



STEP CHANGE 2.0

- TESTING THE MODEL -

REDUCING ENVIRONMENTAL FOOTPRINT WHILE STAYING PROFITABLE

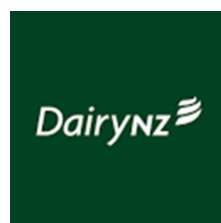


Funded by

Ministry for Primary Industries
Manatū Ahu Matua



and New Zealand Dairy Farmers through



TRIAL OBJECTIVE AND OVERVIEW

The purpose of the Step Change Trial is to create change and to help dairy farmers focus on reducing environmental footprint (GHG emissions and water quality) while maintaining profit. New Zealand farmers are facing increasing regulations around their environmental footprint. They may be required to reduce their N-loss and GHG emissions to comply with national and local regulations along with dairy company requirements.

The study compares two farmlets, one based on current farming practices (control farmlet = Current) and the other (trial farmlet = Future) expected to achieve reduced GHG emissions and N-surplus targets likely to be required by the Zero Carbon Bill and the Essential Freshwater Accord.

The Step Change 2.0 project is a continuation of Dairy Trust Taranaki's original Step Change trial, which started in the 2020/2021 season and has now finished the 6th season of the trial. In addition to testing the performance of the Future farmlet under a variety of different climatic conditions, the Step Change 2.0 trial also includes N-leaching measurements through suction cups and lysimeters to test modelled N-leaching numbers from Overseer.

FARMLET SET UP

Current Herd 54 hectares	Future Herd 54 hectares
 3.1 cows/ha	 2.5 cows/ha
 190 kgN/ha	 75 kgN/ha
 up to 700 kgDM/cow	 up to 300 kgDM/cow

Key differences between the two farmlets:

- Reduced stocking rate on the Future farmlet
- Reduced N-fertiliser on the Future farmlet
- Reduced imported supplements on the Future farmlet
- No summer crop (turnips) on the Future farmlet

To offset some of the reduced N-inputs and further help with reduction of N-loss, the Future farmlet has been undersown with clover and plantain.

MEASUREMENTS

The following parameters are measured throughout the trial and compared between the two farmlets:

- Milk production
- Liveweight, BCS and animal health
- Mating and calving information
- Supplements – all supplements harvested and fed
- Purchased supplements
- Soil carbon
- N leaching – suction cups and lysimeters
- Pasture growth
- Pasture composition and pasture quality

CLIMATE

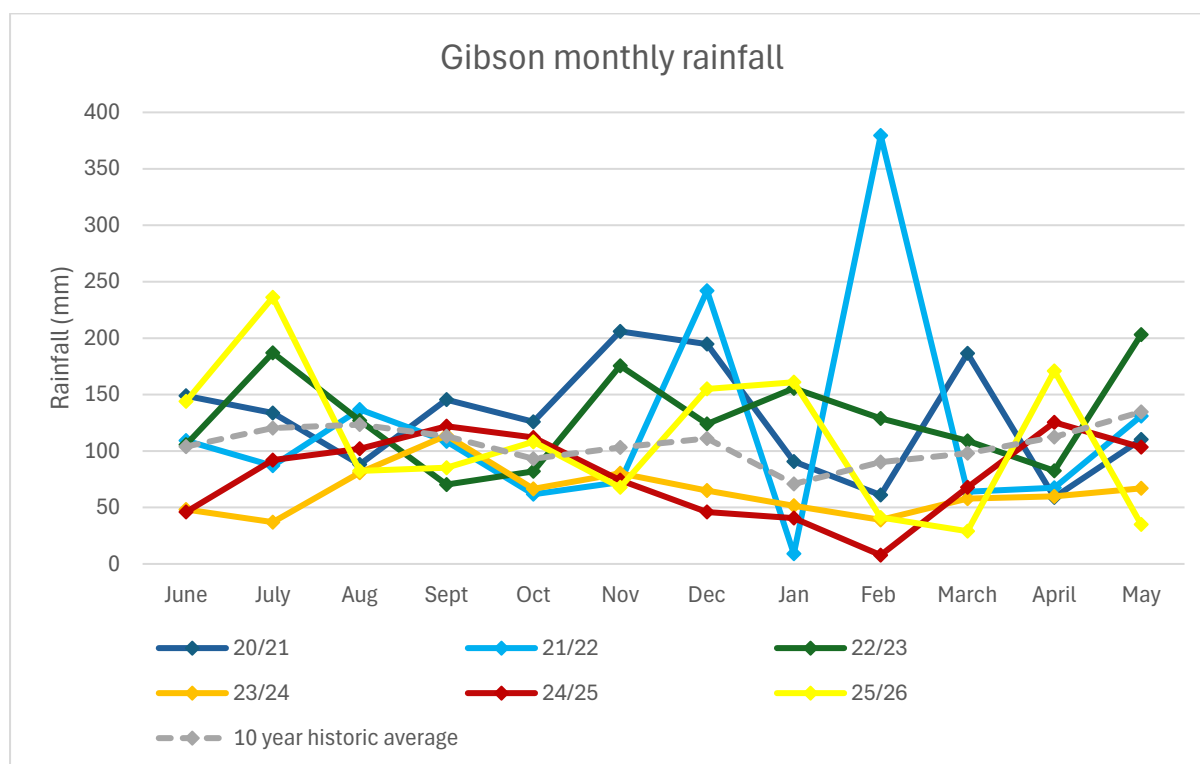


Figure 1 Monthly rainfall over the 6 seasons of the trial.

Over the 6 seasons of the trial the monthly and total rainfall per season has been very variable. There have been some very dry summers, especially in the 2023/24 and 2024/25 seasons. Those two seasons had overall a substantially lower rainfall than the other seasons and the 10-year historic average (Table 1). Overall, all other seasons of the trial had a higher rainfall than the historic average.

Table 1 Annual rainfall

Annual rainfall	20/21	21/22	22/23	23/24	24/25	25/26	10-year historic avg.
mm	1552	1471	1488	767	939	1316	1274

The differences in rainfall between the seasons was also reflected in the soil moisture (Figure 2). The 2024/25 season had exceptionally low soil moisture levels during summer and autumn due to the drought. The low soil moisture carried on into the 2025/26 season with lower levels in winter and spring than the previous seasons.

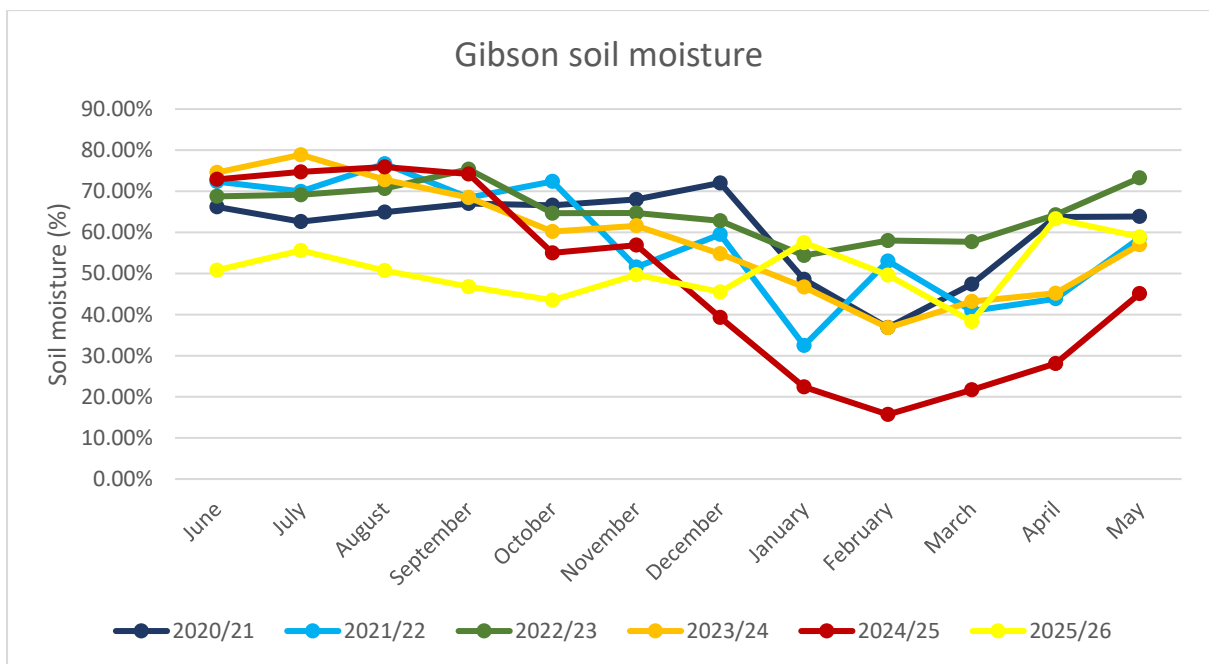


Figure 2 Monthly average soil moisture over the 6 seasons of the trial.

PASTURE GROWTH

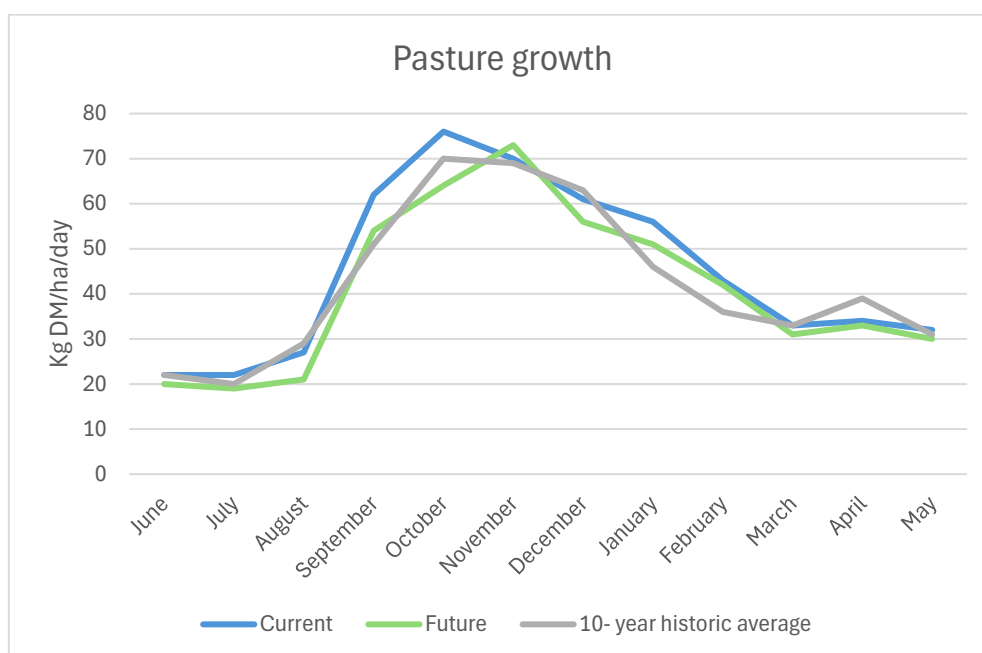


Figure 3 Monthly pasture growth on Current (blue) and Future (green) farmlet for the 2025/26 season compared with 10-year historic average (grey).

Both farmlets had good pasture growth during spring this season and above average growth over summer due to unusually high rainfall in January (Figure 3). Pasture growth slowed below average in April due to dry autumn conditions. The Current farmlet had higher pasture growth than the Future farmlet in spring and early summer due to higher amounts of nitrogen fertiliser applied.

PASTURE COMPOSITION

The Current farmlet is sown in a standard ryegrass/clover mix. About 4 % of the farmlet is regrassed annually following a crop of turnips. On the Future farmlet the existing ryegrass/clover pastures were oversown with plantain and extra clover in the original Step Change program. In addition, during the Step Change 2.0 trial, a subset of paddocks is getting topped up with plantain and clover as required annually in spring. 30% of the farmlet got topped up with plantain and clover during spring 2025 at a rate of 2 kg/ha each.

Pasture samples are taken from 10 paddocks on the Current farmlet and 10 paddocks on the Future farmlet four times per year in spring, summer, autumn and winter, pre grazing for analysis of the botanical composition. In Figure 4 below the botanical composition of the pastures throughout the 2025/26 season is shown.

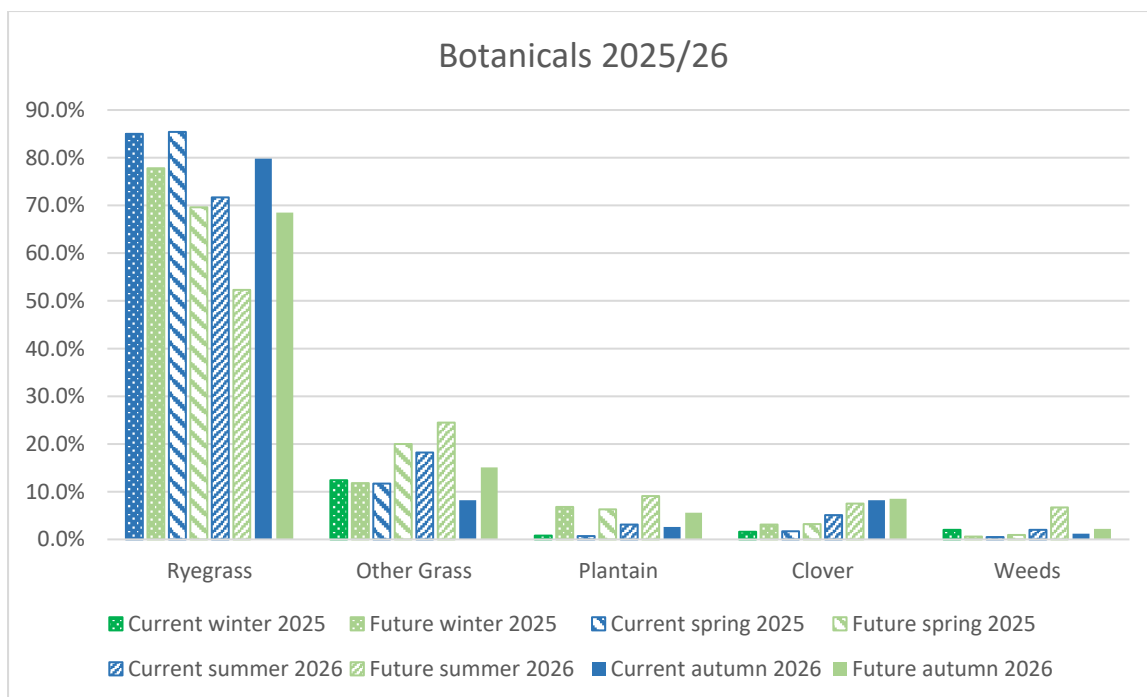


Figure 4 Botanical composition on the Current (blue) and Future (green) farmlet throughout the 2025/26 season.

The amount of ryegrass in the pastures varied throughout the season as expected with lower amounts of ryegrass and higher amounts of other grasses such as summer grasses, in the summer pastures on both farmlets. An average of 5.6 – 9.1% plantain was found in the pastures on the Future farmlet with the highest amount found in the summer pastures. A small amount of naturally occurring plantain was found on the Current farmlet throughout the season. In general, more clover was found on the Future farmlet although the difference between the farmlets was not as high as expected considering the Future farmlet has been oversown with clover.

SUPPLEMENTARY FEED

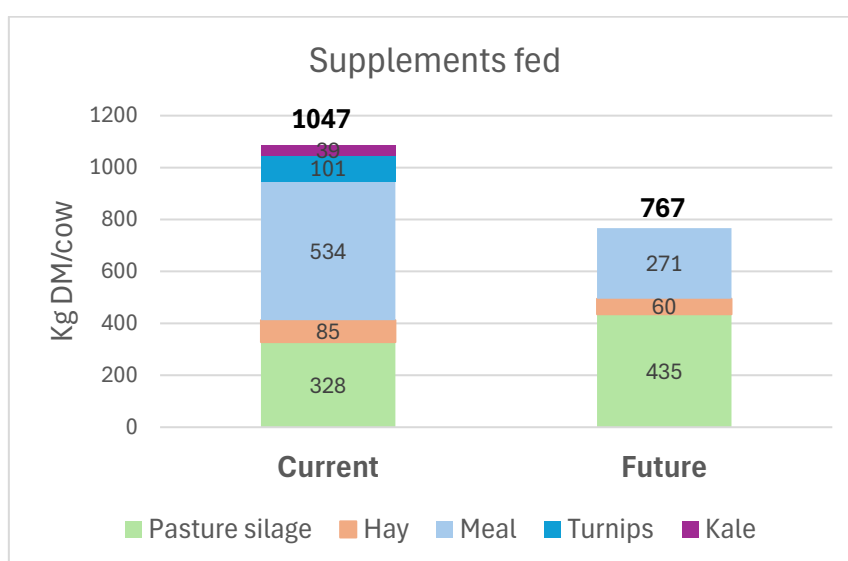


Figure 5 Supplements fed on the Current and Future farmlet (Kg DM/cow) for the 2025/26 season.

Less supplements per cow were fed on the Future farmlet in line with the trial protocol (Figure 5). More PKE-based meal was fed on the Current farmlet while more home-made silage was fed on the Future farmlet. On the Current farmlet 721 Kg DM/cow of the supplements fed were purchased while on the Future farmlet 417 Kg DM/cow of purchased supplements were fed. Apart from a small amount of hay fed during dry off in autumn, all bought-in supplement on the Future farmlet was fed in winter and spring. This exceeded the 300 kg DM/cow limit specified in the trial protocol. However, exceptionally dry conditions in the previous season meant there was no homegrown supplement carried over to support winter and spring feeding, requiring additional supplement to be purchased. This underscores the importance of evaluating farming system performance over multiple seasons, as conditions in one season can have significant carry-over effects, and single-season assessments may not accurately reflect overall system performance.

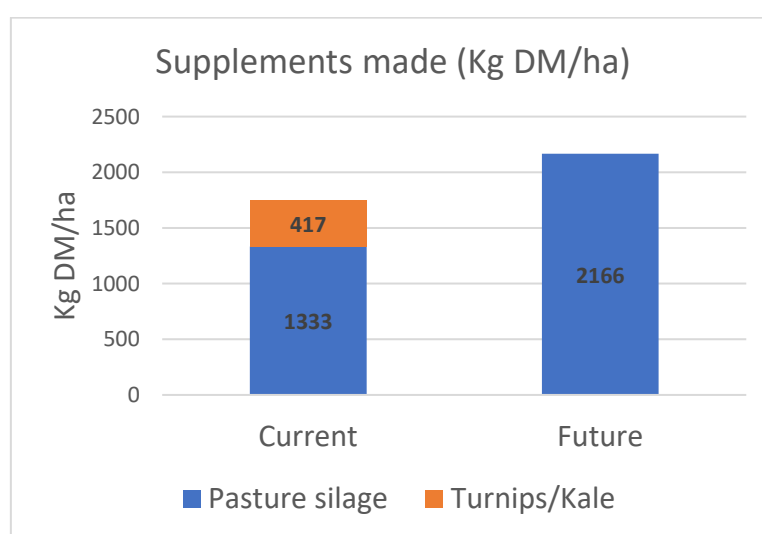


Figure 6 Supplements made on the Current and Future farmlet (Kg DM/ha) for the 2025/26 season.

More pasture silage was harvested on the Future farmlet due to the lower stocking rate resulting in a larger pasture surplus than on the Current farmlet (Figure 6).

MILK PRODUCTION

Table 2 Milk production 2025/26 season

	CURRENT	FUTURE
kgMS/ha	1202	1075
kgMS/cow	392	435
Days in milk	259	285
Average kgMS/cow/day	1.64	1.67
kgLWT (Dec)	486	501
kgMS as % liveweight	81	87

The Future farmlet produced more milk solids per cow in the 2025/26 season while the Current farmlet produced more milk solids per hectare due to its higher stocking rate (Table 2). Milk solids per cow and

per hectare for all 6 seasons of the trial is summarised in Table 3 below. Milk production per hectare has been consistently lower on the Future farmlet as expected due to the lower stocking rate. The difference to the Current farmlet was largest in year one when both herds calved at the same time. From year two onwards the Future herd calved ten days before the Current herd giving a better alignment of pasture growth and feed demand on the Future farmlet in spring. The Future farmlet has consistently had higher milk production per cow due to more days in milk as a result of the lower stocking rate. Over the 6 years of the trial the Future farmlet has produced on average 7.6% more Kg MS per cow and 12.4% less Kg MS per hectare than the Current farmlet.

Table 3 Milk solid production (kg MS) per ha and per cow of the Current and Future farm systems in years 1-6 and the difference between systems.

	Current	Future	Change	Current	Future	Change
	<i>KgMS/ha</i>			<i>KgMS/cow</i>		
<u>Year 1</u>	1276	1060	-16.9%	412	419	+1.9%
<u>Year 2</u>	1249	1093	-12.5%	408	445	+9.3%
<u>Year 3</u>	1211	1093	-9.8%	408	445	+9.3%
<u>Year 4</u>	1144	1007	-12.0%	378	401	+6.2%
<u>Year 5</u>	1159	1013	-12.5%	378	407	+7.7%
<u>Year 6</u>	1202	1075	-10.6%	392	435	+11.0%
<u>Average</u>	1206	1057	-12.4%	396	425	+7.6%

ECONOMICS

Table 4 Income, expenses and operating profit for year 6 of the trial (2025/26 season).

Income	Current	per ha	Future	per ha
kgMS	65,509	1202	58,682	1077
Milk income \$ 9.70/kg MS	\$635,437	11659	\$569,215	10444
Net Stock sales	\$62,426	1145	\$48,624	892
Total income	\$697,863.73	12805	\$617,839	11337
Total expenses	\$470,584	8635	\$377,598	6928
EFS (EBITA)	\$227,280	4170	\$240,242	4408
FEW/kgMS	\$7.18		\$6.43	

Profitability of the two systems varied between the years with the Future system being more profitable when input prices are high. Average profitability across the five years was the same across the six years of the trial (Table 5).

Table 5 Operating profit per hectare generated from the Current and the Future system throughout the study period.

	Current	Future	Change
Operating profit/ha			
<u>Year 1</u>	\$5,357	\$4,700	-12.3%
<u>Year 2</u>	\$5,639	\$5,546	-1.6%
<u>Year 3</u>	\$2,961	\$3,066	+3.6%
<u>Year 4</u>	\$1,630	\$2,019	+23.9%
<u>Year 5</u>	\$4,383	\$4,549	+3.8%
<u>Year 6</u>	\$4170	\$4408	+5.7%
<u>Average</u>	\$4023	\$4048	+0.6%

GREENHOUSE GASES AND N-LOSS ANALYSIS

**Numbers are modelled in Overseer and are calculated differently to LCA which is used in the Fonterra Farm Insight Report*.*

Table 6 Greenhouse Gas (GHG) and Methane (CH₄) emissions expressed as CO₂-equivalents from the Current and the Future farmlets and the difference between the systems in years 1-6.

	Current	Future	Change	Current	Future	Change
GHG t CO₂-eq/ha				CH₄ t CO₂-eq/ha		
<u>Year 1</u>	13.7	10.7	-21.6%	9.4	7.9	-15.4%
<u>Year 2</u>	13.7	10.9	-20.5%	9.2	7.9	-13.6%
<u>Year 3</u>	13.4	10.8	-19.2%	9.2	8.0	-13.0%
<u>Year 4</u>	12.6	10.6	-16.2%	8.4	7.6	-10.0%
<u>Year 5</u>	13.0	10.5	-18.9%	8.5	7.4	-12.8%
<u>Year 6</u>	13.5	11.1	-17.8%	8.9	7.9	-11.6%
<u>Average</u>	13.3	10.8	-18.8%	8.9	7.8	-12.4%

The Future farmlet has consistently achieved lower GHG emissions over the 6 years of the trial. On average it achieved 18.8% lower GHG emissions per hectare and 12.4% lower Methane (CH₄) emission per hectare (Table 6).

The emissions intensity (GHG Kg CO₂-eq/Kg MS) has also been consistently lower on the Future farmlet with an average of 9.8% lower emissions intensity on the Future farmlet (Table 7).

Table 7 Emissions intensity (kg CO₂-eq/kg MS) and the difference achieved between the Current and Future farmlet in years 1-6.

	Current	Future	Change
<i>GHG kg CO₂-eq/kg MS</i>			
<u>Year 1</u>	10.8	10.0	-7.5%
<u>Year 2</u>	11.1	9.9	-10.9%
<u>Year 3</u>	11.2	9.8	-12.2%
<u>Year 4</u>	11.3	10.4	-8.4%
<u>Year 5</u>	11.5	10.3	-10.8%
<u>Year 6</u>	11.3	10.3	-8.8%
<u>Average</u>	11.2	10.1	-9.8%

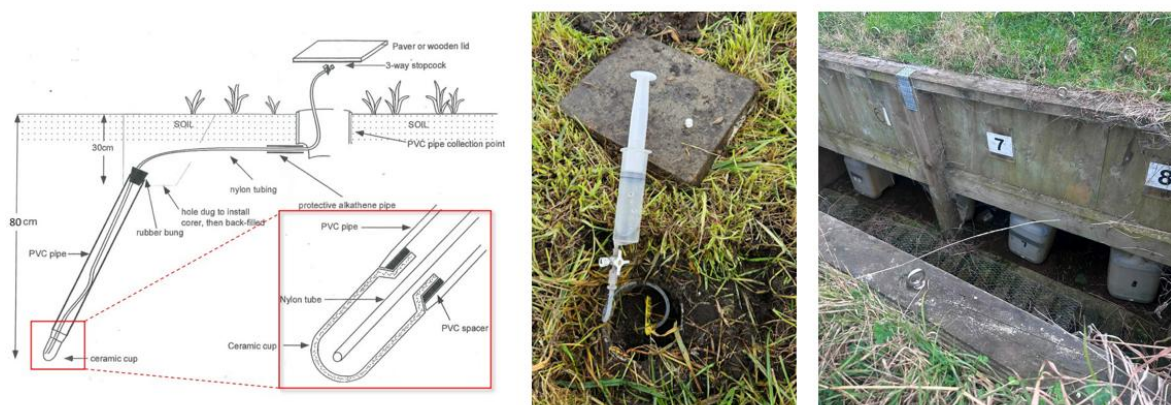
N-loss was also reduced in all 6 years on the Future farmlet (Table 8), -20.0% on average, as a result of lower stocking rate and reduced N-fertiliser input on the Future farmlet.

Table 8 Nitrogen loss (kg N/ha) from the Current and the Future farmlet and the difference between the two systems in year 1-6, calculated using OVERSEER.

	Current	Future	Change
<i>Kg N/ha</i>			
<u>Year 1</u>	41	34	-17.1%
<u>Year 2</u>	43	33	-23.3%
<u>Year 3</u>	43	37	-14.0%
<u>Year 4</u>	35	28	-20.0%
<u>Year 5</u>	38	29	-23.7%
<u>Year 6</u>	40	33	-17.5%
<u>Average</u>	40	32	-20.0%

Measured N-leaching from suction cups:

In year four of the trial, suction cups and lysimeters were installed to measure nitrate and ammonium concentrations in soil water below plant rooting depth to quantify the amount of nitrogen (N) leached. The concentrations of nitrate and ammonium in soil water are multiplied by the amount of water drained beyond this depth to calculate the total amount of N leached (kg N/ha). Drainage amounts are measured using intact soil cores in lysimeters, with drainage typically occurring between March and November.



The suction cups have been sampled over two drainage periods (2024 and 2025). In 2024 the N-loss estimated from the suction cups was 50% lower on the Future farmlet than on the Current farmlet but overall, very low on both farmlets with only 5.2 Kg N/ha on the Current farmlet and 2.6 Kg N/ha on the Future farmlet (Table 9). The low N-loss was related to the dry conditions and the low amount of only 166 mm drainage between January and December 2024. Measured drainage from the lysimeters during 2025 was 297.1 mm, and the measured N-loss was substantially higher than the previous year on both farmlets. There was again a trend of lower N-loss on the Future farmlet compared to the Current farmlet (-15.6%), but the difference was not found to be statistically significant.

In comparison, the Overseer model calculated the N-loss between June 2024 and May 2025 to be 38 Kg N/ha on the Current farmlet and 29 Kg N/ha on the Future farmlet with a difference of 23.7% between the two farmlets. N-loss between June 2025 and May 2026 was calculated to be 40 kg N/ha and 33 kg N/ha respectively, representing a 17.5% difference between both farmlets (Table 9).

The difference between Overseer model estimates and measured N-leaching values from suction cups is driven by both methodological and temporal factors. Overseer estimates N-loss on a dairy season basis (June–May), whereas measured leaching is calculated from drainage collected over a calendar-year period (January–December), with most drainage typically occurring between March and November. As a result, the two approaches only partially overlap and can capture different climatic conditions and management events within their respective reporting periods. In the 2024/25 season, this mismatch was compounded by unusually low drainage (166 mm) during 2024, which limited nitrate movement through the soil profile and resulted in very low measured N-losses. Overseer, however, relies on long-term average climate inputs and does not fully reflect short-term dry conditions, instead estimating losses closer to expected system behaviour. These factors explain why measured losses in 2024 were substantially lower than Overseer estimates for the 2024/25 season, while still showing a similar relative trend between the Current and Future farmlets.

Table 9 Modelled and measured N loss (kg N/ha) from the Current and the Future farmlet in year 5 and 6.

	Current	Future	Change
	Kg N/ha		
<u>2024 Measured</u>	5.2	2.6	-50.0%
<u>2024/25 season Overseer</u>	38	29	-23.7%
<u>2025 Measured</u>	33.1	27.1	-15.6%*
<u>2025/26 season Overseer</u>	40	33	-17.5%

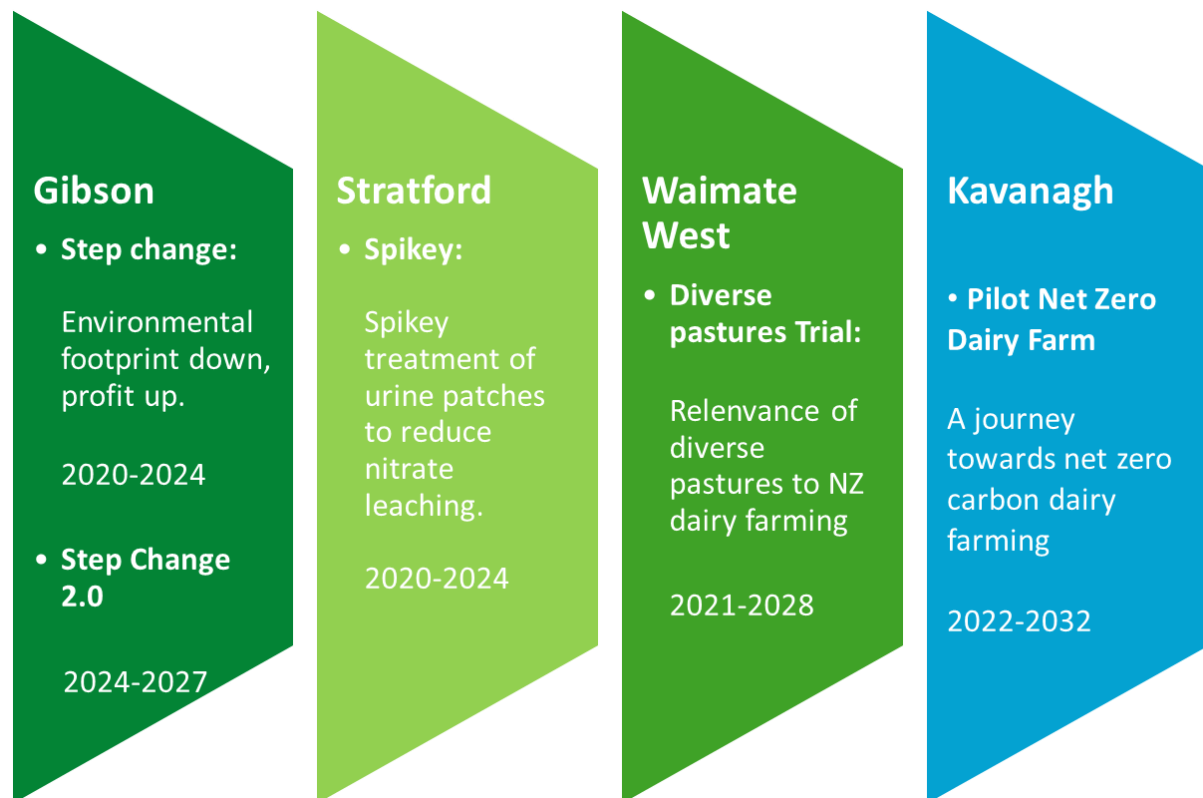
* Difference between Current and Future farmlet not statistically significant

SUMMARY

Over the six years of the StepChange trial the Future farmlet has consistently achieved reduced greenhouse gas emissions and reduced N-loss as calculated using the Overseer model. N-loss measured using ceramic suction cups gives valuable real-life data that can be compared to model data from Overseer.

The impact on profit has been variable with lower payouts and higher input costs being favourable for the Future farmlet. On average, the profit over the six years of the trial is similar, with only a small difference (0.6 %) between the two farmlets.

For more information on Step Change and on the trials that Dairy Trust Taranaki is running on its other three farms sign up to the weekly farm walk notes and follow us across our social media channels.



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