Characterising Drystock Farms for The Southland Economic Model

---

Technical Paper

2018

Authors: Andrew Burtt (Chief Economist, **Beef + Lamb New Zealand**), Lindsay Fung (Environmental Policy Manager, **Deer Industry New Zealand**) and **Environment Southland** staff.

Cover Photo: Northern Southland
Source: Simon Moran

Contents

Image 1: Deer caught in spring snow in coastal Southland (photo courtesy of John Somerville)

1 Introduction

This paper describes the methodology Beef + Lamb New Zealand and Deer Industry New Zealand used in 2018 to determine how all drystock farms in Southland were characterised for inclusion in The Southland Economic Model. This characterisation was based on research on a sample of drystock farms undertaken by Beef + Lamb New Zealand, together with Deer Industry New Zealand and New Zealand Deer Farmers Association – Southland Branch, and cover a wide range of farming operations across the region. This dataset will be used with similar datasets for other industries to assess the economic impacts of achieving limits for fresh water in Southland.

2 Purpose

The purpose was to develop and apply a methodology for taking farm-level data collected from 46 drystock case study farms (39 sheep and beef farms and 7 deer farms) to the region-scale in The Southland Economic Model. The research used to develop the drystock case study farms are described in full in Burtt and Fung (2019 revised edition) Chapter 2: Drystock (Sheep, Beef Cattle and Deer) in *The Southland Economic Project: Agriculture and Forestry Report*.

3 Methodology

3.1 Agricultural Areas

Southland is divided into five Freshwater Management Units (FMUs): Fiordland and Islands, Waiau, Aparima, Ōreti and Matāura. The latter four FMUs have large areas of agricultural land. For The Southland Economic Project, the Waiau FMU was split at the Duncraigen Road weir to form the Te Anau Basin and Lower Waiau, and the Mataura FMU was split at the township of Gore to form the Upper and Lower Mataura[1]. These areas were used in the selection of the drystock case study farms and they also form the basis of the 33 economic zones within The Southland Economic Model[2]. In summary, the six agricultural areas were as follows (also refer to Figure 1):

- Te Anau Basin (Waiau FMU)
- Lower Waiau (Waiau FMU)
- Aparima (Aparima FMU)
- Oreti (Oreti FMU)
- Upper Mataura (Mataura FMU)
- Lower Mataura (Mataura FMU)

Twelve farm types were identified based on land use, property size, and environmental conditions across these areas.

[1] Following this work, the upper and lower Mataura agriculture areas were combined in The Southland Economic Model to save computing resources. The wet / dry and poorly drained / well drained are relied upon to spatially locate farms within the Mataura FMU.

[2] The 33 Economic zone categories are described in McDonald, N., McDonald, G., Harvey, E., & Vergara, M. J. (2020) The Southland Economic Model: Technical Report. Market Economics for Environment Southland.

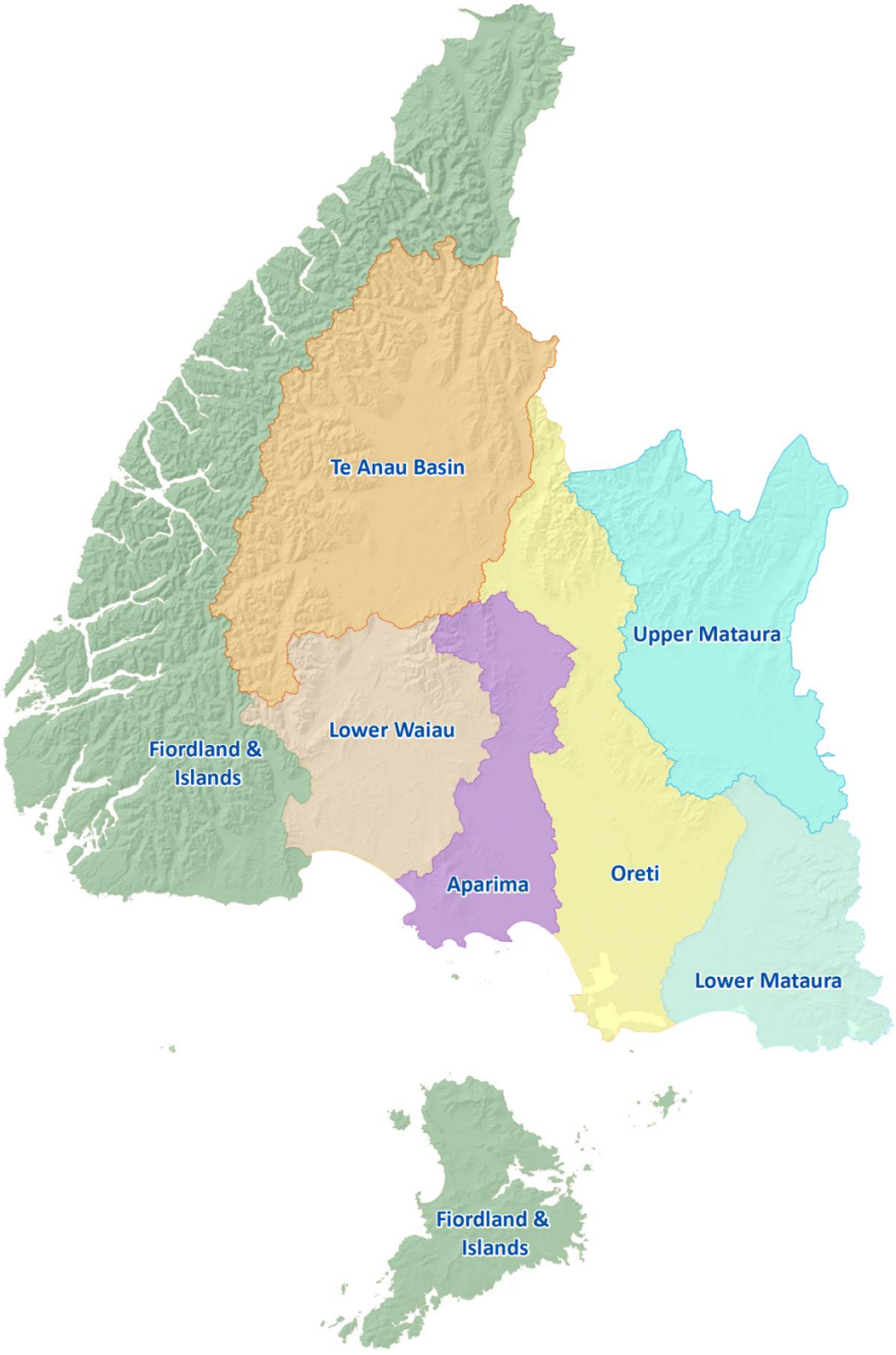

Figure 1: Six Main Agricultural Areas in Southland (and the Fiordland & Islands FMU)

3.2 Drystock Farm Types

Key characteristics of the case study farms were relevant to both the baseline and mitigation Overseer analysis: farm size and topography, rainfall and soil drainage, proportion of non-grazing area, proportion of grazing area in crop, and livestock mix[3] (Moran, Pearson, Couldrey, & Eyre, 2019)[4]. These farm characteristics influence how nutrient losses are estimated by OVERSEER but it was not easy to identify patterns in the results from a set of case studies because each farm's production system is complex and unique. Although the complexity of the farms makes it challenging to identify patterns, there were at least four factors that appear to be related to nitrogen loss for the 36 sheep and beef farms analysed using Overseer: farm size, the raising or grazing of dairy cows, and to a lesser extent, proportions of non-grazing area or area in crop. Patterns for phosphorus losses were less clear.

In the research the 36 sheep and beef farms formed two groups based on size: 'large' farms (more than 1,000 hectares grazing area) of which there were nine and 'small' (less than 1,000 hectares grazing area) of which there were 27. The 'large' farms had nitrogen losses equal to or less than 15 kg N/ha/year, and an average stocking rate of 8.5 stock units / grazing hectare (two had higher stocking rates compared with sheep and beef farms as a whole). They also had average non-grazing areas equivalent to just under 12% of the total area, and an area in cropping equivalent to an average of 6.5% of the grazing area. Nitrogen losses on the 'small' farms were more evenly spread.

The first step in the drystock farm characterisation was to classify the drystock case study farms and all Southland drystock farms (using Environment Southland's Land Use Map) into general farm "types" using land use, property size[5], and environmental conditions.

3.2.1 Land Use

In developing the Southland Land Use Map, Pearson and Couldrey (2016) identified two broad drystock land use classes, "Sheep and Beef" and "Deer", which were defined using the following land use categories:

Sheep and Beef = Sheep; Beef; Sheep and Beef; Livestock Support; and Mixed Livestock and Arable.

Deer = Specialist Deer; Mixed Livestock (sheep, beef, deer); and Majority Deer with Mixed Livestock.

3.2.2 Property Size

The farms in each of the two drystock land use classes were then divided by property size into:

Large farms (total area is greater than or equal to 1,000 hectares); or

Small farms (total area is less than 1,000 hectares).

[3] Possible additional factors not included in the description of farm characteristics were stocking rates and fertiliser use.

[4] Moran, E. Pearson, L., Couldrey, M., & Eyre, K. (2019) *The Southland Economic Project: Agriculture and Forestry Report.* Technical Report. Publication no. 2019-04. Environment Southland, Invercargill, New Zealand.

[5] 'Property' is primarily defined by parcels with the same Valuation New Zealand number. A property is not necessarily the same as all of the land within a farm business.

As a simplifying assumption, total area was used rather than grazing area as in the original analysis, which meant slightly more farms were treated as 'large' than may have otherwise been the case.

3.2.3 Environmental Conditions

Large farms were treated as a specific farm type because they can cover a wide range of environmental conditions (topographies, rainfall bands, and soil types). By comparison, small farms were further classified by topography, rainfall, and soil drainage because they were considered more likely to fit a specific set of environmental conditions.

Topography

For the small farms, topography was measured using the slope classes in OVERSEER® nutrient budgets (referred to as OVERSEER) and classified into:

- Flat and Rolling (less than 16°); or
- Easy Hill and Steep (equal to or greater than 16°).

Small farms with both slope classes, or only slopes ≥16°, were identified as "Mixed Slope" and were not grouped by rainfall bands and soil types. Small farms with flat to rolling topographies (<16°) were classified by rainfall and soil types.

Image 1: Beef cattle near the Te Anau Basin (photo courtesy of Simon Moran)

Rainfall

Using the OVERSEER rainfall map (NIWA), which provides average annual rainfall, each farm was classified as:

- Wet (≥1,000 mm per year); or
- Dry (<1,000 mm per year).

Soil Type

Using the soil drainage definitions in OVERSEER, the soil type for each farm was classified as:

- Well drained (well drained, and moderately well drained); or
- Poorly drained (imperfectly drained, poorly drained, and very poorly drained).

3.3 Drystock Farm Typology

Table 1 summarises the drystock farm types and codes used and Table 2 describes the drystock farm typologies.

Figure 2 and Figure 3 show the sheep and beef farms and the deer farms in Southland spatially by farm type. Sheep and beef farms (sheep, beef, sheep and beef, mixed livestock, and mixed livestock and arable) were estimated to cover around 59 % of the developed area in Southland (roughly 1.3 million hectares) while deer farms (specialist deer and majority deer) covered around 3.4 % of this area.

Table 1: Drystock farm types and codes

Farm Type	Farm Code Type
Sheep and Beef, large farms	S+B/L
Sheep and Beef, mixed slope	S+B/M
Sheep and Beef, flat, wet and well drained	S+B/F/W/W
Sheep and Beef, flat, wet and poorly drained	S+B/F/W/P
Sheep and Beef, flat, dry and well drained	S+B/F/D/W
Sheep and Beef, flat, dry and poorly drained	S+B/F/D/P
Deer, large farms	D/L
Deer, mixed slope	D/M
Deer, flat, wet and well drained	D/F/W/W
Deer, flat, wet and poorly drained	D/F/W/P
Deer, flat, dry and well drained	D/F/D/W
Deer, flat, dry and poorly drained	D/F/D/P

Table 2: Drystock farm types

Land Use	Property Size	Environmental Conditions	
		Topography	Rainfall and Soil Type
Sheep and Beef	Large (≥1,000 total ha)		
	Small (<1,000 total ha)	Mixed Slope (all slope classes)	
		Flat (<16° slope only)	Wet – Well drained
			Wet – Poorly drained
			Dry – Well drained
			Dry – Poorly drained
Deer	Large (≥1,000 total ha)		
	Small (<1,000 total ha)	Mixed Slope (all slope classes)	
		Flat (<16° slope only)	Wet – Well drained
			Wet – Poorly drained
			Dry – Well drained
			Dry – Poorly drained

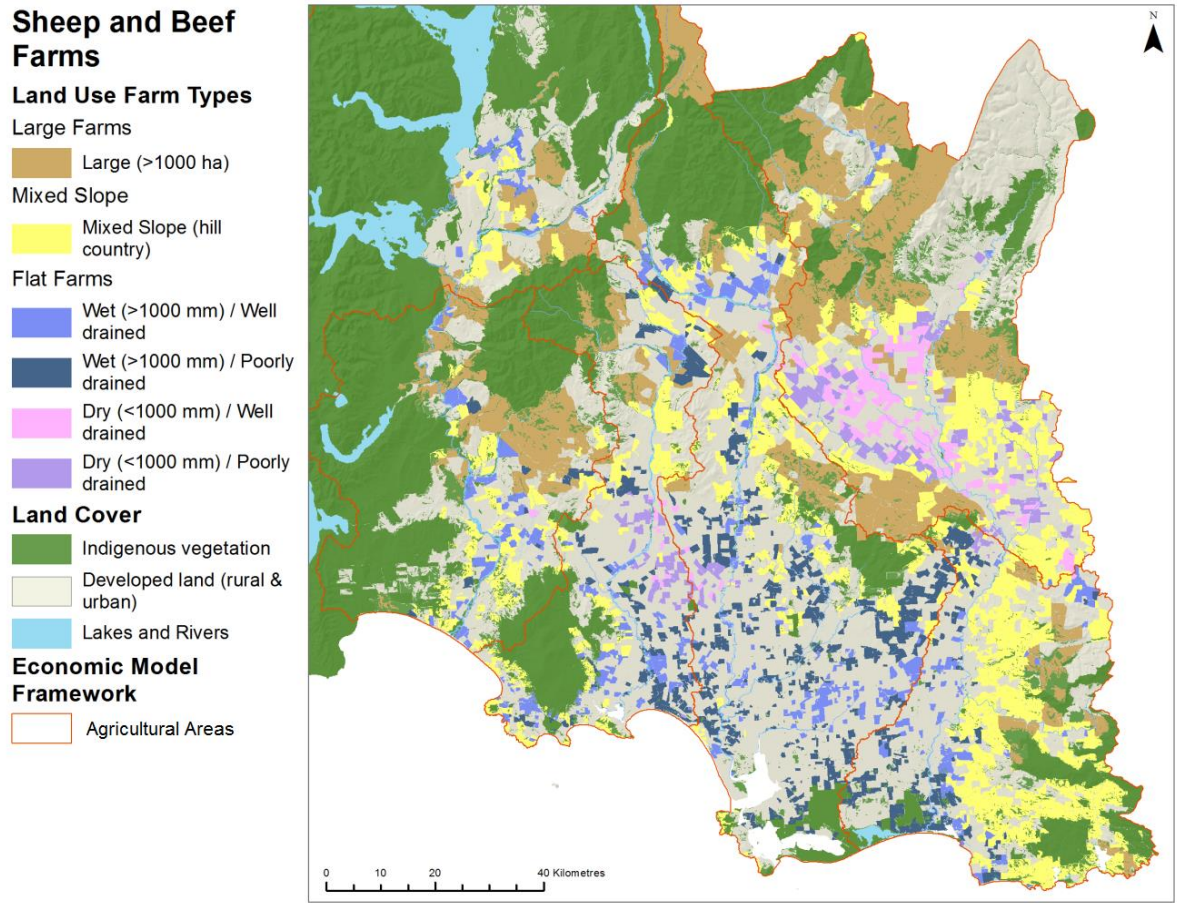

Figure 2: Sheep and Beef farm location and farm type

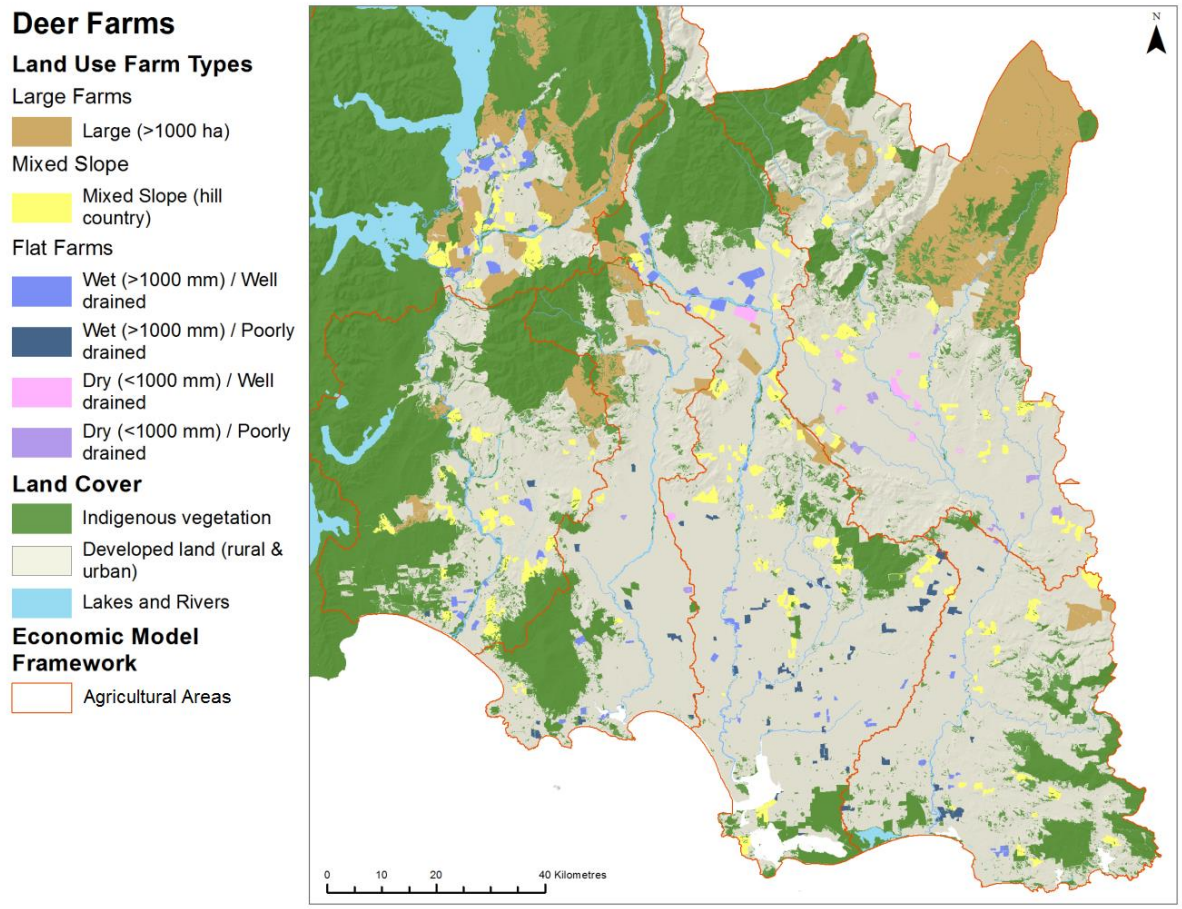

Figure 3: Deer farm location and farm type

3.4 Drystock Farm Characterisation

Once the case study farms were classified by farm type, a percentage was calculated for each farm based on the ratio of that farm's area to that of case study farms for the farm type (total and grazing areas[6]) using the 2015 Southland Land Use Map. Table 33 (below) gives total and grazing areas for all drystock farms in Southland and the case study farms using the 'large', 'mixed slope' and 'flat' and also the 'wet' and 'dry' characteristics.

The overall grazing area of the region was overestimated. While the non-grazing area of the case study farms was known through the OVERSEER analysis because information about laneways/races, yards, infrastructure, and homes was gathered, this knowledge was not generally available region-wide. This was an identified limitations of the Southland Land Use Map (Pearson and Couldrey, 2016). However, substantial non-grazing areas were identifiable (e.g. tree blocks and wetlands) and incorporated.

[6] Beef + Lamb New Zealand uses the term 'grazing' for what has been known as the effective or productive area of a farm and 'non-grazing' for ineffective or non-productive areas of a farm to better recognise the ecosystem services that come from non-grazing land. Ineffective area is a misleading term because it is not generally unproductive. These areas play an essential 'supporting role' in a farm system and the wider catchment. The nutrient losses from the ineffective area of a farm are low, and essentially 'dilute' the usually higher losses from a farm's effective area. Some ineffective areas, such as wetlands, can also catch and take up a farm's nutrient losses.

Beef + Lamb New Zealand (B+LNZ) and Deer Industry New Zealand (DINZ) staff used simplified versions of Figure 2 and 3 (in Google Earth), along with other information sources (such as the B+LNZ Sheep and Beef Farm Survey), to consider farm characteristics, such as production system, enterprise mix, profitability, and ownership type. Their subject matter experts also reflected on factors that were common or unique about the case study farms, for example livestock breed or infrastructure, and the extent to which they may reflect other farms within their farm type.

3.4.1 Constructed Deer Farm (Farm #99)

Through the characterisation process, the representatives of the industry groups also identified gaps in coverage by farm types or under-representation, for example a mixed slope (hill country) deer farm with a venison production system. In this instance, such a deer farm system is understood to be relatively common in Southland but was not represented in the initial study.

To represent a venison production system, an additional farm was constructed. The Ministry for Primary Industries (MPI) 2012 South Island deer farm monitoring model was used as a proxy for Southland venison deer farms, along with information for one of the existing deer case study farms that operated with a velvet production system. The MPI monitoring model was based on information from 20 deer farms and a cross-section of agribusiness representatives and its aim was to typify a deer farm in the southern South Island (Ministry for Primary Industries, 2012[7]).

As this was a constructed farm case study with no physical location, relevant climate and soils information were derived from a deer industry Focus Farm (Sustainable Farming Fund project 05/103) located near Lumsden for the OVERSEER analysis.

3.4.2 Resolving Under Representation

In general, where a farm type was significantly under-represented (i.e. deer farmed for venison rather than for velvet production) the case study farm that most closely matched the under-represented farm type was used as a proxy for it with the following changes:

- Livestock classes were adjusted to reflect the focus on venison production (i.e. the number of mixed age stags was decreased and the number of weaners and yearlings retained for venison growth was increased), while the overall stock units for the farm were unchanged;
- Different animal management practices and any implications for feed/nutrition requirements were noted;
- Financial information was re-evaluated; and
- The farm production system was then subject to OVERSEER nutrient budget analysis and re-assessed to meet the new parameters.

As a result of this industry assessment, the aggregate area for each of five of the farm types was adjusted (the farms are not identified below because of confidentiality issues). The final percentages

[7] Farm Monitoring 2012 South Island Deer, https://www.mpi.govt.nz/news-and-resources/economic-intelligence-unit/farm-monitoring/2012-farm-monitoring-programme/

represented by each case study farm add to 100% of the area (both total and grazing) within the case study farms for a farm type.

3.4.3 Characterisation by Farm Type

Table 3 describes all farms in Southland and the case study farms by farm type using two measures: the number of farms and the farm area (total and grazing). The area of each farm type in an agricultural area is given in the next section (Tables 8 & 9).

Table 3: Number of farms and area attributed to each type of sheep and beef, or deer, farm in Southland

	Region[8]			Case Studies[9]		
Farm type code	**Number of Farms**	**Total Area (ha)**	**Grazing Area (ha)**	**Number of Farms**	**Total Area (ha)**	**Grazing Area (ha)**
S+B/L	92	225,821	188,193	7	12,312	10,420
S+B/M	751	209,515	187,955	8	4,075	3,978
S+B/F/W/W	326	51,382	48,521	8	2,401	2,273
S+B/F/W/P	486	71,046	64,852	6	1,648	1,392
S+B/F/D/W	124	22,947	22,461	1	208	198
S+B/F/D/P	155	24,865	24,505	2	364	353
D/L	32	166,001	136,622	5	10,430	8,380
D/M	125	44,329	39,494	2/3	725/1194	667/1098
D/F/W/W	67	11,130	10,524	1	170	160
D/F/W/P	50	7,396	6,886	1	231	164
D/F/D/W	12	2,857	2,765	1	300	295
D/F/D/P	13	2,210	2,121	1	216	205

4 Results

The results of using the methodology described above, are in the following tables. Tables 4, 5, 6 and 7 give the weightings used as a percentage of total and grazing areas. Tables 8 and 9 give the final areas of the sheep and beef farms and the deer farms within each agricultural area and farm type in Southland. The assessment is done by proportion of farm area: if the majority of both total and grazing area (i.e. >50%) is in farm type 'x' then the whole farm area was classified as farm type 'x'.

[8] Properties
[9] Farm businesses

Table 4: Weightings for sheep and beef farms in Southland – % of total area

	Large (≥1000 ha)	Small (<1000 ha)				
Case study farm reference	All	Mixed slope	Wet, well drained	Wet, poorly drained	Dry, well drained	Dry, poorly drained
7	16.2%					
15	19.9%					
37	5.6%					
35	12.9%					
23	13.4%					
27	23.4%					
31	8.5%					
28		19.6%				
5		13.7%				
14		8.8%				
38		13.1%				
39		5.0%				
2		9.4%				
12		18.2%				
21		12.2%				
3			22.7%			
8			22.9%			
10			7.0%			
13			10.6%			
16			13.9%			
20			6.0%			
32			11.7%			
34			5.2%			
1				24.8%		
9				8.6%		
22				26.7%		
30				12.8%		
36				8.7%		
4				18.4%		
29					100.0%	
18						42.3%
24						57.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 5: Weightings for sheep and beef farms in Southland – % of grazing area

	Large (≥1000 ha)	Small (<1000 ha)				
Case study farm reference	All	Mixed slope	Wet, well drained	Wet, poorly drained	Dry, well drained	Dry, poorly drained
7	8.6%					
15	19.7%					
37	5.3%					
35	15.0%					
23	15.5%					
27	27.1%					
31	8.9%					
28		18.9%				
5		13.7%				
14		9.0%				
38		13.3%				
39		5.0%				
2		9.5%				
12		18.4%				
21		12.2%				
3			23.8%			
8			22.8%			
10			6.4%			
13			10.9%			
16			14.1%			
20			5.1%			
32			11.7%			
34			5.3%			
1				28.7%		
9				8.8%		
22				28.9%		
30				9.7%		
36				9.8%		
4				14.1%		
29					100.0%	
18						43.1%
24						56.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 6: Weightings for deer farms in Southland – % of total area

	Large (≥1000 ha)	Small (<1000 ha)				
Case study farm reference	All	Mixed slope	Wet, well drained	Wet, poorly drained	Dry, well drained	Dry, poorly drained
11	7.9%					
19	32.9%					
43	20.8%					
17	12.3%					
25	26.1%					
41		39.3%				
42		15.2%				
99		45.5%				
45			100.0%			
44				100.0%		
40					100.0%	
46						100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note - Farm 99 is the constructed deer farm. The weighting of venison farms was set at 3:1 for farm #99: farm #42.

Table 7: Weightings for deer farms in Southland – % of grazing area

	Large (≥1000 ha)	Small (<1000 ha)				
Case study farm reference	All	Mixed slope	Wet, well drained	Wet, poorly drained	Dry, well drained	Dry, poorly drained
11	9.1%					
19	28.8%					
43	19.9%					
17	13.7%					
25	28.5%					
41		39.2%				
42		15.2%				
99		45.6%				
45			100.0%			
44				100.0%		
40					100.0%	
46						100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 8: Extent of sheep and beef farmland (at a property scale) by agricultural area and farm type in Southland

Agricultural Area	Farm type code	Total Area (ha)	Grazing Area (ha)
Te Anau Basin	S+B/L	16,874	15,078
	S+B/M	8,762	8,452
	S+B/F/W/W	4,014	3,849
	S+B/F/W/P		
	S+B/F/D/W		
	S+B/F/D/P		
Lower Waiau	S+B/L	36,130	27,784
	S+B/M	18,848	15,861
	S+B/F/W/W	8,275	7,699
	S+B/F/W/P	2,206	2,049
	S+B/F/D/W	199	199
	S+B/F/D/P		
Aparima	S+B/L	11,890	9,291
	S+B/M	22,787	19,863
	S+B/F/W/W	9,779	9,191
	S+B/F/W/P	14,412	12,580
	S+B/F/D/W	811	786
	S+B/F/D/P	5,406	5,310
Oreti	S+B/L	41,400	32,676
	S+B/M	35,683	30,409
	S+B/F/W/W	19,342	18,240
	S+B/F/W/P	39,095	36,788
	S+B/F/D/W	1,424	1,384
	S+B/F/D/P	2,275	2,249
Upper Mataura	S+B/L	103,724	91,754
	S+B/M	52,761	50,303
	S+B/F/W/W	1,156	1,091
	S+B/F/W/P		
	S+B/F/D/W	20,513	20,092
	S+B/F/D/P	16,237	16,017
Lower Mataura	S+B/L	15,803	11,610
	S+B/M	70,674	63,066
	S+B/F/W/W	8,817	8,451
	S+B/F/W/P	15,333	13,434
	S+B/F/D/W		
	S+B/F/D/P	946	928

Table 9: Extent of deer farmland (at a property scale) by agricultural area and farm type in Southland

Agricultural Area	Farm type code	Total Area (ha)	Grazing Area (ha)
Te Anau Basin	D/L	46,018	35,171
	D/M	6,450	6,075
	D/F/W/W	4,081	3,900
	D/F/W/P		
	D/F/D/W	60	57
	D/F/D/P		
Lower Waiau	D/L	10,195	7,976
	D/M	9,299	7,865
	D/F/W/W	1,230	1,130
	D/F/W/P	425	378
	D/F/D/W		
	D/F/D/P		
Aparima	D/L	10,612	9,101
	D/M	1,195	785
	D/F/W/W	761	652
	D/F/W/P	1,053	947
	D/F/D/W		
	D/F/D/P	236	236
Oreti	D/L	2,392	2,234
	D/M	14,260	12,482
	D/F/W/W	4,236	4,073
	D/F/W/P	4,283	4,026
	D/F/D/W	1,071	1,018
	D/F/D/P	116	92
Upper Mataura	D/L	93,848	79,258
	D/M	8,147	7,739
	D/F/W/W		
	D/F/W/P		
	D/F/D/W	1,726	1,691
	D/F/D/P	1,771	1,706
Lower Mataura	D/L	2,936	2,882
	D/M	4,978	4,548
	D/F/W/W	822	769
	D/F/W/P	1,634	1,535
	D/F/D/W		
	D/F/D/P	88	86