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Future Dairy Farm Systems for Northland Project

Chris Boom and Kim Robinson
June 2025

Summary

This study compares three Northland dairy farm systems

- **Baseline Farm** – kikuyu/Italian ryegrass pastures, 3.0 cows/ha, up to 190 kg N/ha applied

- **Alternative Pastures Farm** - over 70% of land in tall fescue/cocksfoot/chicory-based pastures, 3.0 cows/ha, up to 190 kg N/ha

- **Low Emissions Farm -** designed to have reduced greenhouse gas (GHG) emissions, kikuyu/Italian ryegrass pastures, 2.2 cows/ha, no N applied.

The four completed seasons of this study have shown quite different results. Milk production was highest on the Baseline Farm in 2021/22 and 2024/25 which featured dry summers and cows on the Alternative Pastures Farm dried off early. Milk production in 2022/23 and 2023/24 seasons was highest on the Alternative Pastures Farm.

Milk production on the lower stocked Low Emissions Farm has been between 25% and 39% lower than the Baseline Farm. The variation in milk production on the Low Emissions Farm appears to be related to variance in clover presence. Over the four seasons pasture on the Baseline Farm has averaged 7% clover while the Low Emissions Farm has averaged 23%.

Financial analysis of each farm (using actual milk price) across the four years of the study shows that on average the Baseline and Alternative Pastures Farms have had similar profitability. Although the Low Emissions Farm has not always been the least profitable farm, overall it has averaged $719/ha lower than the Baseline Farm.

	Milk Solids kg/ha				Farm Operating Profit $/ha			
	2021/22	2022/23	2023/24	2024/25	2021/22	2022/23	2023/24	2024/25
Baseline Farm	1,284	1,204	1,112	1,289	$4,952	$1,906	$171	$4,864
Alternative Pastures Farm	1,213	1,269	1,178	1,188	$4,699	$2,669	$459	$3,959
Low Emissions Farm	794	910	790	1,002	$2,974	$2,234	-$463	$4,231

Averaged across the four seasons to date, the Low Emissions Farm has reduced GHG levels close to target compared to the Baseline Farm (using the Overseer model). The methane reductions have been more variable, partly due to fluctuating milk production per cow. Emissions intensity (GHG/kg MS) has improved, primarily through a reduction in the embedded emissions associated with PKE and nitrogen fertiliser while maintaining relatively high milk production per cow.

Low Emissions Farm vs Baseline Farm	Methane	Nitrous Oxide	GHG/kg MS
Targeted Reduction	25%	50%	-
Actual Reduction	27%	47%	13%

Removing nitrogen fertiliser on the Low Emissions Farm quickly resulted in a large increase in clover presence. Flooding from cyclone Gabrielle eliminated clover from most of the farm and took 8 months to restore. Variation in performance of this farm has shown how dependent no-nitrogen systems are on clover presence.

This study has provided results under contrasting climatic conditions. Extended dry summers appear to favour kikuyu/Italian ryegrass-based pastures, whereas the Alternative Pastures Farm performed well in the normal to wetter summer rainfall seasons. Reducing stocking rate and withholding nitrogen fertiliser to reduce GHG emissions on the Low Emissions Farm has reduced farm profit.

Background

Northland farm systems are at the forefront of the effects of a warming climate and demonstrate the challenges that the rest of New Zealand will experience over time. In Northland, ryegrass persistence is relatively poor, rust and pest damage are increasing and regression to kikuyu often occurs within two to three years after sowing new ryegrass pastures. Kikuyu is productive during summer/autumn, however it has poorer nutritive value, is difficult to manage and has low winter/spring growth. Farmers are looking for alternative pasture species which may be more persistent and resilient in the face of climate change.

Farmers are also being encouraged to lower GHG emissions on dairy farms. Despite an abundance of modelled information farmers are uncertain as to whether the strategies to reduce emissions are physically or financially sustainable, particularly the lowering of stocking rate on kikuyu pastures.

This farm systems trial, conducted at Northland Agricultural Research Farm near Dargaville, is designed to test and compare farm systems which may be used in the future to mitigate and adapt to the effects of a warming climate.

Trial Design

This project compares three farm systems:

1. **Baseline Farm** – existing Italian ryegrass/kikuyu pastures with imported feed (mainly PKE) to fill feed deficits. Stocking rate 3.1 cows/ha and up to 190 kg applied N/ha
2. **Alternative Pastures Farm** – target 75% of pastures in alternative pasture species to ryegrass/kikuyu – currently tall fescue, cocksfoot, legumes & herbs - with imported feed (PKE) to fill feed deficits. Stocking rate 3.1 cows/ha and up to 190 kg applied N/ha
3. **Low Emissions Farm** – existing Italian ryegrass/kikuyu pastures. Targeting a 25% reduction in methane emissions and 50% reduction in nitrous oxide emissions (compared to the Baseline Farm). Stocking rate 2.2 cows/ha, no nitrogen fertiliser application. Little or no imported feed

The trial commenced in June 2021 and will run for five seasons to test these systems under a range of climatic conditions. Trial measures capture pasture and milk production and composition, profit, labour input and management difficulty and environmental impact.

Introduction of New Pastures

The Alternative Pastures Farm was set up by sowing 74% of the farm area during 2020 and 2021, into tall fescue, cocksfoot, white and red clovers and chicory. Plantain and Persian clover were added in some paddocks. Between 15 - 20% of these alternative pastures have been resown each autumn.

These pasture establishment costs have been similar across each year, averaging $1,138/ha, including tractor time, man hours and contractor costs for drilling.

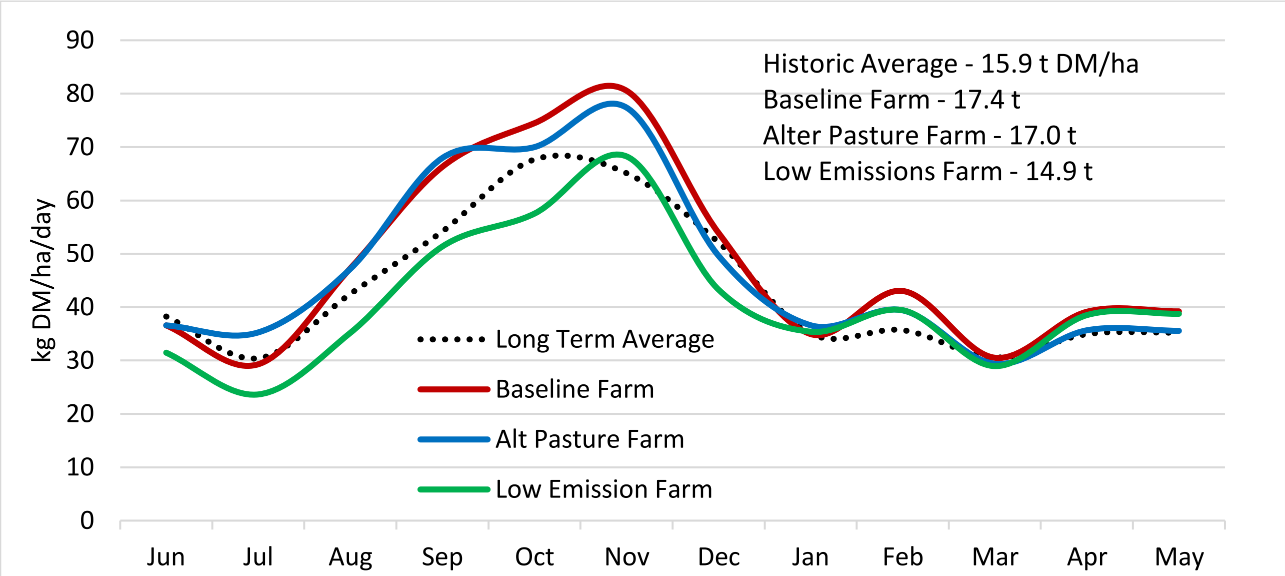
The other two farms (Baseline Farm and Low Emissions Farm), and the 26% portion of the Alternative Pastures Farm that was not sown in new species, have older pastures with approximately 70% kikuyu presence. All kikuyu-based paddocks on all three farms are mulched every autumn and under-sown with Italian ryegrass. This provides control of kikuyu stolon and boosts winter/spring growth and quality to complement the summer/autumn active kikuyu.

Pasture Growth

Figure 1 shows the pasture growth differences between these pastures as calculated by weekly rising platemeter assessments. Pasture growth on the Baseline and Alternative Pasture Farms has generally been similar.

The lower pasture growth of the Low Emissions Farm during winter and spring is the result of no nitrogen applications. Across the four seasons the Baseline and Alternative Pastures Farms have averaged 176 kg N/ha. This calculates to a farm systems nitrogen response of 14.4 kg DM/kg N. This relatively good nitrogen response is despite the high clover presence on the Low Emissions Farm.

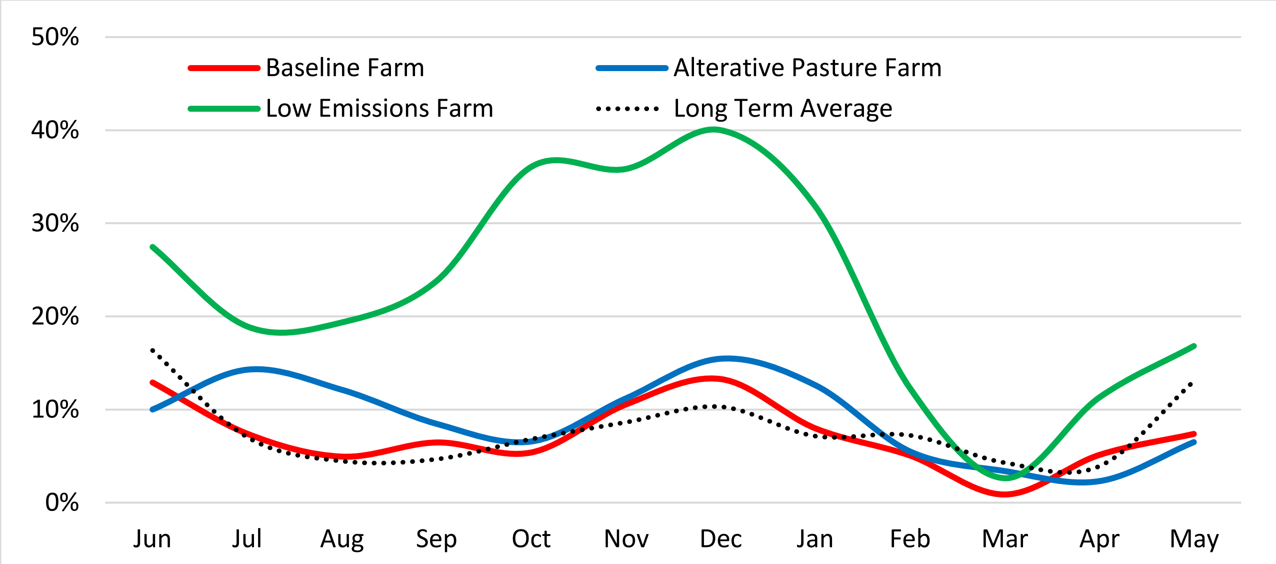
Figure 1. *Four-year average pasture growth rates, as calculated by pre – post grazing platemeter assessments.*



Pasture Composition

Pasture samples are collected monthly from the next three paddocks to be grazed on each farm and analysed for feed quality and species present. Figure 2 shows the presence of clover for the three seasons. The clover was entirely white clover on the Baseline and Low Emissions Farms with a small amount of red clover on the Alternative Pastures Farm.

Figure 2. *Clover presence in pasture sampling to grazing height (% clover), average of four years.*



Removing fertiliser nitrogen from the Low Emissions Farm resulted in a rapid increase in clover content at the start of the trial continuing through until February 2023 when flooding from cyclone Gabrielle wiped out clover on 90% of all three farms. The clover recovery was very slow, taking 10 months until it was fully recovered to pre flood levels. This lack of clover appeared to depress pasture and milk production on the Low Emissions Farm through the 2023/24 season. In 2024/25 the Low Emissions clover content recovered to between 30% and 50% from June to December, supporting a sustained level of high milk production from pasture (2.0kgMS/c/d) right through until early December. This clover content appears to be important for providing adequate protein in the diet for high producing milking cows when N fertiliser is removed.

Supplement Fed & Pasture Eaten

Farms are managed so that if pasture supply is inadequate then home grown or purchased supplement is fed to cows to keep pasture grazing residuals at the desired level (1500-1600 kg DM/ha). There is a limit of 800 kg DM/cow/annum (around 15% of total requirements) of purchased feed so that pasture system differences are not masked by high supplement use.

Table 2 shows the average amount of supplement fed/annum over the four seasons, the cost of those supplements, and the calculated feed eaten for each of the farms. The Baseline Farm has fed more purchased supplement than the Alternative Pastures Farm during winter/spring in all three seasons.

Table 2. *Supplement made and purchased, cost of that supplement and calculated pasture eaten – average of four seasons.*

Farm	Supplement	Kg DM/cow fed	Cost of Supplement (incl Freight)	Total Cost of Supplement c/kg DM	Calculated Pasture Eaten t/ha
Baseline Farm	Home-made Silage	252	$52/bale	20.3	13.0
	PKE	626	$401/t	44.5	
	Purchased Silage	155	$93/bale	36.2	
	Total	**1,033**			
Alternative Pastures Farm	Home-made Silage	238	$52/bale	20.3	13.3
	PKE	560	$401/t	44.5	
	Purchased Silage	185	$93/bale	36.2	
	Total	**983**			
Low Emissions Farm	Home-made Silage	415	$52/bale	20.3	10.5
	PKE	239	$401/t	44.5	
	Purchased Silage	17	$93/bale	36.2	
	Total	**671**			

Despite the lower stocking rate on the Low Emissions Farm, the low pasture growth rates and pasture covers during winter has resulted in some PKE being required to fill the feed gap and boost body condition score of cows.

The calculated pasture eaten data indicates that the Alternative Pastures Farm had the highest pasture eaten in all seasons to date while cows on the Low Emissions Farm consumed 2.8 t DM/ha less pasture than the Baseline Farm.

Milk Production

Milk production is shown in table 3 and figures 3 & 4. Highest farm production each season has alternated between the Alternative Pastures Farm and the Baseline Farm, with no significant difference overall. Climatic variation between seasons is responsible for this difference. The two seasons with a dry summer saw the Alternative Pastures Farm dried off early while the Baseline Farm continued milking longer due to the higher level of kikuyu in the pasture.

On average, milk production on the Low Emissions Farm has been 348 kg MS/ha lower than the Baseline Farm. Milk production has been especially low during the 2021/22 and 2023/24 seasons when clover levels in the pasture were lower. The 2022/23 & 2024/25 seasons had high clover levels in the pasture, sometimes >50% of pasture, which appear to have supported relatively good milk production.

Table 3. *Seasonal Milk Production (kg MS/ha & kg MS/cow).*

	2021/22		2022/23		2023/24		2024/25	
Farm	**MS/ha**	**MS/c**	**MS/ha**	**MS/c**	**MS/ha**	**MS/c**	**MS/ha**	**MS/c**
Baseline Farm	1,284	409	1,204	392	1,112	375	1289	430
Alternative Pastures Farm	1,213	397	1,269	406	1,178	386	1188	393
Low Emissions Farm	794	370	910	399	790	355	1002	450

Figure 3. *Milk Production – kg MS/ha/day (10 day average), average of 2021/22, 2022/23 & 2023/24 seasons, compared against the 2024/25 season.*

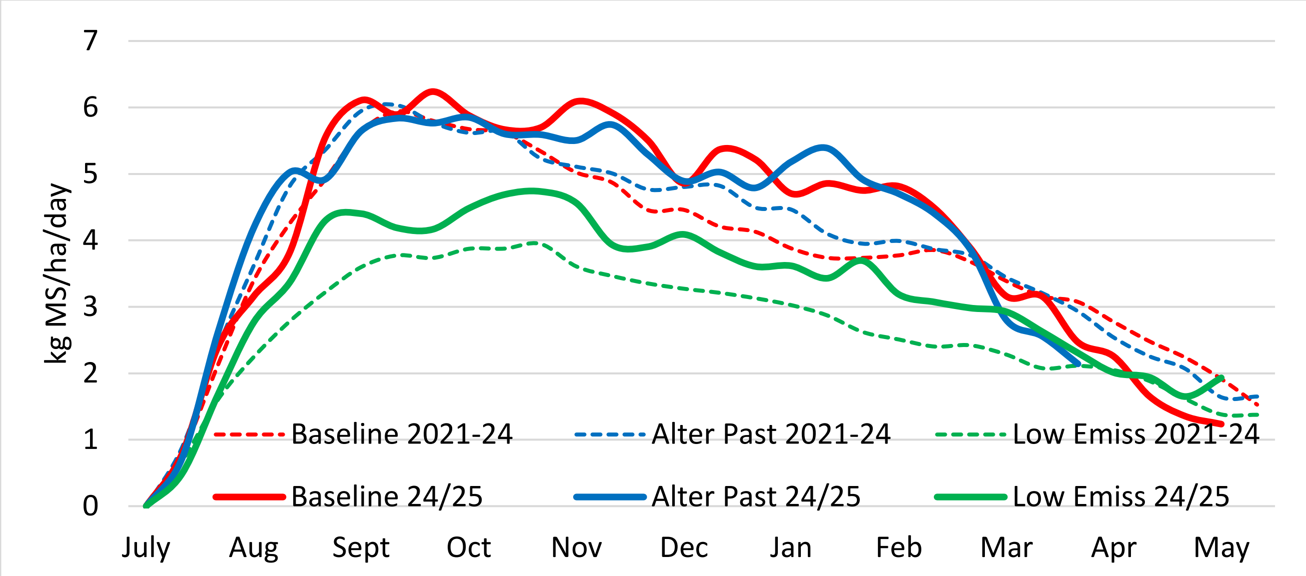
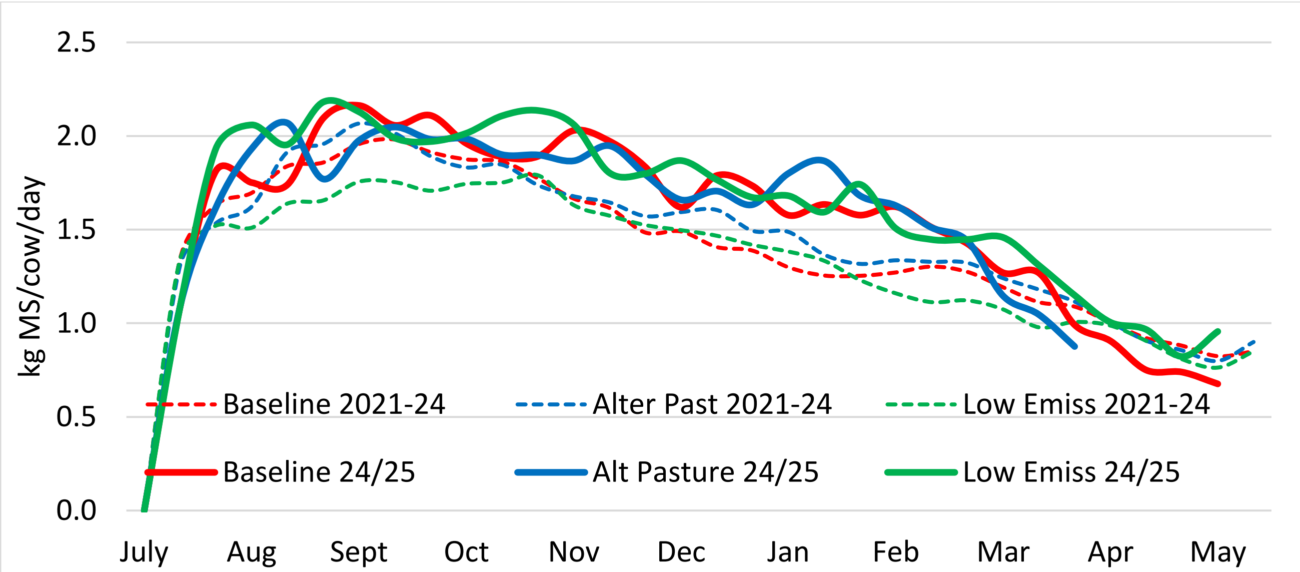


Figure 4. *Milk Production – kg MS/cow/day (10 day average), average of 2021/22, 2022/23 & 2023/24 seasons, compared against 2024/25 season.*



Mating Results

Table 4 shows the mating results for the four seasons. There is no consistent difference between farms. The high empty rate on the Baseline Farm this season is suspected bull failure.

Table 4. *Six week in-calf and empty rates.*

Farm	2021/22 Season 6 week in-calf	Empty Rate	2022/23 Season 6 week in-calf	Empty Rate	2023/24 Season 6 week in-calf	Empty Rate	2024/25 Season 6 week in-calf	Empty Rate
Baseline Farm	79%	11%	81%	10%	81%	8%	70%	20%
Alternative Pastures Farm	74%	9%	82%	11%	85%	4%	73%	10%
Low Emissions Farm	75%	3%	82%	12%	73%	10%	76%	2%

Greenhouse Gas Emissions

Greenhouse gas emissions were calculated using the Overseer model and are shown in table 5.

Table 5. *Calculated GHG Emissions using Overseer Model, average of three seasons and 2024/25.*

Farm	Avg 1st 3 yrs Methane (CO_2 eq) t/ha	2024/25 Methane (CO_2 eq) t/ha	Avg 1st 3 yrs Nitrous Oxide (CO_2 eq) t/ha	2024/25 Nitrous Oxide (CO_2 eq) t/ha
Baseline Farm	8.3	8.3	2.0	1.9
Alternative Pastures Farm	8.6	8.3	2.1	1.9
Low Emissions Farm Compared to Baseline Farm	5.9 28% reduction	6.5 22% reduction	1.0 48% reduction	1.1 42% reduction

Emissions have been relatively similar between the Baseline and Alternative Pastures Farms, due to similar stocking rate, milk production, PKE and N inputs. The Low Emissions farm has averaged 28% lower methane and 48% lower nitrous oxide for the first three years of the trial. The higher performance on the Low Emissions Farm during the 2024/25 season led to lower reductions in methane and N2O compared to the previous three years. The methane levels fluctuate somewhat in line with milk production and stocking rate, as methane is closely related to feed eaten.

Emissions intensity was calculated through the new Fonterra LCA model. The Low Emissions farm has consistently produced milk with lower emissions intensity, primarily due to three key factors – low emissions associated with PKE and N fertiliser, and good milk production per kg liveweight which dilutes maintenance feed methane across more kgMS.

Table 6. *Calculated Total GHG Emissions using Fonterra LCA for 2024/25.*

Farm	Total Emissions kgCO2e/t FPCM	% of Baseline Farm
Baseline Farm	825	
Alternative Pastures Farm	851	103%
Low Emissions Farm	743	90%

Financial Analysis

Four-year average milk production and operating profit for the three farms is summarised in Table 7. Fonterra dividend income is excluded from this financial analysis. Expenses are based on actual farm expenses with some adjustments for labour and administration to compensate for extraordinary expenses involved in running the research trial. Records of additional labour and tractor time for each farm have been used to allocate the vehicle, R&M, and depreciation expenses.

The Baseline and Alternative Pastures Farms have shown similar farm operating profit across the four years. The Low Emissions Farm has averaged $719/ha lower than the Baseline Farm. However, this farm has not always been the least profitable which shows that this system can be somewhat competitive under certain conditions.

Table 7. *Four-year average milk production and operating profit*

Farm	Average Milk Production Kg MS/ha	Change relative to Baseline %	Average Farm Operating Profit $/ha	Change relative to Baseline %
Baseline Farm	1,222		$2,926	
Alternative Pastures Farm	1,212	-1%	$2,960	+1%
Low Emissions Farm	874	-28%	$2,207	-25%

Table 8 shows the 2024/25 season financial detail. In this season the Baseline Farm has been the most profitable followed by the Low Emissions Farm. If the milk price had been $8.00/kg MS then the operating profit on the Low Emissions Farm would have been close to the Baseline Farm.

Table 8. *2024/25 Financial Results - income, expenses, and operating profit for the three farms ($/ha).*

Financial Summary 2024/25 Season	Baseline Farm	Alternative Pastures Farm	Low Emissions Farm
Income	**$/ha**	**$/ha**	**$/ha**
Income from milk ($10.00/kg MS)	$12,889	$11,881	$10,018
Other income (excl Fonterra Divid)	$10	$10	$10
Income from stock & baleage sales	$610	$614	$453
Total Income/ha	**$13,509**	**$12,505**	**$10,480**
Expenses			
Wages	$2,135	$2,122	$1,555
Animal Health	$569	$572	$435
Breeding Expenses	$266	$267	$200
Shed expenses	$209	$210	$168
Electricity	$368	$370	$286
Grazing	$578	$581	$428
Calf rearing	$87	$88	$65
Silage Making	$138	$95	$109
PKE	$710	$672	$304
Purchased Silage	$171	$205	$0
General Fert	$243	$243	$243
Nitrogen Fert	$343	$342	$0
Regrassing	$308	$372	$308
Weed and Pest	$53	$53	$53
Vehicle Expenses	$409	$362	$337
R&M Buildings	$59	$59	$51
R&M General	$671	$673	$581
R&M Effluent	$186	$182	$117
Administration	$185	$185	$175
Insurance	$208	$208	$191
Rates	$149	$149	$149
Depreciation	$603	$543	$498
Total Operating Expenses/ha	**$8,646**	**$8,546**	**$6,250**
Farm Working Expenses $/kg MS	**$6.25**	**$6.74**	**$5.69**
Operating Profit (at $10/kg MS)	**$4,864**	**$3,959**	**$4,231**

2024/25 Operating Profit with Alternative Milk Prices			
Operating Profit at $6.00/kg MS	-$292	-$793	$224
Operating Profit at $8.00/kg MS	$2,286	$1,583	$2,227
Previous Seasons Operating Profit			
2021/22 Operating Profit - $9.30/kg MS	$4,952	$4,699	$2,974
2022/23 Operating Profit - $8.22/kg MS	$1,906	$2,669	$2,234
2023/24 Operating Profit - $7.83/kg MS	$204	$494	-$439

Discussion

Over the four seasons of this trial there have been two relatively dry summers and two relatively wet summers. The wet summers have benefited the tall fescue and cocksfoot pastures on the Alternative Pastures Farm, whereas the dry summers have favoured the Baseline Farm with kikuyu pastures. It should be noted that the kikuyu pastures are intensively managed with mulching and under-sowing of Italian ryegrass each autumn, making the Baseline Farm a relatively high performing system. There were four perennial ryegrass paddocks sown two years ago for comparison. They appear to produce 0.5-1.0tDM/ha less than the intensively managed kikuyu/Italian ryegrass paddocks as estimated by weekly walks with the rising plate meter.

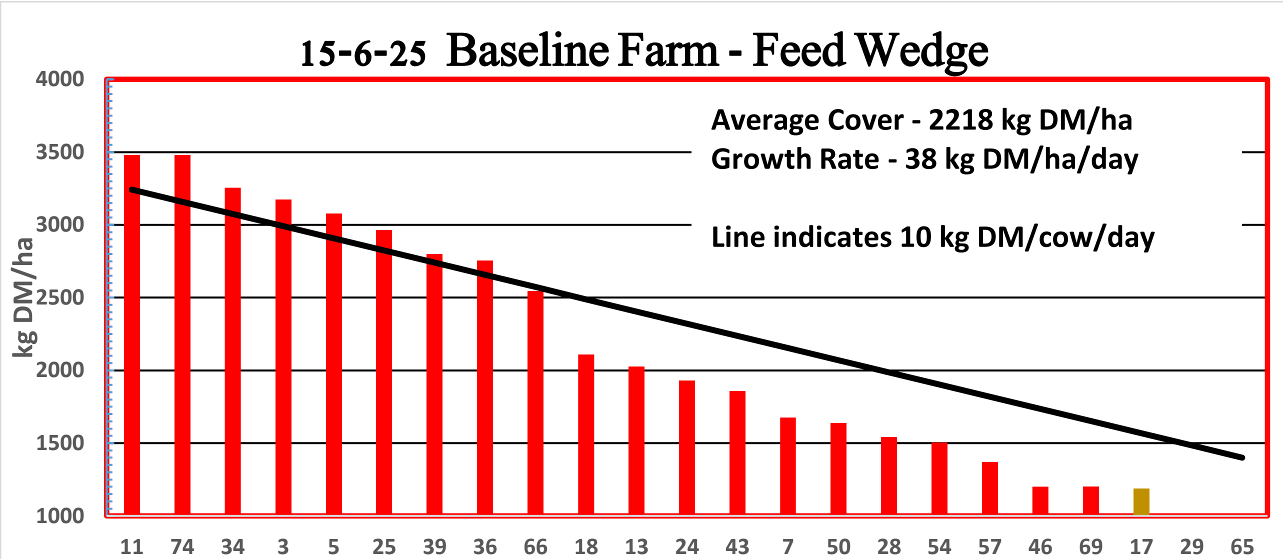
The removal of nitrogen fertiliser from the Low Emissions Farm has resulted in a consistent overall reduction in pasture growth during winter and spring compared with the Baseline Farm, averaging 2.5 t DM/ha/annum less pasture across the four years of this study.

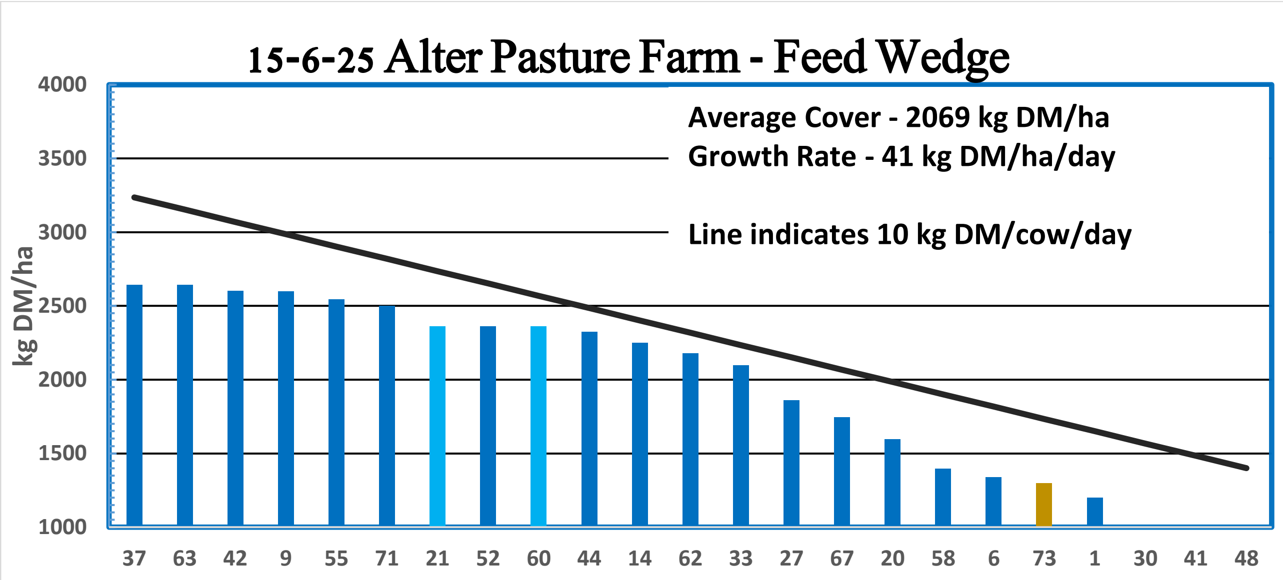
Clover levels on the Low Emissions Farm rapidly increased when nitrogen applications ceased on these pastures. The paddocks had a long history of nitrogen applications prior to this study. However, this did not compensate for the lack of nitrogen applied. Calculations indicate an average total farm system response of 14.4 kg DM/kg N applied on the Baseline Farm over the three years. This response was greatest during the 2023/24 season when there were very low clover levels on the Low Emissions Farm following flooding from cyclone Gabriel.

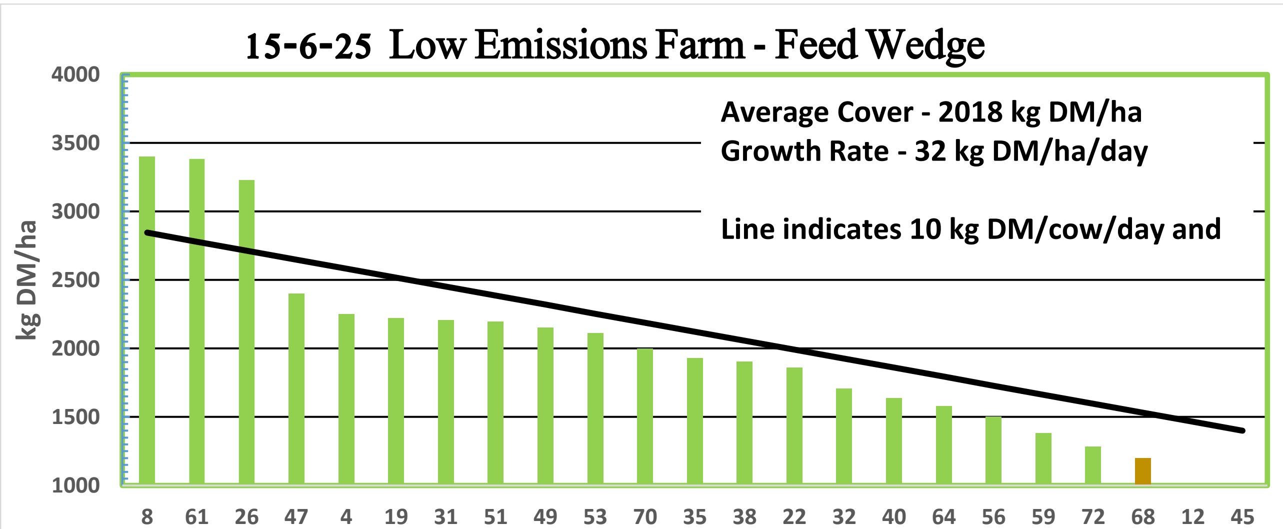
Averaging data over the four years of this project, the Low Emissions Farm showed 348 kg MS/ha lower milk production and $719/ha lower operating profit than the Baseline Farm. Variation between seasons shows how dependent the Low Emissions Farm is on clover presence to reduce the impacts of removing nitrogen applications.

This project expected to reduce methane emissions by 25% and nitrous oxide emissions by 50% on the Low Emissions Farm compared to the Baseline Farm. The actual (modelled) reduction so far has been in line with these targets, reflecting the reduction in stocking rate and milk production. The consistent reduction in emissions per kg milk solids indicates the potential for lower input systems like the Low Emissions Farm to be more efficient from a GHG emissions perspective.

This project will continue for one more season and to date has shown that there has been no advantage (or disadvantage) to replacing kikuyu/Italian ryegrass based pastures with tall fescue/cocksfoot based pastures. It has also shown that achieving an aggressive GHG emissions reduction target through reducing stocking rate and removing nitrogen fertiliser (which is generally considered the cheapest form of supplement) would significantly reduce the economic sustainability for most farmers.


15-6-25 Baseline Farm - Feed Wedge
Average Cover - 2218 kg DM/ha
Growth Rate - 38 kg DM/ha/day
Line indicates 10 kg DM/cow/day
kg DM/ha
4000
3500
3000
2500
2000
1500
1000
11 74 34 3 5 25 39 36 66 18 13 24 43 7 50 28 54 57 46 69 17 29 65


15-6-25 Alter Pasture Farm - Feed Wedge
Average Cover - 2069 kg DM/ha
Growth Rate - 41 kg DM/ha/day
Line indicates 10 kg DM/cow/day
kg DM/ha
4000
3500
3000
2500
2000
1500
1000
37 63 42 9 55 71 21 52 60 44 14 62 33 27 67 20 58 6 73 1 30 41 48


15-6-25 Low Emissions Farm - Feed Wedge
Average Cover - 2018 kg DM/ha
Growth Rate - 32 kg DM/ha/day
Line indicates 10 kg DM/cow/day and
kg DM/ha
4000
3500
3000
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2000
1500
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8 61 26 47 4 19 31 51 49 53 70 35 38 22 32 40 64 56 59 72 68 12 45

Factors affecting the profitability of supplementary feed use

Key Messages

- **The cost of extra milksolids from supplement can be higher than face value**
- **For every $1 spent on supplements, farm working expenses (FWE) can increase by up to $0.95 effectively doubling the cost of the supplement**
- **Milksolids responses generally decrease with increasing supplement amounts**
- **Profit is more sensitive to the milksolids response than supplement price**
  - **Focus management efforts accordingly, i.e. monitor residuals for efficient use of supplements rather than chasing supplement price deals**

Maximising milk responses to supplements

- **Minimise supplement wastage**
- **Monitor pasture residuals and be prepared to pull supplement out when residuals rise**
- **Use pasture residuals, rather than milk production, to drive supplementary feeding decisions**
- **Be aware of the impact of inshed feeding on supplement responses i.e. feeding for cow flow, not pasture deficit, could have a high marginal cost if pasture is being wasted or topped**

Background

Supplement feeding to boost milk production has increased significantly over the last twenty years, particularly since the introduction of Palm Kernel Expeller (PKE) into the dairy sector. Farmers generally monitor their milksolids production to assess the return on this supplement, but it can be difficult to determine this at a system level. A 3-year farm systems supplementary feeding trial conducted by Northland Dairy Development Trust in 2018-2021 showed that not all milk responses are profitable, due to the relatively high cost of the extra milk produced.

The trial compared three farmlets to assess milk response. The base farm (Pasture only) imported no supplementary feed, while the other two farms used varying levels of supplement, primarily PKE (PKE only) or with some extra DDG (PKE Plus) when the fat evaluation index (FEI) was limiting milk quality. Milk production on the supplemented farms was compared with the Pasture Only farm to calculate a milk response in grams of MS per kgDM fed. The Pasture only farmlet was stocked at 2.7 cows/ha compared to 3.1 cows/ha for the two supplement farmlets.

Results

The milksolids responses to increased stocking rate and supplementary feed were relatively high but decreased with increasing levels of supplement (Table 1). Pasture residuals were monitored closely, and supplement levels were altered frequently as residuals rose above or fell below the target of 1600 kgDM/ha. There was no effect of treatment on reproductive performance over the three years, noting that 6 week in-calf rates and empty rates were all at industry target, indicating cows were well fed in all herds.

Table 1: 3-year average milksolids production, supplementary feed use, and milksolids response

	Milksolids yield (kgMS/ha)	Milksolids yield (kgMS/cow)	Supplement Purchased (kgDM/cow)	Milksolids Response (gMS/kgDM)
Pasture Only	916	342		
PKE Only	1209	389	837	113
PKE Plus	1328	426	1253	91

Income and expenses were recorded on each farmlet, with machinery use and staff hours recorded separately allowing the hidden costs (additional farm working expenses: FWE) associated with supplement feeding, primarily in the areas of staff time, machinery and extra milking costs, to be captured. The figures were then adjusted for inflation into 2024 dollars.

For each $1 spent on supplement, other farm expenses rose by $0.95, effectively doubling the cost of the supplement.

This had a significant impact on the profitability of supplement use. Comparing the extra cost with the extra milk production allowed the marginal cost of extra milk to be calculated.

Table 2: 3-year average financial results (adjusted into 2024 $)

	Farm Working Expenses ($/kgMS)	Marginal cost extra milk ($/kg MS)	Operating Profit @$8.50/kgMS	Operating Profit @$9.00/kgMS	Operating Profit @$9.50/kgMS
Pasture Only	$6.70		$1,821	$2,279	$2,737
PKE Only	$6.85	$7.68	$2,131	$2,735	$3,339
PKE Plus	$7.02	$9.38	$2,032	$2,696	$3,360

Profit decreases when the marginal cost of producing the extra milk is above the milk price. Care must be taken when using average farm working expenses to assess supplement profitability because the marginal cost of the extra milk produced may be significantly higher.

Profit was more sensitive to milk responses than supplement price, and decreased by:

- $620/ha for every 25 gMS/kgDM lower response
- $274/ha for every $100/t extra PKE price

Results suggest more time should be spent monitoring pasture residuals and adjusting feeding than chasing cheaper supplement prices.

Principles of Marginal Milk

The marginal milk price is calculated by taking the additional costs associated with producing more milk from supplementary feed and dividing it by the additional milksolids produced from that supplement. Marginal milk is based on the principle that the increase in MS production associated with supplementary feed inputs is large to begin with but gets smaller and eventually flattens with increasing input i.e. the law of diminishing returns.

Example calculation

	Production (MS/ha)	Extra milksolids (kg/ha)	Total Cost ($/ha)	Extra cost ($)	Marginal cost of extra milk ($/kg MS)
Pasture Only	916		$6,455		
PKE Only	1209	293	$8,704	$2,249	$7.68 ($2,249/293)
PKE Plus	1328	119*	$9,820	$1,116*	$9.38 ($1,116/119)

*Difference between PKE only and PKE plus farmlets

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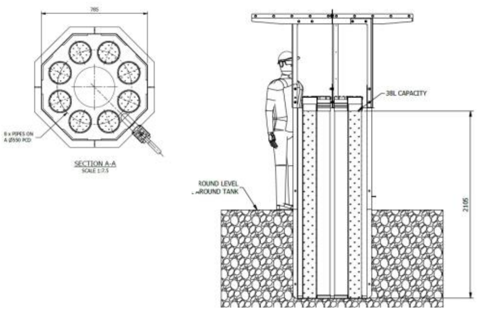
AGFIRST

EcoPond Technology to Reduce Methane Emissions on Northland Dairy Farms

Professor Keith Cameron and Professor Hong Di, Lincoln University.

An EcoPond test unit has been installed on the Northland Agricultural Research Farm (NARF) to measure the effectiveness of EcoPond treatment in reducing methane emissions from effluent in Northland.

New Design EcoPond Measurement Unit



Why is EcoPond Needed?

- Premium overseas customers (e.g., Nestlé) expect the NZ Dairy Industry to reduce greenhouse gas (GHG) emissions and so reduce the 'carbon footprint' of the food ingredients they purchase from NZ.
- NZ has a target of reducing methane GHG emissions by 10% by 2030.
- Methane emissions from dairy effluent ponds represents c. 8 - 10% of the total amount of methane emitted from a dairy farm (while 90% comes from the cow)
- EcoPond technology can reduce methane emissions from effluent ponds by over 90%.
- EcoPond technology could therefore help to achieve a 7 to 9% reduction in total on-farm methane emissions.

How does EcoPond work:

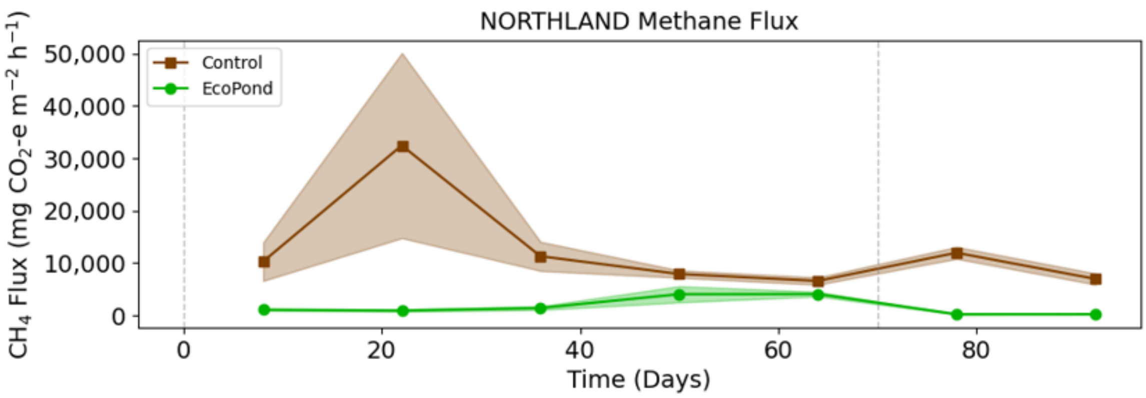
EcoPond technology uses two food additives (iron sulphate and sulphuric acid) to:

1. reduce the activity of the methane producing micro-organisms (methanogens) in the effluent,
2. boost the growth of naturally occurring 'sulphate-reducing bacteria' in the effluent. (The sulphate-reducing bacteria 'out-compete' the methanogens for the organic matter (food) in the effluent), and
3. increase the removal of methane from the effluent.

EcoPond technology mimics 'natural processes' - similar to how sulphate in seawater reduces methane emissions in coastal wetlands compared to freshwater wetlands.

The Results So Far:

- Initial results from the NARF trial show that **EcoPond treatment has reduced methane emissions by over 86%.**



- Emission reductions of over 90% have been achieved in 23 trials across 8 regions and different seasons nationwide.
- Results remain consistent across different seasons.
- EcoPond treatment of the Lincoln University Dairy Farm effluent pond confirms that emissions can be reduced at farm scale and across the season.

Extra benefits: EcoPond treatment also:

1. reduces the risk of phosphate and *E. coli* leaching out of effluent application areas into freshwater,
2. reduces smell, and
3. reduces surface crusting on the pond.

Next Steps:

We're excited about the potential of EcoPond technology to help Northland dairy farmers reduce methane emissions while maintaining premium returns for dairy products.

EcoPond was developed by Lincoln University in collaboration with Ravensdown Ltd and the Ministry for Primary Industries (MPI).

LINCOLN UNIVERSITY TE WHARE WĀNAKA O AORAKI

ravensdown

Ministry for Primary Industries
Manatū Ahu Matua

Body Condition Score Strategies

Paul Edwards, DairyNZ

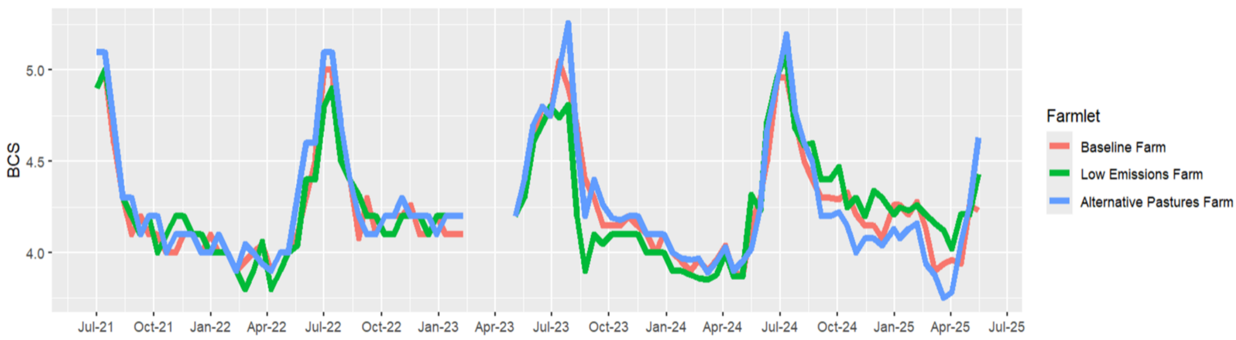
BCS background

- BCS is an estimate of a cows energy reserves and targets at key stages of lactation have been identified to optimise production
  - Pre-Christmas, February-March, pre-calving, pre-mating
- Results consistent across farming systems, cow genetics, or even country
- BCS at calving (1 less at PSM):
  - 5.0 for mature cows
  - 5.5 for two- and three-year-olds
- Targets and strategies tend to be herd-focused, but there is also a need to consider individual cow BCS (≤15% above/below target)

Cows calving at BCS 4.5 will produce less milksolids and cycle three to four days later than they would have, had they calved at BCS 5.0.

BCS @ NARF

- Pre-calving BCS targets generally achieved with the exception of the low emissions farmlet
- Generally consistent, except 24/25 season



Autumn/winter management

- Many may have milked on longer this season, consider how to reach targets in time available
- Not all feeds appear equal

Maximum intake of a dry cow is approximately 2.2-2.4% of liveweight

Max 0.1 BCS gain in last month before calving

Approximate amounts (kg DM) of 'commonly used feeds' required to be eaten for a 1.0 unit increase in BCS.

Breed	kg Lwt[1]	kg Lwt/ BCS	Autumn Pasture	Pasture Silage	Maize Silage	PKE	Kale[2]	Swedes[3]	Fodder Beet[2]
			MJ ME/kg DM						
			11.5	10.5	10.5	11	11	12	12.5
J	350	23	145	110	115	85	150	125	110
J	400	26	165	130	130	100	175	145	125
J x F	450	30	185	145	145	110	195	160	140
Fr	500	33	205	160	160	125	215	180	155
Fr	550	36	225	180	180	135	235	195	170

Maintenance and pregnancy requirements for no body condition score gain (kg/DM/cow/day) 11.0 MJ ME/kg DM autumn pasture

Breed	kg Lwt	Weeks pre-calving			
		12	8	4	2
J	350	5.0	5.7	6.8	7.7
J	400	5.5	6.3	7.6	8.5
J x F	450	6.0	6.8	8.3	9.3
Fr	500	6.5	7.4	9.0	10.1
Fr	550	7.0	8.0	9.6	10.8

Note the differences between maize silage, PKE and pasture silage are not statistically significant, which means we cannot say with full confidence that the numerical difference is real, however this is the best information available for New Zealand farmers.

Mandok et al., 2014 . Dairy Sci. 97:4639–4648 http://dx.doi.org/10.3168/jds.2013-6912

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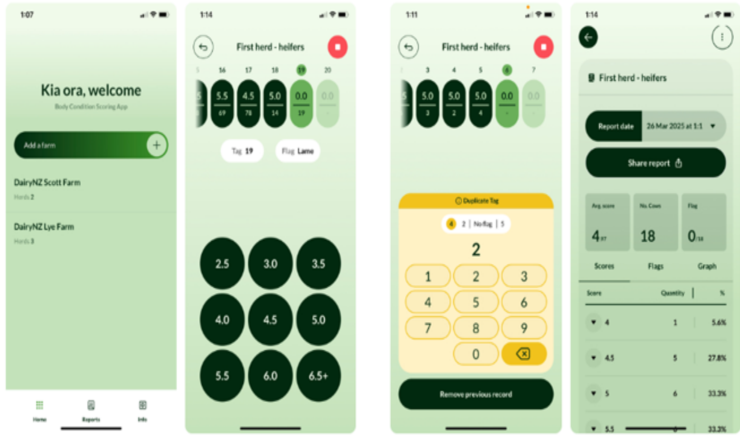
Consider

- Assessing current BCS – min of 70 cows, new app available at https://bcs.app.dairynz.co.nz/
- Preferential treatment of light animals, especially in relation to calving date (little gain in last month)
- Comparing the cost and amounts of different feeds, calculator available at www.dairynz.co.nz/tools/feeding-supplements-to-dry-cows-for-bcs-gain/



App home screen   App scoring   App duplicate tab warning   App report screen

Table to Calculate Value of Feeding Supplements to Dry Cows for Condition Score (BCS) Gain

Adapt this tool for your farm by **changing the figures in any white cell** to reflect your farms costs, utilisation and energy content of different supplementary feeds. Green and grey cells are formulated to calculate the cost per BCS gain based off what you insert into the white cells

Cow Liveweight	450	kg lwt	Kg liveweight per BCS		30	kg			
	Cost per Unit Feed	Unit of Feed	KgDM/ Unit feed	Feed Cost $/tDM	Cost to feed out incl Labour $/tDM	Utilisation Incl losses in storage	c/kgDM Eaten	ME/kg DM	Kg DM Eaten/CS	Cost per BCS gain
Nitrogen	$2.95	/kg N	8	$369	$0	90%	41	11.0	192	$79
PKE Blend Inshed	$480	/tonne	900	$533	$30	95%	59	11.0	122	$73
PKE trailers	$400	/tonne	900	$444	$50	85%	58	11.0	109	$63
Maize Silage Purchased	$0.45	/kg DM	1	$450	$70	85%	61	10.7	141	$86
Grazing	$35	/week	70	$500	$0	85%	59	11.0	192	$113
Pasture Silage N Boosted Made on Farm	$0.35	/kg DM	1	$350	$70	80%	53	10.5	141	$74
Baleage	$80	/bale	200	$400	$90	85%	58	10.7	138	$80
Baleage	$120	/bale	200	$600	$90	96%	72	10.7	138	$99

Return per BCS Gain (BCS 4.0 to 5.0)

Milksolids	12	kg MS @ milk price of	$8.50	$102	
Milksolids/BCS: BCS 3.0-4.0 = 18 kgMS; BCS 3.5-4.5 = 15 kgMS; BCS 4.0-5.0 = 12.5 kg MS					
Reproduction	(and milk production year 2)			$60	12 week mating
Gross Return from BCS Gain				$162	Will be higher if BCS less than 4.0

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More info in TechNote 30 https://www.dairynz.co.nz/media/y1vkmfko/technote-30_web.pdf

Notes