irrigation water in volume and consistency of supply, as well as animal management and farm management to maintain a given level of production.

6.2 Irrigation increase and relative water use efficiency

This section traces the increases in irrigation areas and probable irrigation use efficiency in Timaru District compared with Canterbury and New Zealand.

6.2.1 Changes in areas irrigable 2002 to 2012

The area in hectares of land irrigable in Timaru District, in Canterbury and in New Zealand increased strongly over the period 2002 to 2012. This increase for Timaru District was from about 30,000 hectares to 50,000 hectares, for Canterbury from 300,000 to 470,000 and for New Zealand from 470,000 to 720,000 hectares.

This indicates that Timaru's share of the Canterbury area increased a little from 9.8% to 10.5%. Similarly the Canterbury share of the New Zealand areas has increased a little from 65.1% of the New Zealand total, to 65.6%. These figures indicate that Canterbury has about two-thirds of the area under irrigation in the whole country, and Timaru District has an important share of the Canterbury area.

Table 16 Irrigable area details Timaru, Canterbury, New Zealand 2002 to 2012

Territorial authority	Total land area	Total area equipped for irrigation	Irrigable area by flood systems	Irrigable area by spray systems	Irrigable area by micro systems	Irrigable system not specified	Share of total land area irrigable
			Hectares				*%*
2002							
Timaru District	234,056	29,550	*na*	*na*	*na*	*na*	12.6%
Canterbury	3,375,651	304,413	*na*	*na*	*na*	*na*	9.0%
New Zealand	15,589,885	467,636	*na*	*na*	*na*	*na*	3.0%
2007							
Timaru District		45,068	1,351	41,697	482	2,242	19.3%
Canterbury		410,328	68,630	332,002	6,017	14,485	12.2%
New Zealand		619,293	110,917	456,705	41,657	34,653	4.0%
2012							
Timaru District		49,820	1,970	47,588	311	*na*	21.3%
Canterbury		473,373	53,913	413,728	5,093	*na*	14.0%
New Zealand		721,740	94,481	579,465	45,908	*na*	4.6%
Increase to 2012 from:		2002	2007	2007	2007		2002
Timaru District		20,270	619	5,891	-171		69%
Canterbury		168,960	-14,717	81,726	-924		56%
New Zealand		254,104	-16,436	122,760	4,251		54%
Irrigation profile 2012							
Timaru District		100	4	96	1		
Canterbury		100	11	87	1		
New Zealand		100	13	80	6		

Sources: Statistrics NZ Agricultural Census, BERL

6.2.2 Indicators of relative water use efficiency

Changes in the hectares irrigable by different irrigation types gives an indication of the relative efficiency of water use in irrigation. Table 16 shows some keys aspects of irrigation in Timaru District and gives some high-level indicators as to its relative efficiency. The fact that the data have been collected under slightly different categories at each Census makes some comparisons difficult, but the general picture is relatively clear:

- Timaru District had a higher share of its total land area irrigable in 2002 (12.6%) than either Canterbury (9%) or New Zealand (3%)

- between 2002 and 2012, Timaru District area of land irrigable increased by a greater percentage (69%) than either Canterbury (56%) or New Zealand (54%)
- over the whole period 2002 to 2012 the share of land irrigated in Timaru District was greater than the share in Canterbury (by a factor of about 1.5), and much greater than the share in New Zealand as a whole (by a factor of about 4)
- rather surprisingly between 2007 and 2012, while Canterbury and New Zealand reduced their land areas irrigable by the relatively inefficient flood irrigation systems, Timaru District increased that area by a small amount
- nevertheless, as at 2012 Timaru District had a higher share irrigable by the more-efficient spray systems, (96% compared with 87% and 80% for Canterbury and New Zealand respectively), and a lower share irrigable by the flood systems (4% in Timaru compared with 11% in Canterbury and 13% in New Zealand)
- in 2012 New Zealand had a higher share in the even more efficient, but more expensive micro irrigation systems. Being so expensive, these systems are usually only installed for permanent crops which generate high value production per hectare such as orchards, and some horticultural crops. In New Zealand these systems are installed in 6% of the irrigable area, but only in 1% in Timaru District and Canterbury.

The indications from the irrigation data as for other agricultural and horticultural data are that Timaru District enjoys a higher level of relatively highly productive land than either Canterbury or New Zealand.

In terms of opportunity to improve the efficiency of water use, the indications from this data are that for Timaru District there could be some opportunity to increase efficiency of water use by converting some flood irrigation areas to spray irrigation systems. However as the share in flood systems is already well below the share in Canterbury and New Zealand, this opportunity, we understand from stakeholders, is relatively limited.

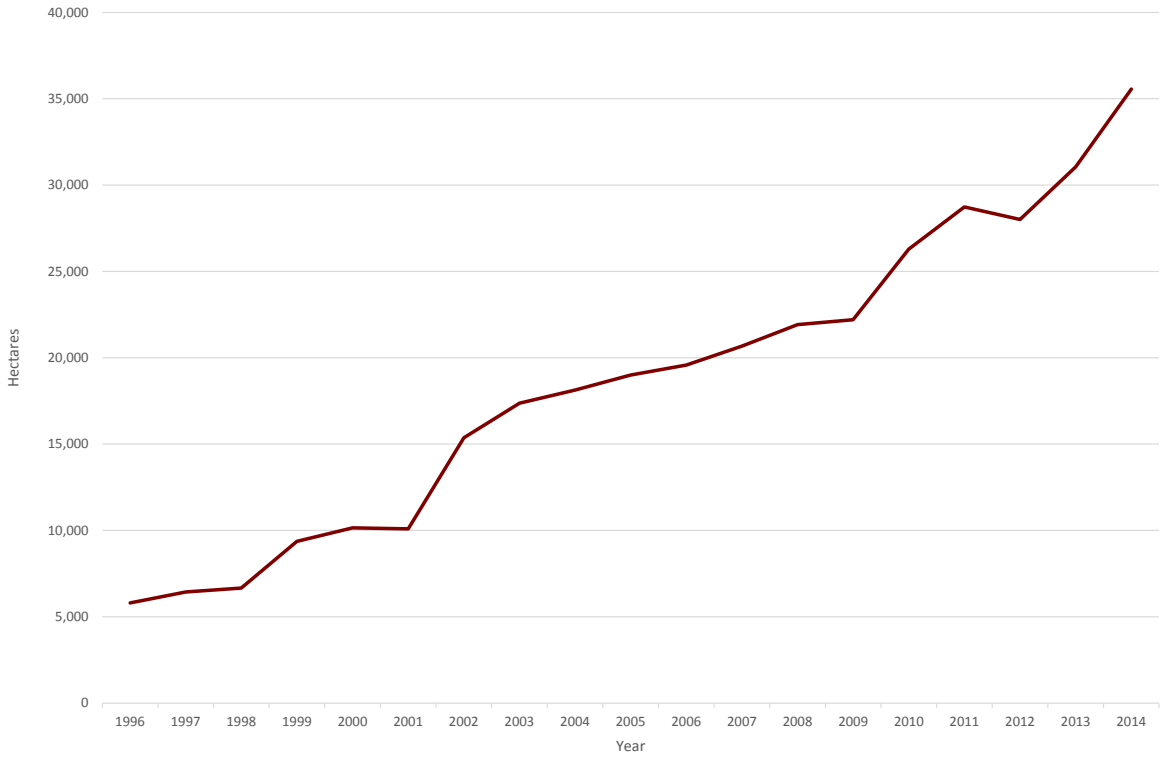
6.3 Dairy expansion

Figure 13 shows that the total area in milking 'platforms' on dairy farms in Timaru District increased from about 4,800 hectares in 1996 to over 36,000 hectares in 2015. This is an increase by a multiple of six times between 1996 and 2015.

Figure 14 shows that the number of cows in milk increased over the same period from 19,000 in 1996 to over 130,000 in 2015, an increase by a multiple of about seven times.

Figure 15 shows that in the same period the milk solids production increased from about 4,800 tonnes in 1996 to 51,000 tonnes in 2015, and increase by over ten times.

Figure 13 Area in dairy milking platforms 1996 to 2015, in Timaru



Source: LIC, DairyNZ, NZ Dairy Statistics

Figure 14 Cows in milk 1996 to 2015, in Timaru

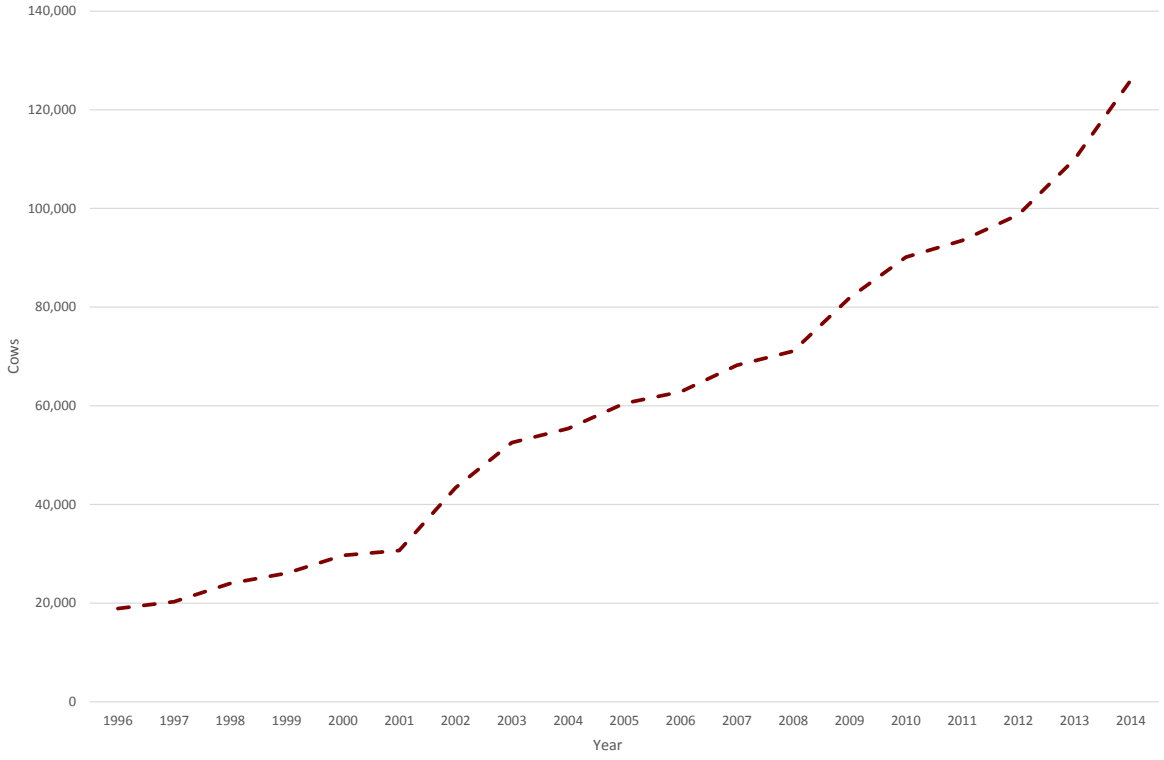
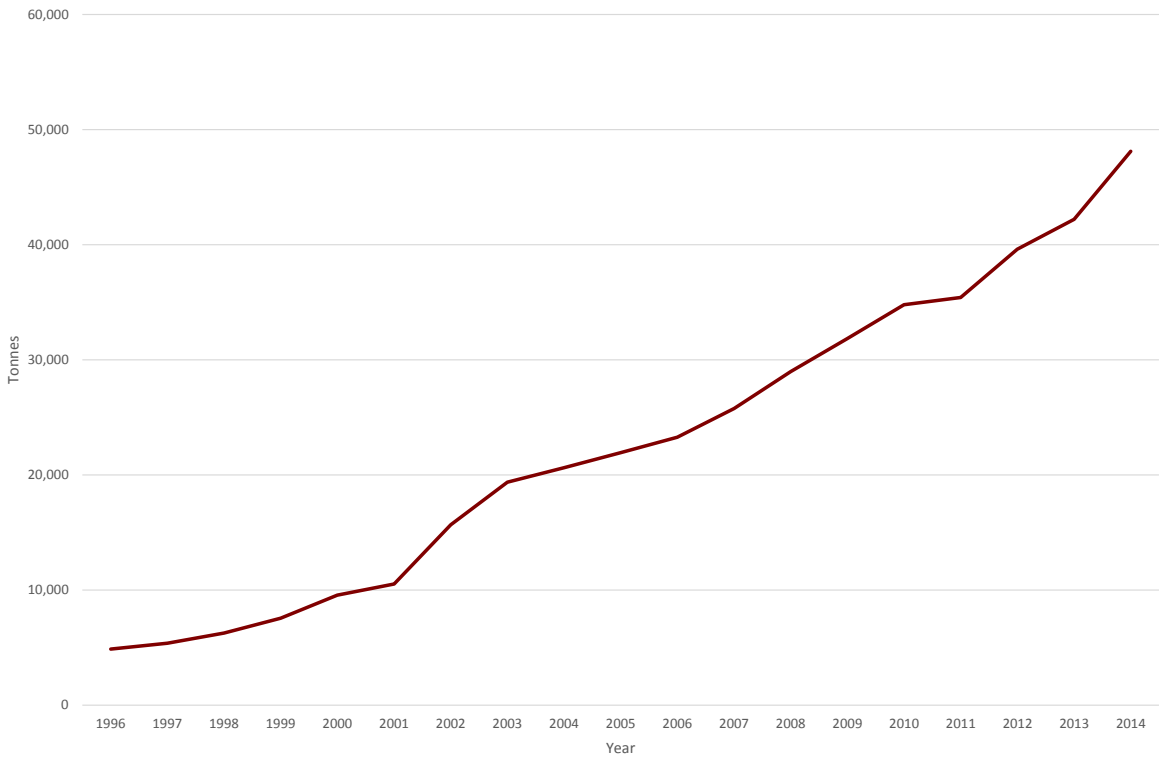


Figure 15 Timaru milk solids production 1996 to 2015, in Timaru



Source: LIC, DairyNZ, NZ Dairy Statistics

6.3.1 Area under irrigation 2002 to 2012

We do not have detailed information on the area of land which is irrigated for use in dairy production on the 'milking platforms' of farms or the area of irrigated land used in dairy support to raise calves and replacement heifers and to provide grazing and feed for off-farm wintering for the milking herd. We do have estimates that in Timaru District, in 2002, there were 29,550 hectares under irrigation, of which we estimate about 26,000 hectares to be under spray irrigation. At this time the LIC/DairyNZ data indicates that there was about 15,000 hectares in the milking platforms on dairy farms. The total area under irrigation was thus about 1.7 times the area on the dairy production farms.

By 2012 there were about 47,600 hectares in Timaru District under spray irrigation, and that compares with approximately 28,000 hectares in milking platforms. In this year the area under spray irrigation was also a factor of 1.7 times the area in dairy milking platforms. The indication is that even if all milking platforms mainly used spray irrigation, there was still an additional large area under spray irrigation.

Stakeholders in the industry including NZ Beef & Lamb professionals and South Canterbury consultants have told BERL that they find that dairy support capacity is about 70% of the capacity required for the cows in milk. It could well be therefore, that the increase in area under spray irrigation from 2002 to 2012 is largely responsible for the increase in milk solids production including production on the milking platforms and the provision of feed for dairy support operations over that period.

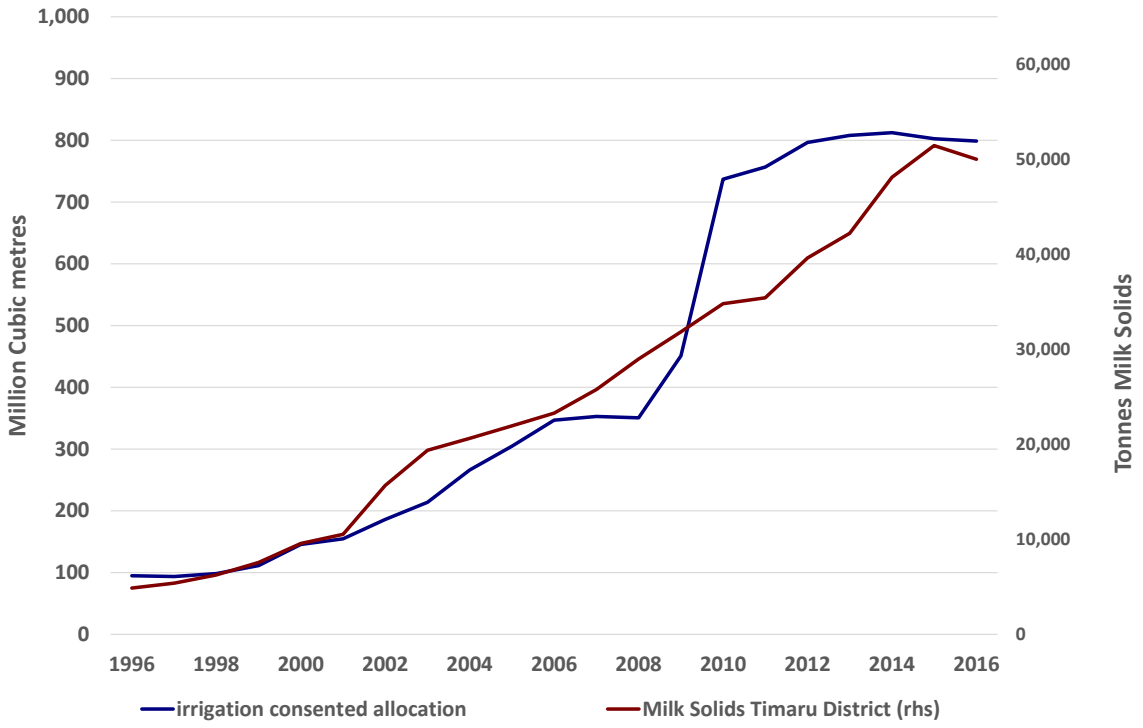
As shown in Figure 15 the Milk Solids (MS) production increased from 15,660 tonnes in 2002, to 39,600 tonnes in 2012.

6.4 Irrigation consented allocation and dairy production

The consented allocation assessed by producers as necessary for their production has increased steadily since the mid-1980s as shown in section 5.4. This amount which they assessed as necessary has increased at a similar rate as the level of dairy production over the period 1996 to 2015. The 1996 start date is early in the period of expanded dairy production in Timaru District, and is also the period for which BERL has been maintaining detailed databases from the LIC/Dairy NZ published data for Territorial Local Authorities (TLAs). The total milk production as shown in the graph, is estimated from the farms' production, not the solids delivered to the various processing plants. We estimate total production as the number of cows in milk times the average production of MS per cow. On this basis we can estimate the tonnes of MS produced in any TLA. In this case we have estimated it for the Timaru TLA.

In Figure 16 the two graphs each have their respective axes, the water consented allocation on the left hand axis, and the total tonnes of MS produced on the right hand axis.

Figure 16 Irrigation consented allocation and milk solids production 1996 to 2016



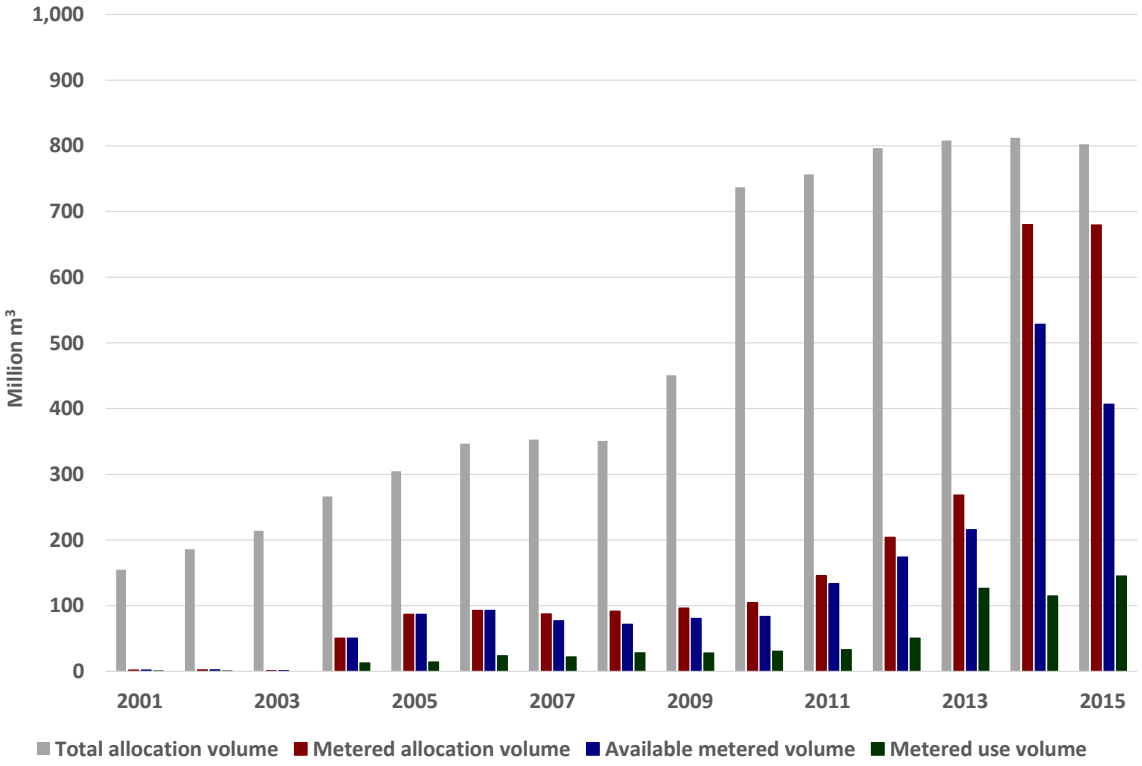
Source: ECAN, NZ Dairy Statistics, BERL

It is clear that irrigation consented allocation and milk solids production have both trended upwards over the period 1996 to 2016. Production relationships on-farm are more complex than such trends. Hence while the common upwards trends is graphic, it does not necessarily imply that increased (or reduced) consented water allocation produces increased (or reduced) MS production pro rata.

6.5 Irrigation allocation, consents and use behaviour

As was the case with total consents, the irrigation consents were mostly converted to metered consents over the period 2011 to 2014.

Figure 17 Water allocations, available volumes and use 2001 to 2015



Source: ECAN

Since irrigation consents make up the majority of water consents, the path of metering for irrigation reflects the path for all consents as shown in Figure 17. This chart as well as showing the consented metered allocation volume, also shows the available metered volume. This amount is less that the allocation volume because over a part of the irrigation season the water available from one or other source has had to be restricted. In the latest seasons, when most of the water takes are metered, the restriction has reduced the volumes available by about 150 million cubic metres in 2014 and 280 million cubic metres in 2015.

Again, as with the total allocations and usage, we note that with irrigation, even though the irrigators felt the need to have access to (in 2015) 680 million cubic metres, of which 400 million cubic metres was available over the season, they actually used only about 150 million cubic metres.

Given the importance to the OTOP economy of irrigation and in particular dairy production and dairy support using irrigation, it will be important to understand the actual needs for irrigation water in volume and consistency of supply necessary to maintain a given level of dairy production.

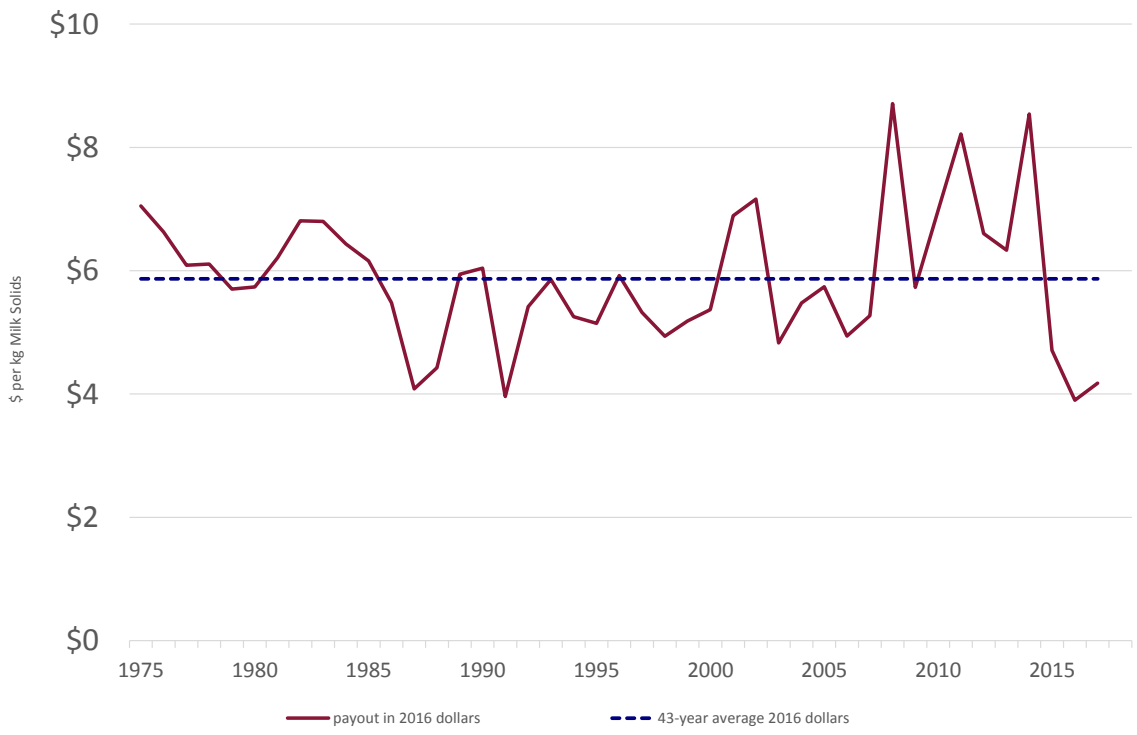
6.6 Probable future commercial influences on dairying

The information analysed in this report indicates that adoption of more intensive practices by investing in irrigation has been a major factor in the expansion of dairy production in the OTOP zone. By following through the commercial factors at play during the main expansion period since the early 1990s we can get some indication of the possible impacts on the Baseline economy, should these commercial factors change in future.

The main factor which dictates the expansion or contraction, and the intensity of husbandry and feeding practices in dairy production at any time is the spending power of the farmgate payout to farmers per kilogram of milk solids produced. We have taken the actual payout for each season since 1975, and adjusted these using

the New Zealand Consumer Price Index (CPI) to give an indication of the spending power in terms of 2016 New Zealand dollars of the annual payout. The track of this inflation adjusted dairy payout is shown in Figure 18.

Figure 18 Inflation-adjusted dairy farm payout in real 2016 dollars from 1975 to 2016



The graph shows that for much of the time from the early 1990s to 2005 the payout was mostly in the range $5 to $6 per kg MS, when expressed in 2016 dollars. Looking back to Figure 16 the indication is that a payout at that level was sufficient to support quite strong dairy production increase over that period.

From 2008 to 2014 the payout was at or above $6 per kg MS, and hit three peaks above $8 per kg MS. These extremely high payouts have been seen in other BERL research to have resulted in significant increase in development of further land for dairying, and increased supplementary feeding of the milking herd with imported Palm Kernel Extract (PKE), and with locally purchased grains and prepared feed. Detailed investigation of these on-farm commercial and farm management changes is beyond the scope of this report on the Baseline economy of the OTOP zone. However this detailed analysis has been successfully applied by BERL in other situations, e.g. the limit-setting process for the Lindis River minimum flow determined recently by Otago Regional Council.

Investigation of on-farm commercial and management implications will be essential in the OTOP zone to model alternative scenarios of animal husbandry, nutrition and farm management systems as part of the limit-setting process.

The recent fall in the payout to below $4 has raised doubt about the viability of some of the dairy production areas and systems developed under the stimulus of the recent high payouts.

The current BERL assessment, supported by recent sales prices in the Chicago dairy product market is that for the 2017-18 season the payout could be expected to return to about $6 per kg MS. Therefore the general question now is the extent to which a steady payout of about $6 per kg MS will be sufficient for most producers to be able to return to the previous lower-cost production system and survive commercially. The average payout over the ten years, 2006 to 2015 was about $6.60, so apart from the few producers who established their viability

due only to the three $8 plus peaks, most producers could be expected to revise their production systems and pull through.

It is in this environment that OTOP farmers will be aiming to maintain production while reducing their water requirement and environmental footprint by reducing cow numbers. A range of initiatives by farmers, their consultants and industry researchers like LIC and DairyNZ and the private sector are likely to achieve these increases in productivity over time. Industry bodies and others are generating guidelines for example on approaches to improved calf-rearing and growing out such that when they enter the herd they produce more per cow and remain in the herd for more lactations than is presently the case. This is a very effective way of increasing production from a given total quantum of feed 'footprint'.

This comes right back to the possible impacts on the Baseline economy of the OTOP zone due to changes that may be found necessary in the course of the water limit-setting process. To accurately assess the likely magnitude of these impacts it will be necessary to model improved, moderate-cost, yet higher productivity farm production systems into scenarios of improved water use in the OTOP zone whether from existing water sources or new ones.

Appendix A Employment Growth 2004 to 2014, by Industry for Timaru, Canterbury and New Zealand

Table 17 Employment growth 2004 to 2014, by industry for Timaru

Industry	2014 March year	Average annual growth rate 2004 to 2010	Average annual growth rate 2010 to 2014	Average annual growth rate 2004 to 2014
Agriculture, Forestry and Fishing	3,330	1.1%	4.2%	2.3%
Mining	18	7.6%	-19.1%	-4.0%
Manufacturing	4,482	-2.8%	1.9%	-1.0%
Electricity, Gas, Water and Waste Services	186	6.6%	10.9%	8.3%
Construction	2,388	5.4%	3.0%	4.4%
Wholesale Trade	1,068	0.9%	2.5%	1.5%
Retail Trade	2,682	2.2%	-0.5%	1.1%
Accommodation and Food Services	1,440	3.1%	-0.9%	1.5%
Transport, Postal and Warehousing	1,308	2.4%	1.2%	2.0%
Information Media and Telecommunications	252	0.4%	-3.3%	-1.1%
Financial and Insurance Services	390	2.1%	-2.5%	0.2%
Rental, Hiring and Real Estate Services	531	-0.1%	6.4%	2.4%
Professional, Scientific and Technical Services	1,122	3.4%	-1.0%	1.6%
Administrative and Support Services	870	-3.3%	4.7%	-0.1%
Public Administration and Safety	750	3.3%	-0.4%	1.8%
Education and Training	1,530	1.3%	-0.7%	0.5%
Health Care and Social Assistance	2,436	2.9%	0.3%	1.9%
Arts and Recreation Services	279	4.2%	2.9%	3.6%
Other Services	777	-0.1%	2.0%	0.8%
Not Elsewhere Included	141	-1.7%	-7.1%	-3.9%
Total	25,980	1.1%	1.3%	1.2%

Source: Annual LEED Statistics NZ

Table 18 Employment growth 2004 to 2014, by industry for Canterbury

Industry	2014 March year	Average annual growth rate 2004 to 2010	Average annual growth rate 2010 to 2014	Average annual growth rate 2004 to 2014
Agriculture, Forestry and Fishing	21,921	0.2%	1.0%	0.5%
Mining	417	11.1%	-1.1%	6.1%
Manufacturing	36,552	-2.2%	-0.7%	-1.6%
Electricity, Gas, Water and Waste Services	2,178	7.9%	5.2%	6.8%
Construction	37,479	3.2%	14.0%	7.4%
Wholesale Trade	15,978	1.1%	0.5%	0.8%
Retail Trade	30,486	1.6%	0.5%	1.1%
Accommodation and Food Services	19,563	2.6%	-1.7%	0.9%
Transport, Postal and Warehousing	13,830	1.1%	0.5%	0.9%
Information Media and Telecommunications	4,245	-0.5%	-3.9%	-1.9%
Financial and Insurance Services	7,050	2.7%	1.8%	2.4%
Rental, Hiring and Real Estate Services	7,215	1.1%	1.0%	1.1%
Professional, Scientific and Technical Services	24,825	4.3%	2.7%	3.7%
Administrative and Support Services	14,247	-0.5%	3.6%	1.1%
Public Administration and Safety	12,492	4.5%	2.2%	3.6%
Education and Training	22,692	2.4%	-1.0%	1.0%
Health Care and Social Assistance	29,448	3.1%	0.5%	2.0%
Arts and Recreation Services	5,226	4.3%	-1.9%	1.7%
Other Services	10,287	1.0%	0.4%	0.7%
Not Elsewhere Included	1,953	-0.9%	-6.5%	-3.2%
Total	318,084	1.5%	1.6%	1.5%

Source: Annual LEED Statistics NZ

Table 19 Employment growth 2004 to 2014, by industry for New Zealand

Industry	2014 March year	Average annual growth rate 2004 to 2010	Average annual growth rate 2010 to 2014	Average annual growth rate 2004 to 2014
Agriculture, Forestry and Fishing	169,632	-0.6%	1.1%	0.1%
Mining	7,089	7.9%	2.4%	5.7%
Manufacturing	239,028	-1.9%	-0.6%	-1.4%
Electricity, Gas, Water and Waste Services	15,105	5.4%	3.1%	4.4%
Construction	192,237	2.5%	2.7%	2.6%
Wholesale Trade	117,360	0.2%	0.5%	0.3%
Retail Trade	220,956	1.0%	0.3%	0.7%
Accommodation and Food Services	158,292	2.6%	1.5%	2.2%
Transport, Postal and Warehousing	96,456	0.9%	0.5%	0.7%
Information Media and Telecommunications	44,424	0.7%	-0.5%	0.3%
Financial and Insurance Services	66,153	3.0%	1.9%	2.5%
Rental, Hiring and Real Estate Services	52,443	-0.5%	1.5%	0.3%
Professional, Scientific and Technical Services	214,653	2.9%	2.6%	2.8%
Administrative and Support Services	124,206	1.2%	3.0%	2.0%
Public Administration and Safety	113,877	4.8%	1.6%	3.5%
Education and Training	186,429	2.2%	0.5%	1.5%
Health Care and Social Assistance	217,815	3.5%	1.8%	2.9%
Arts and Recreation Services	42,285	4.2%	0.4%	2.7%
Other Services	80,529	1.4%	0.8%	1.1%
Not Elsewhere Included	16,368	-1.3%	-4.8%	-2.7%
Total	2,375,337	1.4%	1.1%	1.3%

Source: Annual LEED Statistics NZ