Future Farm Systems to reduce environmental footprint and maintain profitability

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The objective of the Taranaki Step-Change trial was to compare two farm systems: a Current system, representative of many Taranaki (and national) **farms; and a Future system, structured to reduce N-leaching and GHG emissions, while maintaining or improving profitability** (compared with the Current farm)**.**

Results indicate the Future system consistently achieved reduced GHG emissions and N-leaching. On average, there was no difference in profit; however, milk payout, input costs, and climate influenced the profitability of both systems over the years.

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 two-farmlet trial was set up in 2020 and for four years, inputs (e.g., pasture offered, feed and N-fertiliser purchased), and outputs (milk production) were measured, and GHG emissions and N-leaching were estimated using Overseer.

There were three key differences between the two farmlets:

Compared to the Current farmlet the Future farmlet had a reduced stocking rate (3.1 vs. 2.5 cows/ha), a reduced N-fertiliser cap (190 kg N/ha/yr vs. 75 kg N/ha/yr) and reduced supplement inputs (700 kg vs. 300 kg DM/cow/yr).

Milk production per hectare was consistently lower on the Future farmlet and the difference to the Current farmlet was largest in year one when both herds calved at the same time (**Table 1**).

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Table 1: Milk solid production (kg MS) per ha and per cow of the Current the Future farm system in years 1-4 and the difference between systems.

	Current	Future	*Change*	Current	Future	*Change*
	KgMS/ha			*KgMS/cow*		
Year 1	1276	1060	***-16.9%***	412	419	***+1.9%***
Year 2	1249	1093	***-12.5%***	408	445	***+9.3%***
Year 3	1211	1093	***-9.8%***	408	445	***+9.3%***
Year 4	1144	1007	***-12.0%***	378	401	***+6.2%***

Milk solid production per ha was consistently lower on the Future farmlet compared to the Current farmlet. Milk production per cow was higher on the Future farmlet, achieved through more days in milk, particularly in years 2-4, when the calving date had been adjusted forward. Both herds were dried off early in year four due to drought.

From year two on the Future herd calved ten days before the Current herd. As a result of more days in milk the annual milk production per cow was higher in the Future herd (**Table 1**).

Table 2: Greenhouse Gas (GHG) and Methane (CH_4) emissions expressed as CO_2-equivalents from the Current and the Future farmlets and the difference between the systems in years 1-4.

	Current	Future	*Change*	Current	Future	*Change*
	GHG t $CO_{2\text{-eq}}$/ha			*CH_4 t $CO_{2\text{-eq}}$/ha*		
Year 1	13.7	10.7	***-21.6%***	9.4	7.9	***-15.4%***
Year 2	13.7	10.9	***-20.5%***	9.2	7.9	***-13.6%***
Year 3	13.4	10.8	***-19.2%***	9.2	8.0	***-13.0%***
Year 4	12.6	10.6	***-16.2%***	8.4	7.6	***-10.0%***

GHG and CH_4 emissions from the Future farmlet were lower than from the Current farmlet and achieved CH_4 2030 emission reduction targets in all four seasons.

The Future system achieved reductions in GHG emissions and N-leaching in all four years of the trial (**Table 2 and 4**). Encouragingly, it also consistently achieved a reduction in emissions intensity (**Table 3**).

Table 3: Emissions intensity (kg CO_2-equivalent/kg MS) and the difference achieved between the Current and Future farmlet in years 1-4.

	Current	Future	*Change*
	GHG kg $CO_{2\text{-eq}}$/kg MS		
Year 1	10.8	10.0	***-7.5%***
Year 2	11.1	9.9	***-10.9%***
Year 3	11.2	9.8	***-12.2%***
Year 4	11.3	10.4	***-8.4%***

In addition to a reduction in total emissions, the Future system also achieved a reduction of emissions intensity in all four years. Emissions intensity was highest on both farmlets in year 4 when milk production was reduced due to early dry off.

Profitability of the two systems varied between years. When milk payout was lower, and input costs higher, the Future farmlet was more profitable (**Table 5**).

Table 4: Nitrogen loss (kg N/ha) from the Current and the Future farmlet and the difference between the two systems in year 1-4, calculated using OVERSEER.

	Current	Future	*Change*
	Kg N/ha		
Year 1	41	34	***-17.1%***
Year 2	43	33	***-23.3%***
Year 3	43	37	***-14.0%***
Year 4	35	28	***-20.0%***

Nitrogen leaching was consistently lower on the Future farmlet as a result of lower stocking rate and reduced fertiliser and supplement inputs.

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

	Current	Future	*Change*
	Operating profit/ha		
Year 1	$5,357	$4,700	***-12.3%***
Year 2	$5,639	$5,546	***-1.6%***
Year 3	$2,961	$3,066	***+3.6%***
Year 4	$1,630	$2,019	***+23.9%***

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 four years was the same across the four years of the trial.

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