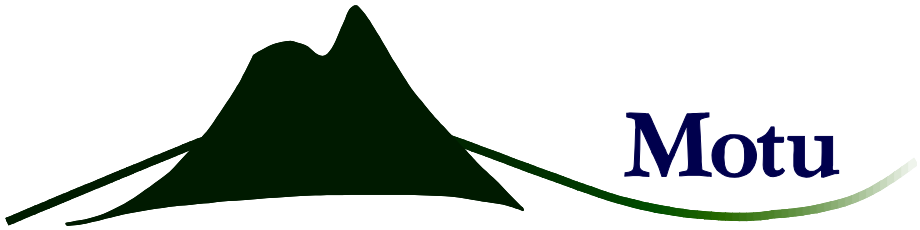

LURNZ Simulation Results for 2025

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1. Introduction

This paper reports the latest simulation results from the Land Use in Rural New Zealand (LURNZ) model. The LURNZ model produces dynamic paths of rural land-use change, land-use maps, and maps of land-use change. LURNZ can also produce maps of land-use intensity and greenhouse gas (GHG) emissions. Along with the maps, LURNZ produces tables corresponding to the maps by Regional Council and Territorial Authority. The simulations presented in this paper project rural land use change between 2013 and 2025.

2. The LURNZ Model

The LURNZ model provides dynamic simulations of land-use change for rural land in New Zealand. LURNZ simulates the four main uses of rural land in New Zealand: dairy, sheep/beef, plantation forestry, and scrub. Land-use change is simulated at the national level, where the amount of land in each land use is a function of export commodity prices and interest rates (Kerr and Olssen 2012). These annual national level changes are then summed across the simulation years, and the net changes in each land-use are allocated spatially to produce maps of land use and land-use change (Timar 2011, Anastasiadis et al. 2014). Based on the simulated changes in land use, LURNZ can also project farming intensity for dairy (kg of milk solids per hectare) and sheep/beef (stock units per hectare) land (Timar and Kerr 2014). LURNZ can then project GHG emissions for both dairy and sheep/beef, net emissions (sequestration less emissions from deforestation) for forestry, and sequestration on scrub land. See http://www.motu.org.nz/research/detail/documentation_of_motus_lurnz_model for more information about how the national level changes are calculated, a description of the spatial allocation algorithm, and a description of how land-use intensity and GHG emissions are calculated.

The LURNZ model is primarily a tool for analysing the effect of climate policy on land use (Kerr et al. 2012). LURNZ is used to compare the land-use outcomes between different climate policy scenarios (e.g. different carbon prices) or to compare a policy scenario to a baseline. The simulation reported in this paper compares land-use outcomes between a \$25 t-CO_2-eq carbon price scenario and a baseline scenario (i.e. zero carbon price).

3. Simulation Results

The simulation results reported below simulate land-use change between 2013 and 2025. Figures 1 and 2 display the national level changes in land use areas for the baseline scenario and

the $25 carbon price scenario respectively, while Figure 3 shows the difference in simulated land use areas between the two scenarios. The figures plot historical data from 1974-2012, as well as the simulated areas for the period 2013-2025. In both scenarios, the amount of sheep/beef land continues its downward trend, while dairy land is projected to increase over the period 2013-2025, but at a slower rate than during the 2000s. Plantation forestry area is projected to remain relatively constant over the period in the baseline scenario, while it is projected to increase over the projection period in the carbon price scenario. Figure 3 shows that forestry land is projected to increase more under a carbon price scenario compared to the baseline, while sheep/beef and scrub areas are lower under the carbon price scenario.

Figure 1: Land use areas for LURNZ land uses assuming a zero carbon price, 1974-2025

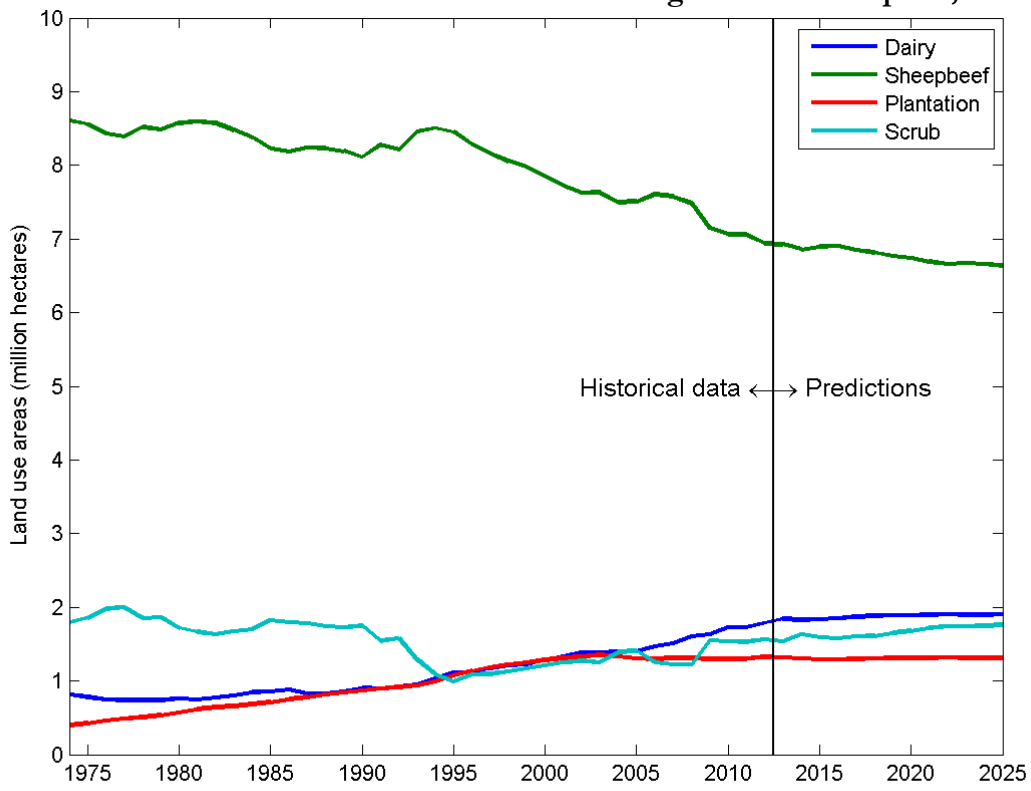


Figure 2: Land use areas for LURNZ land uses assuming a $25 carbon price, 1974-2025

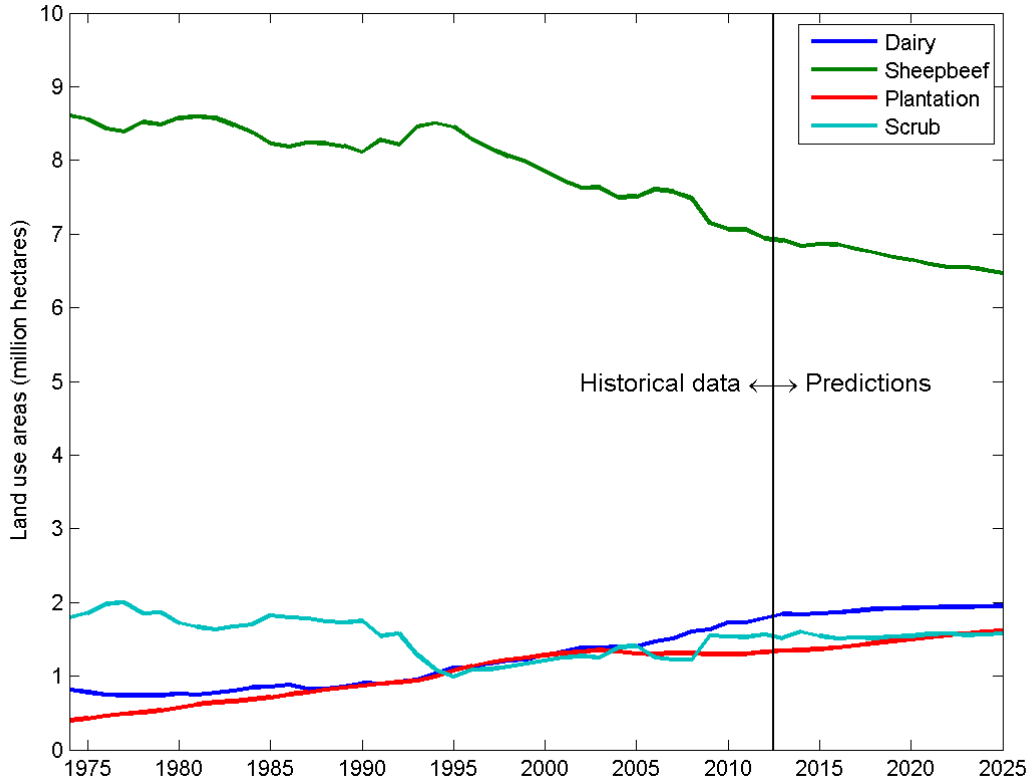
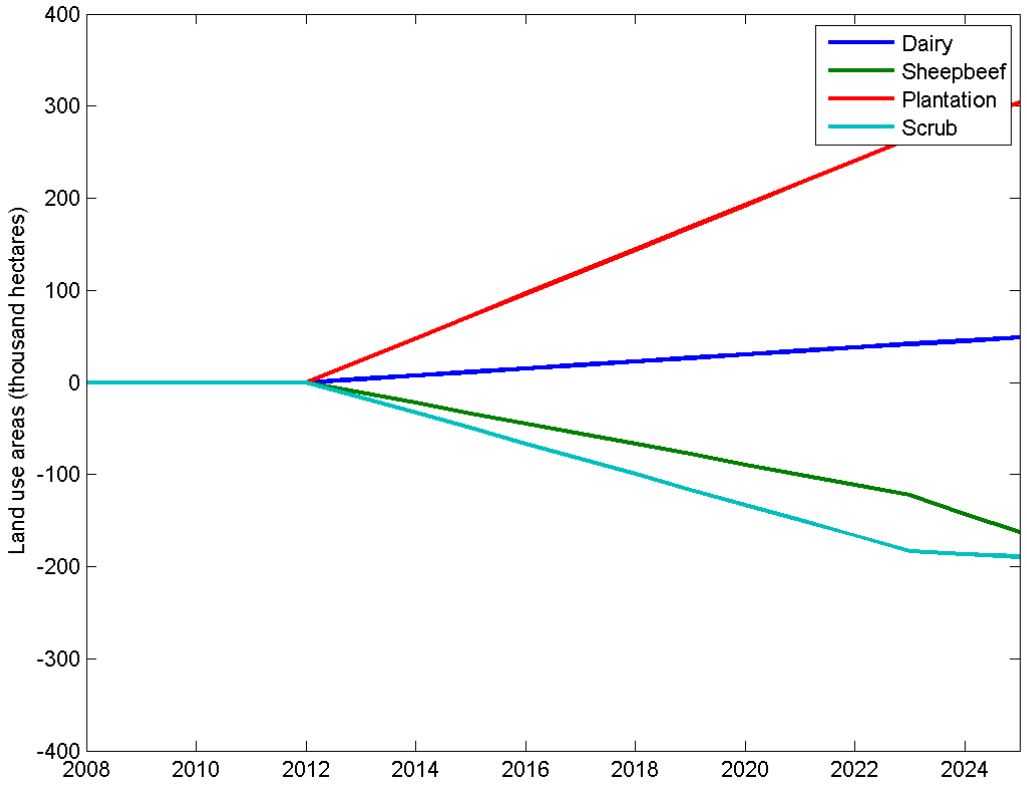


Figure 3: Difference in land-use areas between the baseline and $25 carbon price scenario



Figures 4, 5, and 6 show the LURNZ land-use map for 2025, the original (2012) land use of the pixels projected to change use, and the final (2025) land use of those pixels in the baseline scenario. Sheep/beef land around Christchurch is projected to convert to dairy and this accounts for the majority of the increase in dairy land over the period. Some central South Island sheep/beef land is projected to be abandoned to scrub, as is some sheep/beef land on the east coast of the North Island.

Figures 7 and 8 show the differences in land use between the 2025 land-use maps for the baseline and $25 carbon price scenarios. The pixels shown are those that are projected to have different land uses in the two scenarios. Figure 7 shows the projected land use for pixels in the baseline scenario, while Figure 8 shows the projected land use for pixels in the $25 carbon price scenario. All other pixels (not shown) are projected to be in the same land use under both scenarios. Much of the land projected to revert to scrub by 2025 in the baseline scenario (the blue pixels in Figure 7) is projected to be in forestry in the carbon price scenario (the green pixels in Figure 8).

Figures 9 and 10 show the projected land-use intensity and GHG emissions in 2025 for sheep/beef land in the baseline scenario. Sheep/beef land-use intensity is measured as the number of stock units per hectare. Stock units are a standardised measure of the amount of livestock on a piece of land, based on feed requirements. LURNZ also produces measures of farming intensity on dairy land and that is measured as kilograms (kg) of milk solids per hectare. GHG emissions are measured as kg of carbon dioxide equivalent (CO_2-eq) per hectare.

Tables 1 and 2 show the differences in projected land-use intensity and GHG emissions in 2025 between the baseline and $25 carbon price scenarios by region. The differences are calculated as land-use intensity (GHG emissions) in the carbon price scenario less the intensity (emissions) in the baseline scenario. Table 1 shows that the land-use intensity of dairy land is higher in the carbon price scenario in all regions, while land-use intensity of sheep/beef land is lower in all regions. Table 2 shows that GHG emissions from dairy are projected to be higher in all regions, reflecting higher projected land-use intensity. This is offset by lower emissions from sheep/beef and forestry in the carbon price scenario.[1] Scrub sequestration is lower in the carbon price scenario as there is less scrub land where carbon can be sequestered. Overall, total emissions from agriculture are projected to be lower in every region by 2025 as a result of 13 years of a price on carbon.

[1] Forestry emissions are calculated as deforestation emissions less carbon sequestered. A negative value indicates that sequestration outweighs emissions from deforestation.

Figure 4: LURNZ land use map, 2025

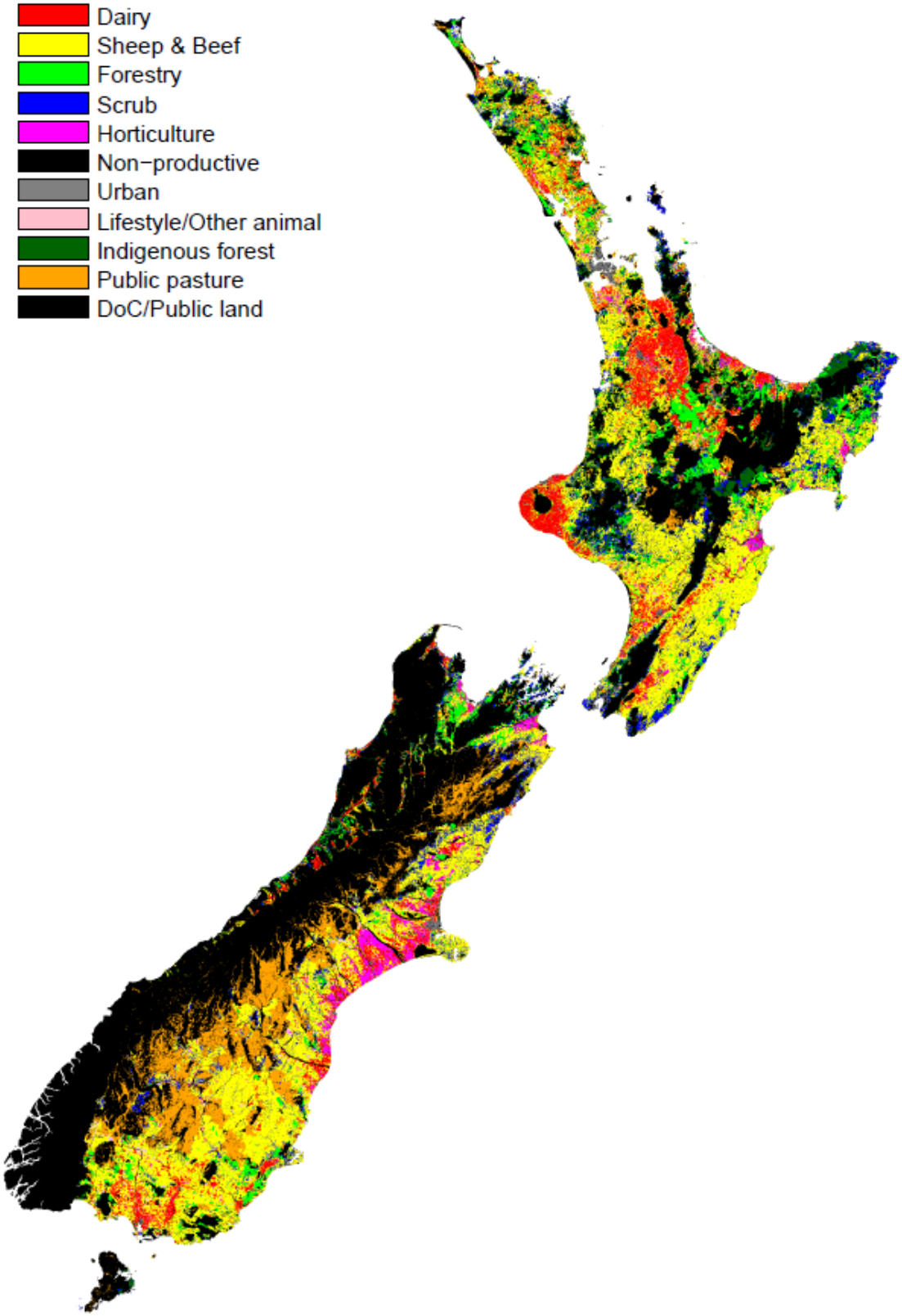


Figure 5: Land-use change map, original use in 2012

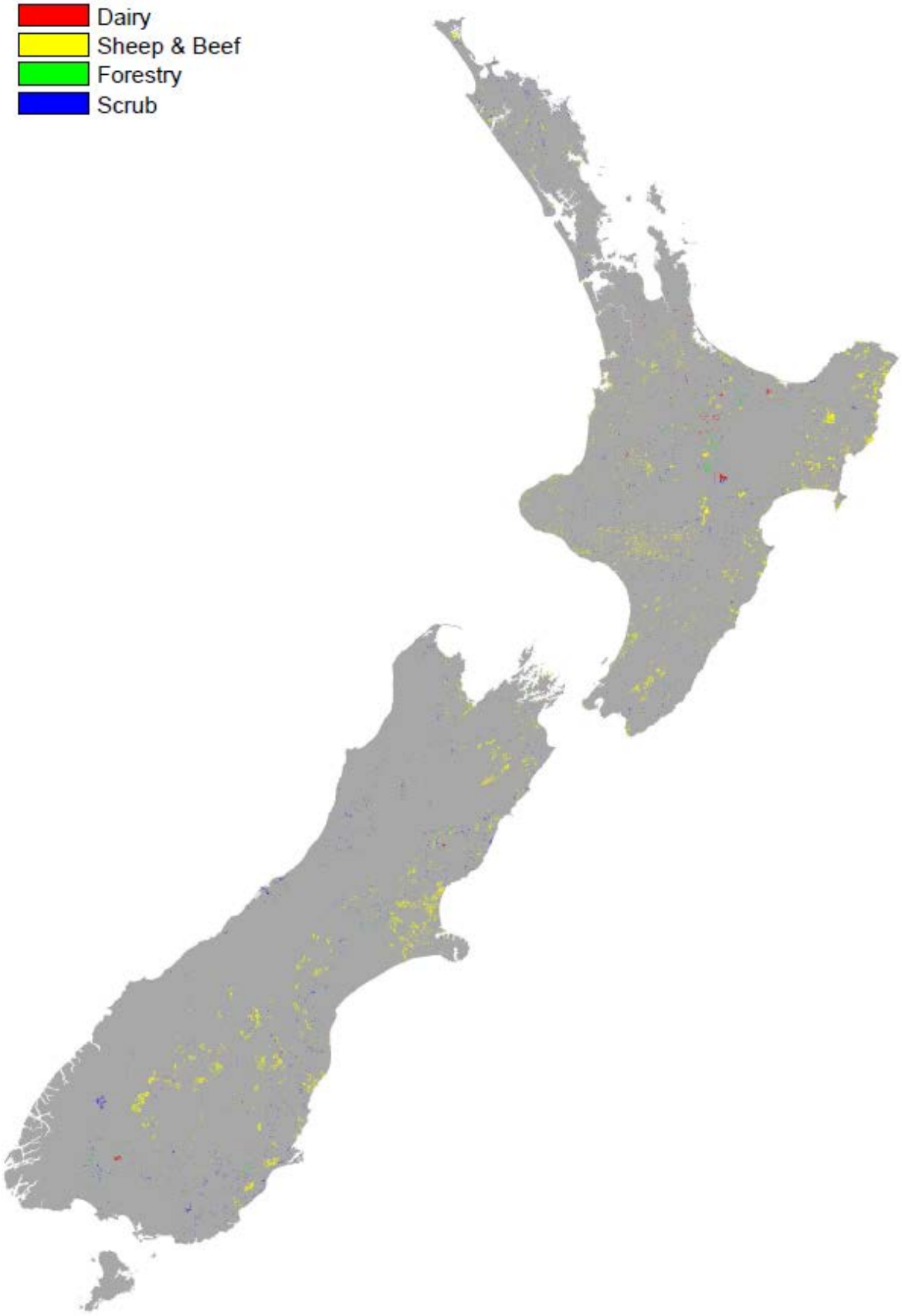


Figure 6: Land-use change map, final land use 2025

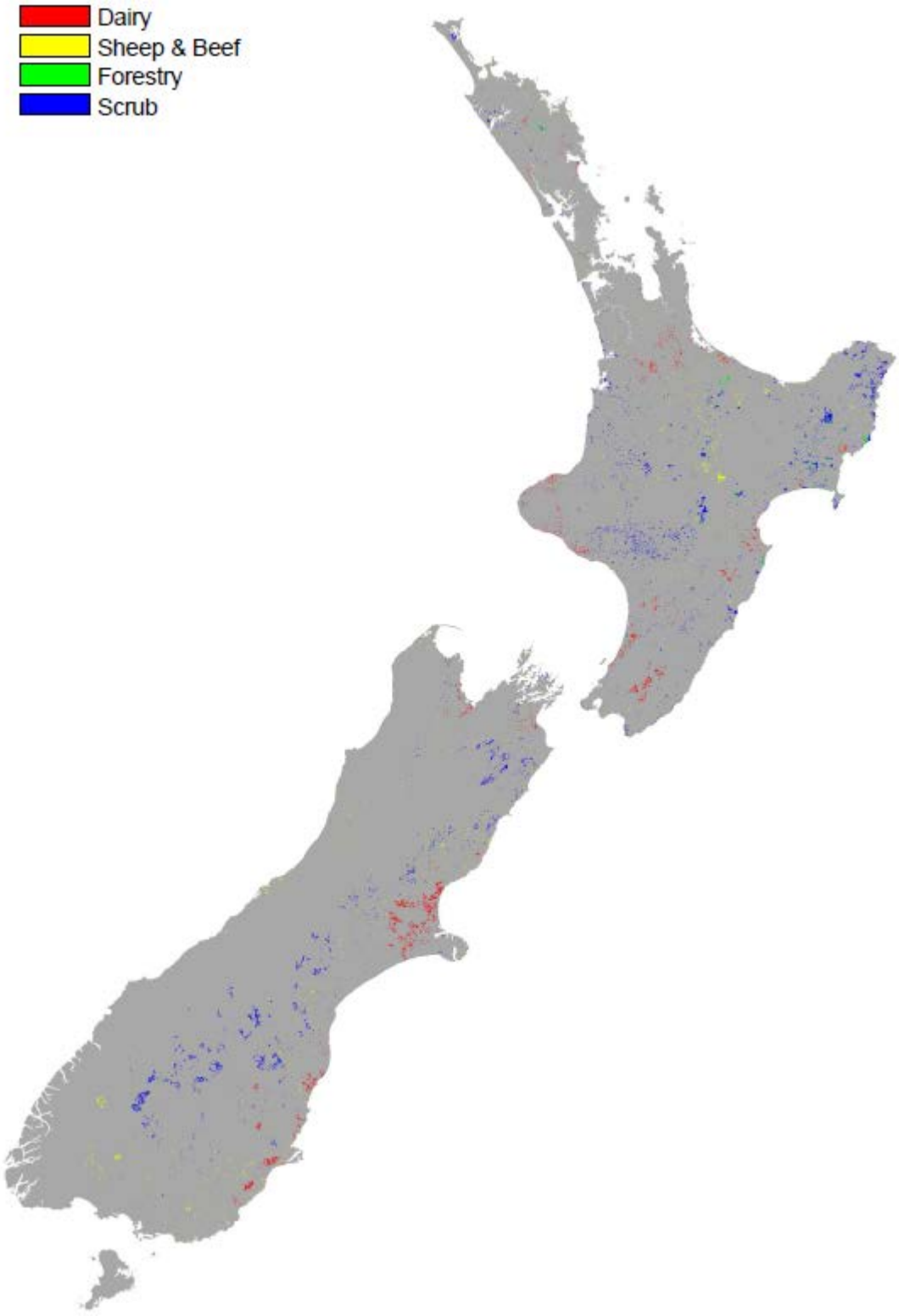


Figure 7: Difference between baseline and $25 carbon price scenarios - baseline 2025 land use

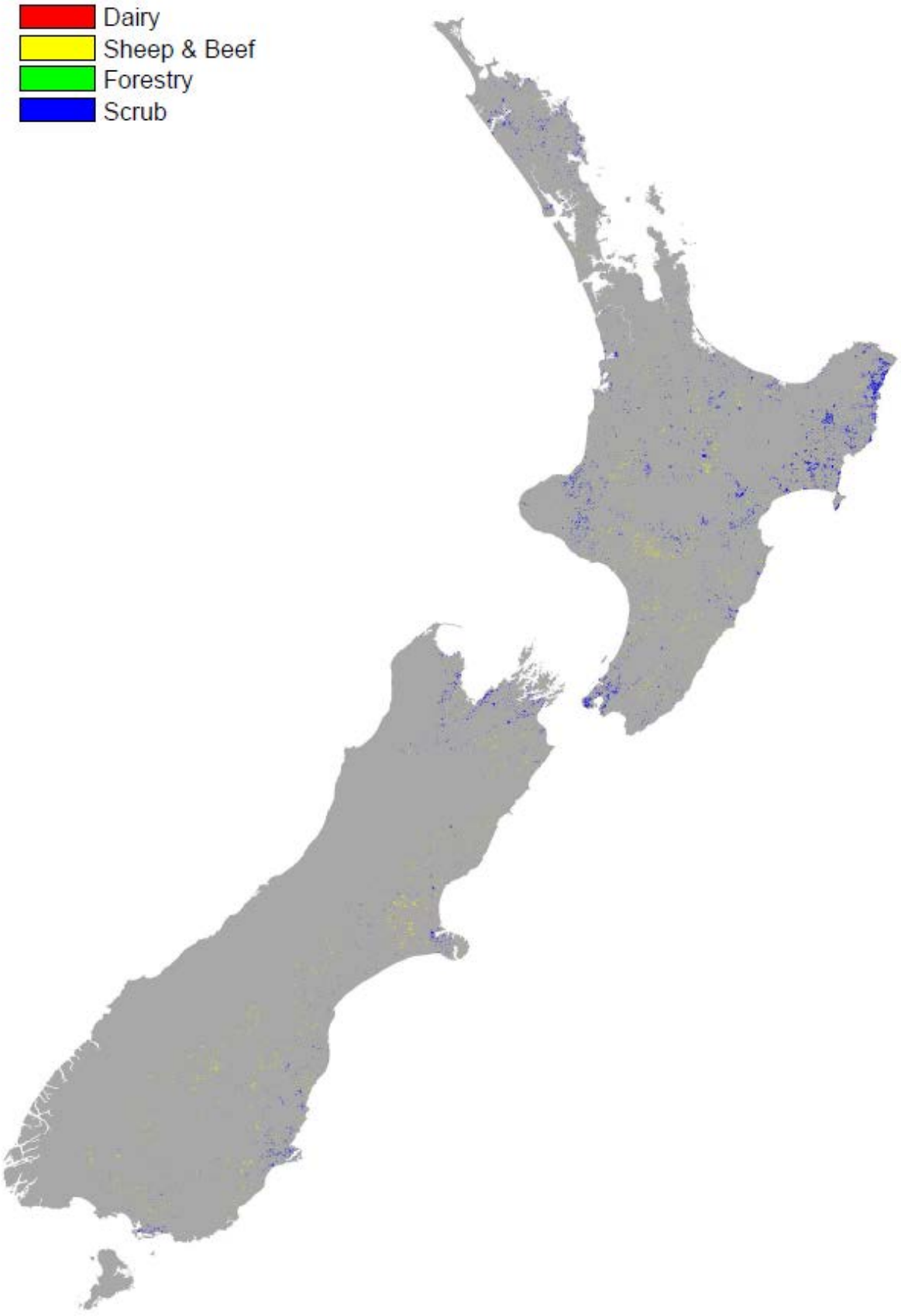


Figure 8: Difference between baseline and $25 carbon price scenarios - $25 carbon price land use

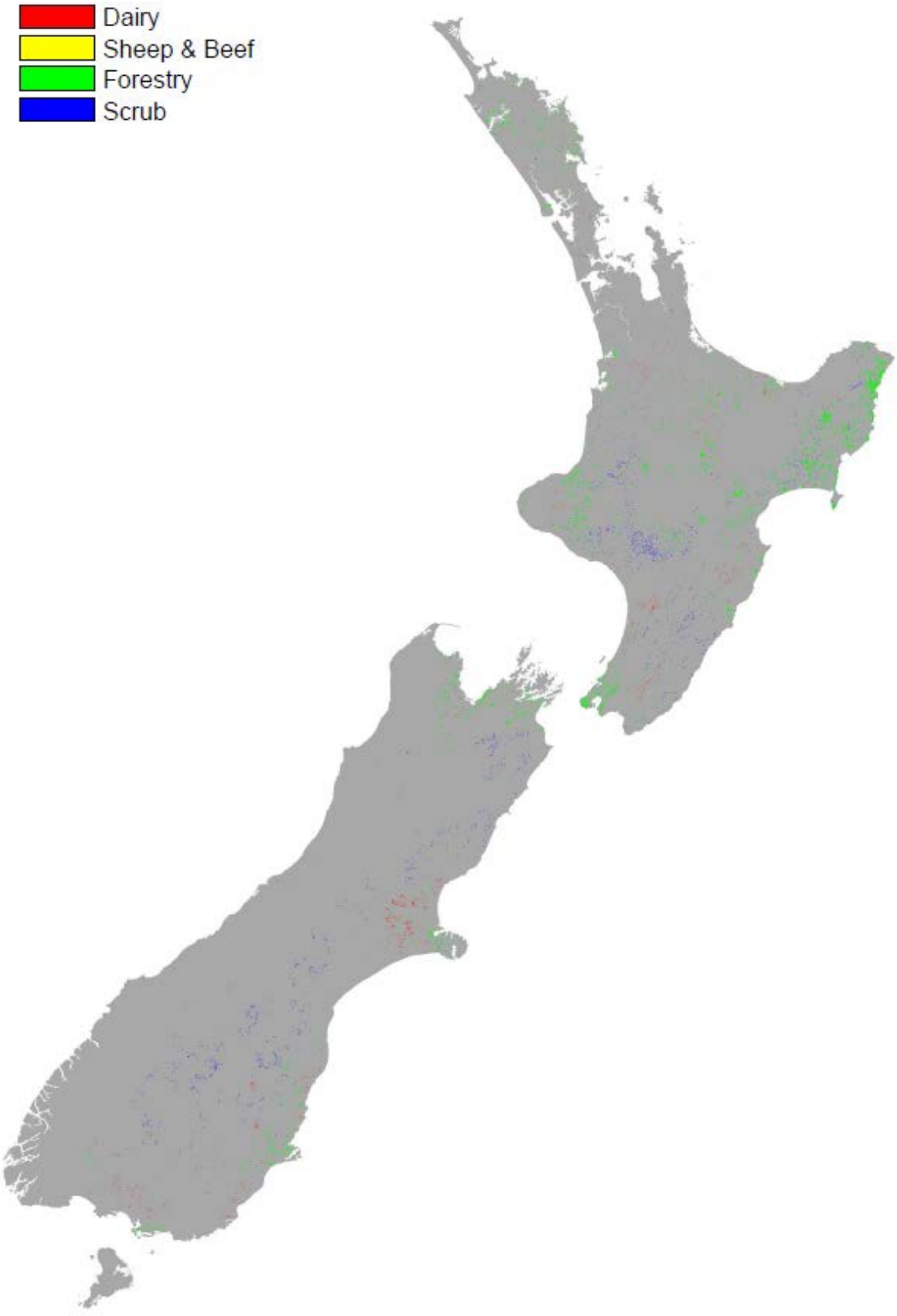


Figure 9: Sheep/beef land-use intensity in 2025, stock units per hectare

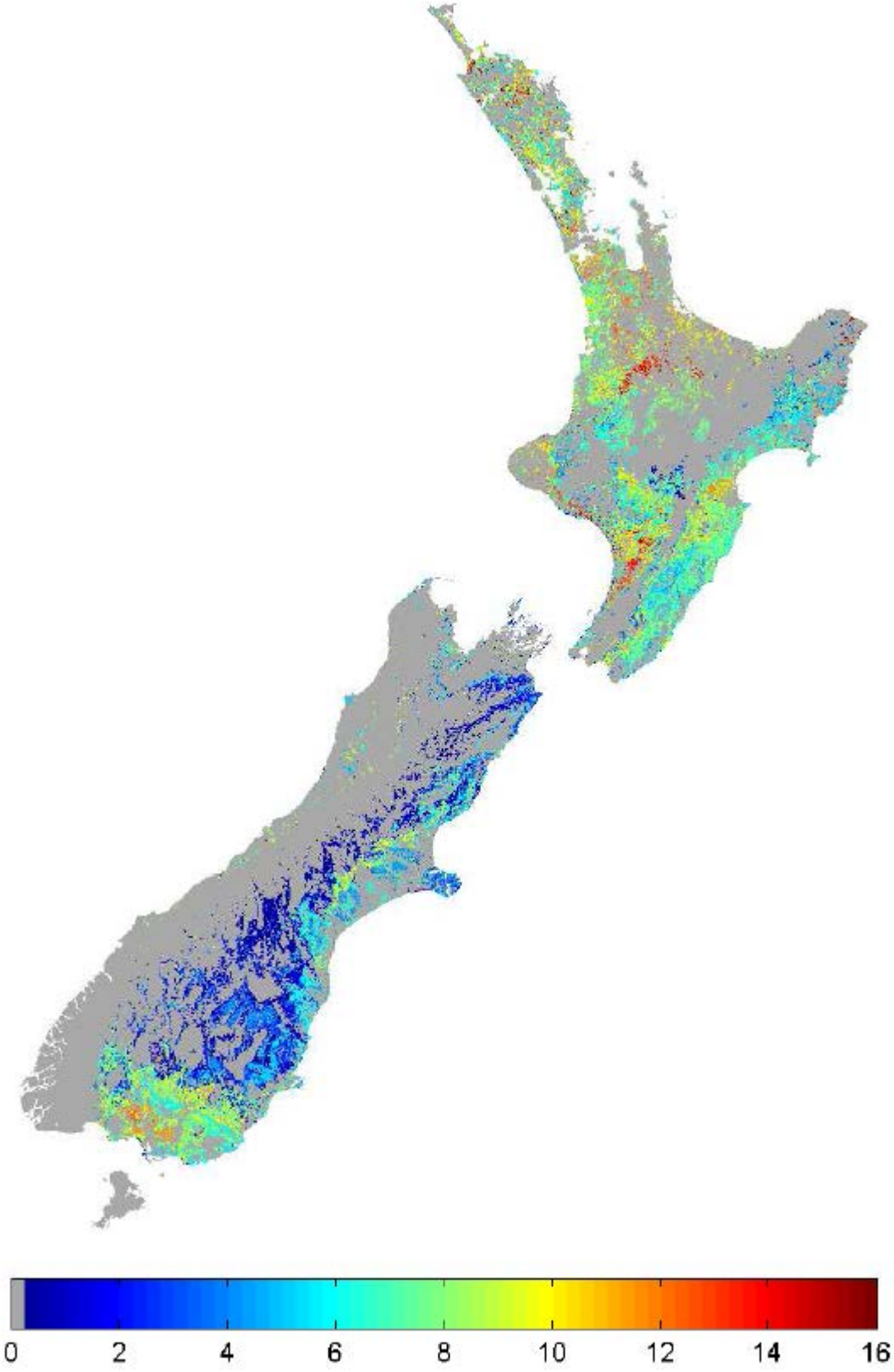


Figure 10: Sheep/beef emissions in 2025, kg CO_2-eq per hectare

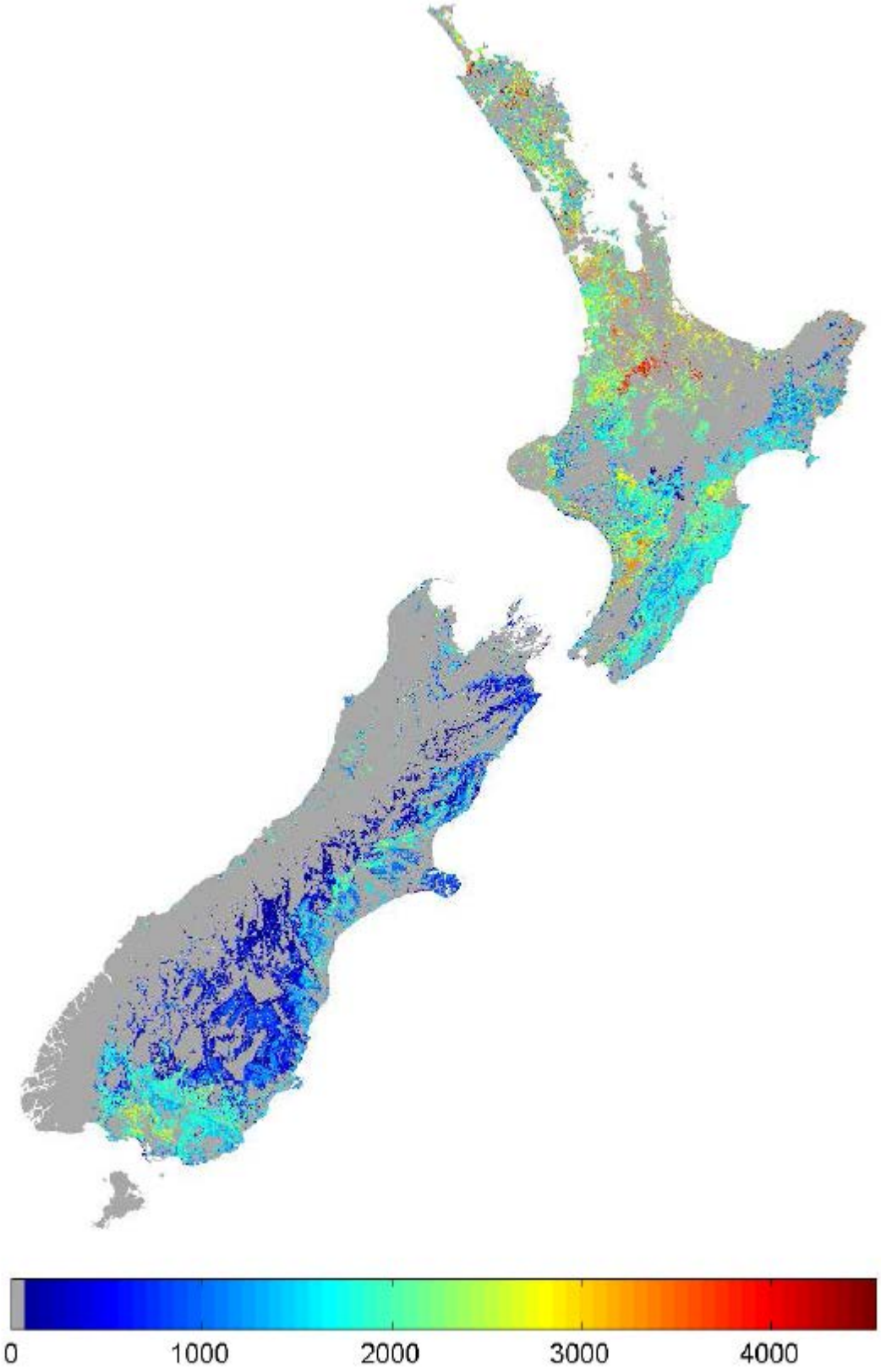


Table 1: Differences in 2025 land-use intensity between the baseline and $25 carbon price scenarios

Regional Council	Dairy (kg mild solds)	Sheep/beef (stock units)
Northland	1152035	-35234
Auckland	1065389	-26236
Waikato	5448702	-133633
Bay of Plenty	1779391	-39688
Gisborne	240603	-41383
Hawke's Bay	2866271	-66249
Taranaki	1658414	-45007
Manawatu-Wanganui	4399709	-199088
Wellington	2086885	-49028
West Coast	479000	-6852
Canterbury	15907298	-132450
Otago	5978760	-59799
Southland	3767726	-66515
Tasman	1011854	-12045
Nelson	21997	-685
Marlborough	219968	-14503

Table 2: Differences in 2025 GHG emissions between the baseline and $25 carbon price scenarios, t-CO_2-eq

Regional Council	Dairy emissions	Sheep/beef emissions	Net forestry emissions	Net scrub emissions	Total emissions
Northland	12130	-9603	-555500	272718	-280256
Auckland	11190	-7220	-36163	10830	-21362
Waikato	56456	-36252	-517098	156918	-339977
Bay of Plenty	18521	-10858	-216670	114613	-94394
Gisborne	2534	-10108	-1598910	662133	-944351
Hawke's Bay	29922	-16273	-868328	373368	-481311
Taranaki	17039	-10855	-448063	206830	-235049
Manawatu-Wanganui	45311	-48821	-423783	75862	-351431
Wellington	21642	-12001	-542300	235878	-296781
West Coast	4952	-1574	15850	1270	20498
Canterbury	159728	-30642	-126563	63668	66191
Otago	60409	-13598	-173600	104718	-22072
Southland	38386	-14529	-113325	45050	-44418
Tasman	10418	-2777	-125510	115775	-2094
Nelson	226	-157	-53340	39855	-13416
Marlborough	2265	-3375	-146630	115805	-31935

4. References

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