

18 Otago's Ecological Footprint

18.1 Profile of the region

The Otago region has the second-largest population of any region in the South Island. On census night 2001, the resident population was estimated to be 181,542 or 4.9 percent of the national population. In the period between the 1996 and 2001 census the Otago region experienced a decline of 3540 people or 1.9 percent of the population. Dunedin is the region's largest urban area, accounting for 107,088 residents, or 59.0 percent of the region's population. The region is relatively sparsely populated with an estimated population density of 5.8 people per square kilometre (Statistics New Zealand, 1998s).

The Otago region is the third largest in New Zealand. It occupies an estimated 3,199,000 ha or 11.6 percent of New Zealand's total land area. It is bounded to the west and south by the West Coast and Southland regions respectively with the Pacific Ocean forming the eastern boundary. The Canterbury region forms the northern boundary. The region's highest mountain is Mt Earnslaw (2819 metres); the largest lake is Lake Wakatipu (29,300 ha); and the Clutha river (322 kilometres) is the region's longest. The Clutha river carries the largest volume of water of any nationally. The topography of the Otago region varies considerably. Loess soils cover the river plains and basins with numerous waterways interwoven. The Taieri and Clutha areas are particularly fertile. However, the Central Otago soils are less fertile and a significant proportion of the region's high country is extremely susceptible to erosion. The Southern Alps greatly influence climatic conditions with Central Otago having a semi-arid continental climate. This area is the driest in summer and amongst the coldest in winter, making it one of the most climatically extreme areas nationally. Introduced animal pests such as rabbits, hares, and possums have also ravaged it. Although pastoral farming accounts for 92 percent of land use in the Otago region, this is only made sustainable through human intervention.

The 1997–98 GDP of the Otago region is 4.4 billion or 4.4 percent of the nation's GDP for that year. Sheep, beef and mixed livestock farming (LQ 2.01), mining and quarrying (LQ 1.51), meat processing (LQ 2.26) and accommodation, restaurants and cafés (LQ 1.48) all make sizeable contributions to the region's economy. Sheep and beef farms are among the largest in the country. This reflects their low biological productivity (or production yield per ha). Stocking rates per ha are among the lowest nationally. In 1996 the average Otago farm size was 656 ha, almost 2.6 times the national average.

Mining is another major industry. The Otago region has huge coal reserves, second only to the West Coast region in the South Island. Tourism, particularly in Queenstown, is a substantial and growing industry. The proportion of businesses engaged in cultural and recreational services is among the highest nationally. Central Otago is a significant producer of summerfruit in particular, apricots, nectarines and cherries. A small but growing viticulture industry also exists.

18.2 Overall ecological footprint and comparison with other regions

The Otago region has an estimated ecological footprint of 1,019,050 ha, 9.47 percent of New Zealand's total ecological footprint. This is the fifth-largest ecological footprint of any region in New Zealand. By comparison, Otago's ecological footprint is similar in size to that of the Waikato (1,048,860 ha) and Wellington (1,029,010 ha) regions.

In per capita terms, Otago's ecological footprint is the largest of all regions at 5.41 ha per person. An Otago resident requires 1.8 times more land than the average New Zealander. This is explained by the Otago region's agricultural land being far less productive than the New Zealand average. It is estimated that sheep, beef and mixed livestock farming has the second lowest yield per ha of any region in the country, only higher than the Marlborough region. The fact that the average Otago farm size is the largest of any region at 656 ha or 2.6 times the national average reinforces this finding. Significantly lower than average agricultural productivity is a result of the harsh and rugged hill country, extreme climatic conditions in Central Otago and the presence of introduced animals and weedy plants.

The total useful land available in the Otago region is estimated to be 2,155,440 ha. Otago has an ecological surplus of 1,136,390 ha. This is the second largest surplus of any region and equates to 6.0 ha per Otago resident. This ecological surplus is second only to Canterbury's with an estimated 1,898,230 ha surplus. In this way, the region is self-sufficient in ecological footprint terms.

18.3 Ecological footprint disaggregated by land type

The agricultural land component of the ecological footprint consists of 859,880 ha (refer to Table 18.1). This represents 84.4 percent of Otago's ecological footprint. On a per capita basis, the average Otago resident appropriates 4.57 ha of agricultural land, 2.2 times the national average of 2.12 ha per person. This is a consequence of the region's farms being among the lowest yielding per ha of any in the country. Overall, an estimated 87.6 percent of agricultural land is within region land, while another 9.0 percent is embodied in goods and services purchased by Otago residents from overseas.

Table 18.1 Otago's ecological footprint by land type, 1997–98

Land type	Within region land (ha)	Land from other New Zealand regions (ha)	Land from other nations (ha)	Total land (ha)	Total land (ha per capita)	Total land (% of total)
Agricultural land	753,530	28,980	77,370	859,880	4.57	84.4
Forest land	23,400	1,220	6,190	30,810	0.16	3.0
Degraded land	38,700	480	4,320	43,500	0.23	4.3
Energy land	60,270	1,800	22,660	84,730	0.45	8.3
Total	875,900	32,480	110,540	1,018,920	5.41	100.0

The forest land component of the Otago region's footprint consists of 30,810 ha, 3.0 percent of the footprint. While this is a lower share of the total footprint relative to the nation, in per capita terms it is similar. The Otago region's per capita forest land component is 0.16 ha while the national figure is 0.20 ha. This land is predominantly made up of within region land (23,400 ha), but lesser amounts of forest land are embodied in goods and services purchased from other regions (1220 ha) and from abroad (6190 ha). This component does not include the hypothetical land planted in trees used to sequester CO₂ emissions.

The degraded land component makes up 4.3 percent of the region's ecological footprint (43,500 ha). Most of this degraded land (38,700 ha) is derived from within the region, primarily land occupied by residential homes and businesses (excluding farms and forestry holdings). A further 4320 ha, or 10 percent of all forest land, is embodied in goods and services that Otago residents import from overseas.

Otago region’s energy land component of the ecological footprint is 84,700 ha. This represents 8.3 percent of Otago’s ecological footprint, significantly lower than the national average of 16.6 percent. Nevertheless, in per capita terms the region and nation are similar, requiring respectively per person 0.45 ha and 0.51 ha. An estimated 26.7 percent of the energy land is embodied in international imports consumed by Otago residents.

18.4 Ecological footprint disaggregated by goods and services purchased

18.4.1 Purchase of Otago produced goods and services (P₁+P₂ ... P_n)

The purchase of manufacturing sector products accounted for 556,910 ha of embodied land in Otago’s ecological footprint (refer to Table 18.2). This amounts to 54.6 percent of the entire ecological footprint of the Otago region. Most of this is appropriated from products created within the region (509,410 ha) with small amounts appropriated from other regions (29,020 ha) and other nations (18,480 ha). This constitutes largely agricultural land embodied in food products consumed by Otago residents.

Table 18.2 Otago’s ecological footprint by economic products, 1997–98

Economic products consumed	Within region land (ha)	Land from other New Zealand regions (ha)	Land from other nations (ha)	Total land (ha)	Total land (ha per capita)	Total land (% of total)
Agriculture	100,050	220	1,100	101,370	0.54	9.9
Forestry	1,720	10	20	1,750	0.01	0.2
Fishing and hunting	20	0	10	30	0.00	0.0
Mining and quarrying	610	0	30	640	0.00	0.1
Manufacturing	509,410	29,020	18,480	556,910	2.96	54.6
Utilities and construction	33,560	320	4,610	38,490	0.20	3.8
Services	197,930	670	25,510	224,110	1.19	22.0
Domestic final demand	32,600	2,370	60,780	95,750	0.51	9.4
Total	875,900	32,620	110,540	1,019,050	5.41	100.0

The consumption of land embodied in service sector products (224,110 ha) is also considerable, accounting for 22.0 percent of the entire footprint. The vast majority of this land is appropriated from within the region (197,930 ha), although some 25,510 ha are embodied in service sector goods purchased from international sources. At a first glance the land embodied in service sector products may appear high, particularly given that the physical space occupied by the service sector is relatively low. A close inspection, however, reveals that this is a consequence of significant indirect upstream linkages, each of which appropriates embodied land, and cumulatively is substantial.

The land embodied in the products of other sectors consumed by Otago residents is low by comparison. An estimated 101,370 ha is embodied in agricultural products, a further 33,560 ha is embodied in utility and construction products and a very small amount in forestry products (1750 ha).

18.4.2 Purchase of goods and services produced outside Otago (D₁+D₄)

Otago residents also purchase products made outside the region. In embodied land terms, this equates to 63,150 ha and is mostly appropriated from overseas (60,780 ha). This includes land embodied in goods purchased from retailers that are made overseas but sold locally with an additional mark-up. In this way, land embodied in items such as motor cars and computers purchased by households is included in this figure.

18.5 Ecological Balance of Trade and ecological interdependencies

The land embodied in imports into the Otago regional economy is 244,190 ha (refer to Table 18.3). Land embodied in imports is, however, small in comparison with land embodied in the region's exports which equates to 1,636,610 ha. Overall, this means that in Ecological Balance of Trade terms the Otago region is a substantial net exporter, exporting 1,737,550 ha of embodied land annually.

Table 18.3 Otago's Ecological Balance of Trade by economic sector, 1997–98

Economic sector	Imports purchased by the economic sector (embodied ha)	Exports sold by the economic sector (embodied ha)	Balance of Trade (embodied ha)
Interregional trade			
Agriculture	1,660	275,610	273,950
Forestry	280	7,080	6,800
Fishing and hunting	20	10	-10
Mining and quarrying	40	280	240
Manufacturing	83,160	57,840	-25,320
Utilities and construction	340	2,420	2,080
Services	830	1,890	1,060
Domestic final demand	2,370	0	-2,370
Interregional Balance of Trade	88,700	345,130	256,430
International trade			
Agriculture	8,250	382,640	374,390
Forestry	470	33,560	33,090
Fishing and hunting	500	1,160	660
Mining and quarrying	260	4,190	3,930
Manufacturing	49,110	1,159,430	1,110,320
Utilities and construction	4,760	150	-4,610
Services	31,360	55,480	24,120
Domestic final demand	60,780	0	-60,780
International Balance of Trade	155,490	1,636,610	1,481,120
Total Balance of Trade	244,190	1,981,740	1,737,550

18.5.1 Exports and imports by economic sectors

Sales of manufactured products by the Otago economy were estimated to include 1,217,270 ha of embodied land, ie. land embodied in exports of manufactured products made up 62.4 percent

of the region's total ecological trade surplus. The majority of this land (1,159,430 ha) is embodied in sales of processed agricultural products to overseas nations. By comparison, purchases by the region's manufacturing sector accounted for 132,270 ha of embodied land or 54.2 percent of imports. On an interregional basis, land embodied in manufacturing sector purchases (83,160 ha) is greater than the land embodied in sales of manufactured goods (57,840 ha).

Land embodied in agricultural products that are exported from the Otago region (658,250 ha) is also significant. Sales of stock and horticultural produce most likely account for the embodied agricultural land exported interregionally (275,610 ha) while sales of wool and horticultural produce account for the land embodied in agricultural products heading offshore (382,640 ha).

All other sectors in the Otago economy are minor net exports with the exception of the utilities and construction sector which imports more land in product purchases (5100 ha), than it exports in products (2570 ha). The service sector in the Otago economy imports significantly less embodied land (32,190 ha) than it exports (57,370 ha). The vast majority of imported embodied land is encapsulated in goods and services purchased from abroad (31,360 ha). Backward linkages to farming from the service sector in the Otago economy explains why the land embodied in service sector products heading offshore is so high (55,480 ha).

18.5.2 Exports and imports by type of land

The Otago region is a very large net provider of embodied agricultural land, exporting an estimated 1,551,150 ha to other countries and a further 332,120 ha to other New Zealand regions (refer to Table 18.4). This represents primarily the land occupied by the region's sheep, beef and mixed livestock farms. Generally speaking, the region's agricultural land is embodied in farm products that flow onto local processing/manufacturing facilities and, in turn, leave New Zealand destined for international markets.

Table 18.4 Otago's Ecological Balance of Trade by land type, 1997–98

Economic sector	Land embodied in imports (ha)	Land embodied in exports (ha)	Balance of Trade (ha)
Interregional trade			
Agricultural land	83,510	332,120	248,610
Forest land	1,790	7,230	5,440
Degraded land	850	2,720	1,870
Energy land	2,550	3,070	520
Interregional Balance of Trade	88,700	345,140	256,440
International trade			
Agricultural land	115,070	1,551,150	1,436,080
Forest land	7,850	43,610	35,760
Degraded land	7,810	10,030	2,220
Energy land	24,770	31,820	7,050
International Balance of Trade	155,500	1,636,610	1,481,110
Total Balance of Trade	244,200	1,981,750	1,737,550

Of the remaining land types, an estimated 50,840 ha of forest land, 12,750 ha of degraded land and 34,890 ha of energy land is embodied in products exported from the region. The region is a net exporter of all land types both interregionally as well as internationally.

18.5.3 Overall picture

The embodied land flows associated with the Otago economy are shown in Figure 18.1. This diagram indicates that the Otago region is:

- (1) self-sufficient in terms of land, with a relatively small embodied land area associated with household consumption
- (2) very much an internationally driven export economy.

Land embodied in international exports (1,636,610 ha) outweighs embodied land used in meeting local household demand (1,019,060 ha). Overall, the Otago region exports 1,981,740 ha of embodied land compared with imports of only 244,190 ha resulting in a positive Balance of Trade of 1,737,550 ha.

Figure 18.1 Flows of embodied land through the Otago economy

