SOUTHERN DAIRY HUB

The Research at your Doorstep

Wintering Guide - 2025

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Introduction

At the Southern Dairy Hub, we have a focus on sustainable farming that protects our land and water – with a particular focus on wintering practices. We have completed and are still undertaking a range of research projects to best understand how to support wintering practices in our southern climate and soil conditions.

The winter grazing rules in the Proposed Southland Water and Land Plan provide a solid framework for sustainable practices, crucial for reducing environmental impact and boosting the resilience of dairy farming systems. By adopting these guidelines, we can keep our farms productive and eco-friendly. Southern Dairy Hub is committed to leading by example in sustainable winter grazing practices that support both the environment and the farming community.

This booklet provides an overview of several key projects and research that have taken place at the Hub in recent years.

The abstracts were presented at SDH Field Days in March 2024.

Kale vs Fodder Beet: Farm Systems Comparison (2018-22)

The Southern Dairy Hub, with researchers from DairyNZ, conducted a comparative study to assess the efficacy of kale and fodder beet for wintering, focusing on system intensity and environmental/operational impacts.

Farmlet Setup

The study involved four farmlets, each covering the same total area, comparing two crops (kale and fodder beet) and two system intensities (standard and lower impact). Lower impact systems aimed for a 30% reduction in nitrate leaching by cutting nitrogen fertiliser (from 180 to 50 kg N/ha/annum) and altering lactation supplements (barley/PKE blend vs. fodder beet). Stocking rates in lower impact systems dropped from 3.1 to 2.6 cows/ha. Each farmlet reared its own heifer replacements and followed a common set of feeding rules.

Overall System Comparison

The study highlighted the trade-offs between environmental benefits and profitability. While fodder beet reduced environmental impacts and improved Body Condition Score (BCS), it was less profitable compared to kale. Future fodder beet systems should balance environmental and BCS benefits with maintaining production and profitability, requiring careful feeding strategies and management practices.

Pasture Production

Cutting nitrogen fertiliser reduced annual pasture growth from 13.1 to 11.5 kg DM/ha. Lower impact (LI) farmlets had more clover (15.6% vs. 8.6%) but needed more area topping to maintain pasture quality. On average, fodder beet farmlets conserved more supplement per cow and mowed more area than kale farmlets.

Milk Production

Milk solids (MS) production per hectare increased annually across all farmlets, except for a drop in the 2021-22 season. Kale farmlets consistently outperformed fodder beet farmlets in MS production per cow and per hectare. Factors contributing to kale's higher performance included:

- Inshed feeding access
- Fewer metabolic issues at calving
- More cows in milk at peak
- Higher peak milk production and slower decline
- Better herd age structure allowing for more discretionary culling

Supplementary Feeding

Seasonal variations led to differences in supplementary feeding. Kale farmlets received more supplements per cow during lactation than fodder beet farmlets. During the dry 2021-22 season, fodder beet herds were given PKE in the dairy to fill the feed gap.

Reproductive Performance

Reproductive performance varied, but kale farmlets generally outperformed fodder beet farmlets with:

- Lower use of CIDRs (10.7% vs. 14% of animals)
- Higher 3-week submission rates
- Shorter calving to conception intervals

Animal Health

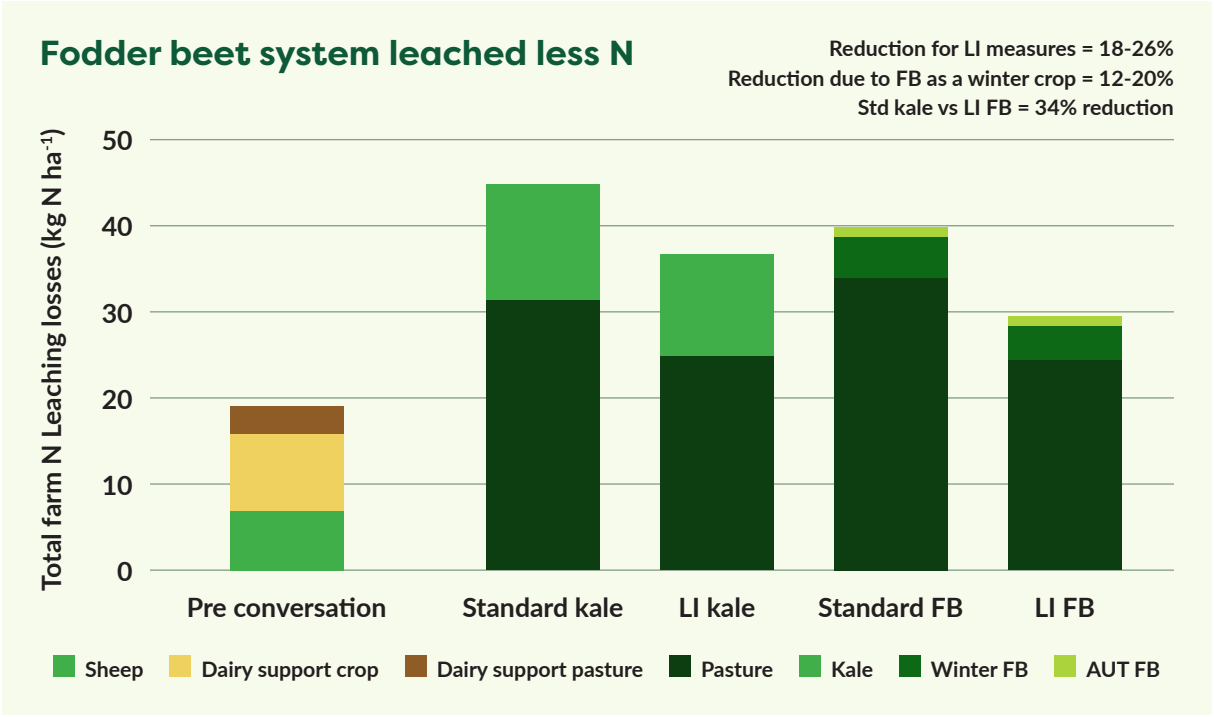
Fodder beet wintering led to more metabolic issues at calving and higher lameness rates. Despite proactive health management, fodder beet herds had higher death rates, reducing discretionary culling opportunities. Kale cows tended to calve later than predicted, while fodder beet cows calved earlier.

Body Condition Score (BCS) Management

Fodder beet systems achieved better winter BCS gains, reducing the need to dry off cows early. Effective in-season management, including OAD milking and inshed feeding, helped maintain BCS during lactation.

Environmental Impact

AgResearch measured nitrogen (N) leaching losses over three years. Results showed winter-grazed fodder beet crops leached 50% less N than winter-grazed kale. The lower impact fodder beet system leached 34% less N than the standard kale farmlet. Lower N inputs in the LI systems resulted in 18-26% lower N leaching losses.



Greenhouse Gas (GHG) Emissions

GHG emissions were calculated for each farmlet, covering enteric methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2).

Key findings

- LI systems had 20% lower methane and 35% lower long-lived gas footprints than standard systems.
- Fodder beet systems had 9% lower methane and 13% lower long-lived gas footprints than kale systems.

Financial Performance

Kale farmlets were more profitable than fodder beet farmlets, driven by:

- Higher milk solids production per cow and hectare
- Lower stock sales in fodder beet herds
- Higher animal health, supplementary feeding, cropping, and staff costs for fodder beet farmlets.

Hay Bale Grazing

Hay bale grazing is a regenerative farming practice that originated in the US, designed to improve soil health while providing winter feed for livestock. This method has been increasingly adopted by farmers, including those at Freedom Acres Dairy Farm, with promising results. Hay bale grazing offers numerous benefits but may require adjustments and careful management to maximise its effectiveness.

Observations at Freedom Acres Dairy Farm

Located on 163 hectares, with 390 crossbreed cows and 100 heifers, Freedom Acres has been practising regenerative agriculture for several years. They have now almost entirely shifted from kale to hay bale grazing for their wintering needs.

In the first season, they started with three paddocks for calving. By the second season, they wintered half their herd using bale grazing.

Soil and Pasture Benefits

Hay bale grazing has significantly improved soil health and pasture quality. The leftover bale litter enriches the soil, leading to better pasture growth and quality. The seeds from the bales germinate early, aided by the insulating effect of the litter, which helps establish new pasture and break down the litter more efficiently.

Animal Welfare Benefits

Cows on bale grazing tend to walk less and ruminate more compared to those on traditional winter crops. This behaviour reduces pasture damage and helps cows maintain body heat, making them more settled during cold conditions. The insulating effect of the bale litter also encourages cows to lie on it rather than bare ground, conserving their energy and leading to better overall health. Calving on bale litter has also decreased calf mortality rates.

Setting Up For Hay Bale Grazing

- Shut up paddocks early to achieve a pre-grazing cover of 3500-4000 kgDM/ha. Set out hay bales in a grid at approximately 30 bales per hectare, spaced 18-20 metres apart.
- Allocate ½ hectare for every 100 cows over three days, ensuring access to water and back fencing. In wet weather, move cows to the next break to prevent pasture damage, returning once conditions improve.
- Choose paddocks carefully, avoiding steep slopes and potential ponding areas. Better results can be expected for well-drained soil types. Quality hay or baleage with seeds is crucial for natural reseeding.

Pros of Bale Grazing

- Reduces nitrogen leaching
- Maintains live plants year-round
- Minimises pasture damage and soil loss risk
- Eliminates the need for cultivation and sprays
- Enhances soil functionality
- Simplifies wintering (shift every 3 days)
- Improves livestock welfare and reduces feed transitioning needs

Cons of Bale Grazing

- Requires more area than conventional crop wintering
- Challenging to make hay in some regions
- Potentially lower feed ME and protein intakes – sourcing quality hay is very important
- Requires a shift in mindset from traditional practices

Trialling Bale Grazing (without bale racks)

- Start with one paddock or a few hectares.
- Place hay bales in a grid at 30 bales per hectare.
- Use any sized mob of cows, adjusting the break sizes proportionately.

Greenhouse Gas Emissions

Reducing greenhouse gas (GHG) emissions on farm is good for business. Scientists are on a quest to identify farming methods that effectively reduce emissions while maintaining farm profitability. They're also examining the carbon footprint of milk production, exploring ways to enhance sustainability throughout the dairy supply chain. Initial findings suggest promising avenues for reducing on-farm emissions while ensuring economic viability.

Key results

By modelling different scenarios for 2030, researchers identified strategies that could lead to a 30% reduction in GHG emissions while maintaining profitable systems. Using 2030 genetics at lower stocking rates maintained milk production, reduced GHG emissions and increased profit (both by 5%). Limiting N fertiliser inputs had the biggest reduction in GHGs, but this limited profitability. Options such as replacing palm kernel expeller (PKE) with locally grown barley grain and implementing agroforestry practices showed significant potential for reducing the carbon footprint of milk.

What's next?

Moving forward, the research team plans to expand their investigations, exploring additional mitigation options and refining their models to provide more accurate predictions. Their ultimate goal is to develop practical, evidence-based solutions that promote environmental stewardship while supporting the long-term success of dairy farming.

Plantain: a Cost-Effective N-Mitigation Tool

The Sustainable Food and Fibre Futures Plantain Potency and Practice Programme is a seven-year initiative aiming to reduce nitrogen losses to water and greenhouse gases from pasture-based sectors by using plantain (Ecotain®).

Research from a farmlet trial at Lincoln University has shown that including Ecotain® plantain in pastures at 15-30% can reduce cumulative nitrate leaching by 18% over two years with no impact on milk production. Over four years at Massey University, cumulative leaching was reduced by an average of 25%, with Ecotain® plantain making up 18-47% of the pastures and 15-30% of the diet. Reductions were higher with higher levels of plantain. Evidence is growing for the effect of plantain on reducing nitrous oxide emissions. Research from AgResearch and the NZ Agricultural and Greenhouse Gas Research Centre has shown that emissions from the urine patch can be decreased by up to 60%. However, results have been inconsistent with some trials resulting in small reductions or even small increases in emissions. More data are required to quantify and upscale this effect in different soils and climates.

How Plantain Works

Plantain reduces nitrogen leaching by diluting urine patches and altering nitrogen partitioning (the proportion of nitrogen excreted as urine). Additional reductions to nitrogen leaching and nitrous oxide emissions occur due to soil processes such as slowing the rate of nitrification. These mechanisms are still under investigation.

Modelling Plantain in Overseer

Modelling (OverseerFM) indicates that for every 10% of plantain in the pasture, there is an average 6% (3-8%) reduction in nitrogen leaching. This reduction only includes the effect of plantain on urine, with any additional benefit from soil processes not accounted for. Systems with a higher proportion of feed as pasture (low supplement and crop) have the highest reduction in leaching from including plantain.

Effectiveness of Different Plantain Cultivars

Different plantain cultivars may vary in their effectiveness, with Agritonic (marketed by Agricom as Ecotain®) standing out as the only cultivar with substantial evidence supporting its effectiveness in reducing nitrate leaching. The plantain programme's trials, including those at SDH, compare nine cultivars of plantain to ryegrass, and early findings show significant differences in seasonal production and nitrate leaching reduction potential. Ongoing trials aim to evaluate additional cultivars for their effectiveness in reducing nitrogen losses.

Milk and Animal Health

Feeding cows Ecotain® plantain has little to no negative impact on milk yield, milk protein, lactose, solids, minerals or vitamins. Some level of milk fat depression has been observed at very high levels of plantain intake. There is no negative effect of Ecotain® plantain on the processability of milk into products such as skim milk, cream, cheese, yoghurt or butter. Levels of the beneficial Omega 3 fatty acid are elevated in milk from plantain pastures. Pastures with plantain have lower facial eczema spores than ryegrass pastures. Management of bloat may be required. Pastures very high in plantain and clover pose some risk of bloat.

Plantain Abundance and Management

Plantain is a short-lived perennial herb that peaks in abundance around 15 months after sowing and declines gradually over four years. Plantain can be established in mixed swards or pure swards with or without clover. Plantain can be established or maintained by broadcasting seed with fertiliser or drilling into existing pastures. Establishing plantain into existing pastures will be most successful in open pastures. In mixed swards, plantain should be managed similarly to ryegrass/clover. Keep rotation lengths less than 30 days to maximise palatability. Weed control options are limited. Control weeds prior to establishment and every three years, re-establishing plantain using broadcasting if required.

Soil Carbon

Healthy soil is the foundation of a productive farm, and soil organic carbon is a critical aspect of soil health. In our New Zealand pasture systems, based on permanent high-producing grass-clover swards, we generally have high soil organic carbon stocks. Maintaining those levels is important for maintaining healthy productive soils and avoiding additional greenhouse gas emissions from soil carbon loss.

Increasing soil carbon

Because of our already high soil carbon stocks, increasing them further is likely to be a challenge. There is some indication that diverse swards, earthworm introduction and full inversion tillage can have positive effects, but there have been too few studies in New Zealand pastures to be confident. Research has shown that management can make a difference - for example, year-on-year maize cropping in the Waikato has resulted in reduced soil carbon, while re-sowing permanent mixed species pastures has partially recovered those losses.

Measuring soil carbon

Soil carbon stocks are a product of carbon concentration (which can be measured from a regular soil test) and soil mass, also known as soil bulk density. These can vary quite a lot, both within and between paddocks, so it is important to implement a sampling regime that can separate the effect of management from the background noise. Soil carbon also changes relatively slowly in response to management, and it may take five years to detect a change amid the background variation. It is therefore important to design a sampling system that captures variation in both space and time.

Southern Dairy Hub

The soil carbon work started with confirmation of the soil types on the farm via a soil mapping exercise completed by a professional pedologist. Then we designed a sampling strategy that accounted for variation in the main soil types and paddock management. This included the high and low fertiliser nitrogen input in the systems trial, winter cropped and permanent pasture paddocks, and effluent paddocks. In all, we sampled 44 of the 104 paddocks on the main milking platform.

Key results

The biggest difference in current soil carbon stocks was due to soil type. The Waikiwi soil had the highest levels at 133.7 tC/ha (to a depth of 30 cm), with the Pukemutu having 110.7 tC/ha and the Makarewa having 96.9 tC/ha. We also found that on the Waikiwi soil the effluent paddocks had 7.0 tC/ha less than non-effluent paddocks. But without any prior measurements, we cannot say that effluent reduces soil carbon.

What's next?

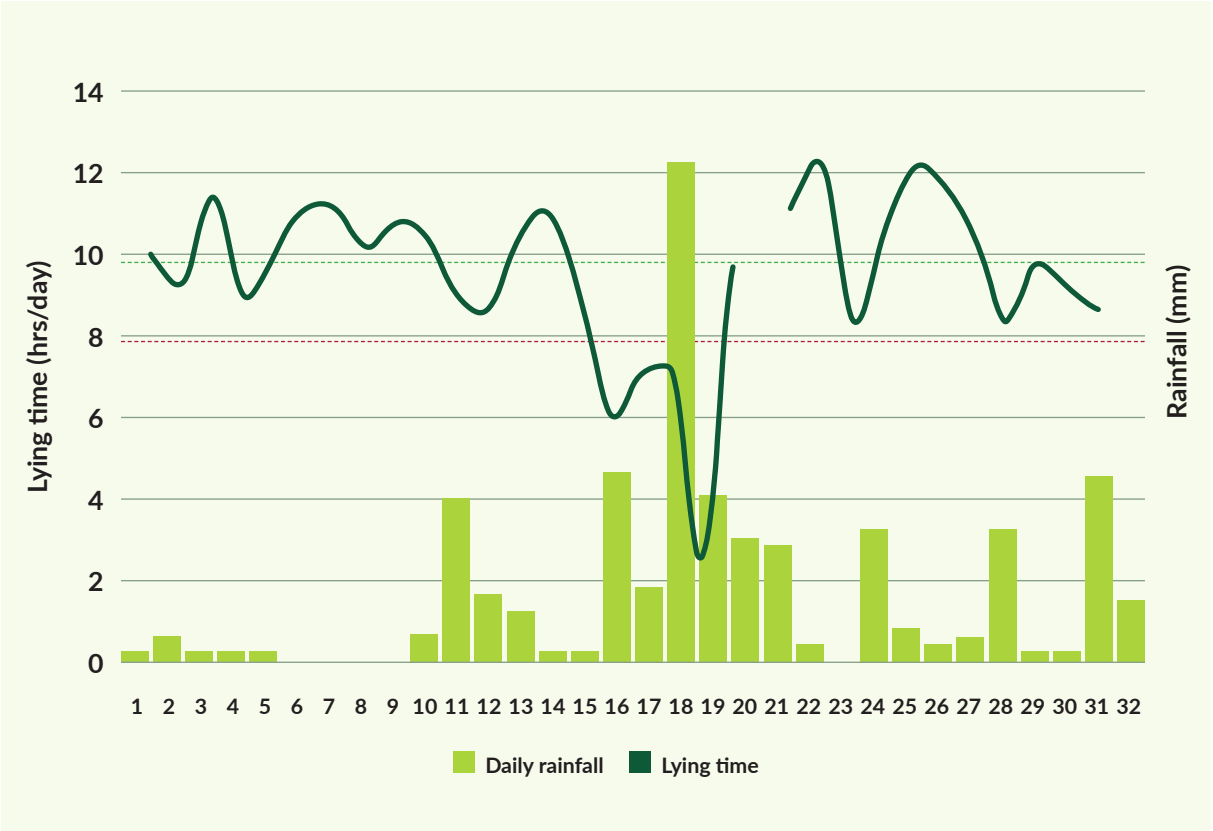
We expect to re-sample the paddocks at the end of the next farmlet systems trial phase (around 2027), to determine whether there is clear evidence of the various management practices affecting soil carbon stocks.

Lying time

Cows are selective about the surface they'll lie on. If the ground is wet, they'll stay standing but become tired and experience a drop in wellbeing as a result. Cows will compensate for shorter lying times during bad weather by increasing their lying time when the weather and ground conditions improve.

Lying time in a grazed system is dependent on weather and ground conditions. Cows require a minimum of 8-10 hours of lying time per day and prefer 10-12 hours. It's important to make sure conditions are good enough for them to lie down comfortably when they want to. This is a requirement of the Dairy Cattle code of welfare.

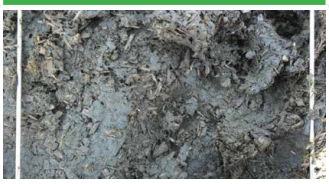
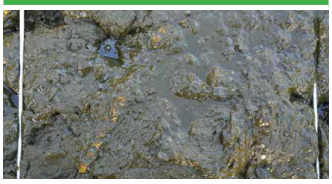
If swale, gullies and waterways are well managed and the soil type is suitable for wintering, cows will experience the majority of winter with a suitable lying area.



Source: DairyNZ Cow care in winter

As shown in a trial completed at the Southern Dairy Hub in 2020, cow lying time is negatively impacted by rainfall events. Neave et al., 2022 – Behaviour of dairy cows managed outdoors in winter: Effects of weather and paddock conditions.

The gumboot scoring method for wintering paddocks

	Gumboot Score 1	Gumboot Score 2	Gumboot Score 3
	 	 	 
Paddock Characteristic	▪ No water pooling ▪ Soil is firm ▪ Cows can lie down ▪ Boot imprint dry and sides remain formed	▪ No water pooling ▪ Soil is sticky ▪ Boot imprint wet, may be sticky and less defined ▪ Cows may lie down	▪ Water pooling ▪ Soil is liquified ▪ Boot imprint disappears ▪ Cows will not lie down
Wet and weather clearing	▪ No actions required. ▪ Feed intake and lying time will not be restricted at gumboot score 1	▪ No actions required	**Crop Paddocks:** ▪ Consider giving access to drier areas behind the backfence ▪ Feed extra crop/ supplement ▪ Spread straw for drier lying surface **Grass Paddocks:** ▪ Remove back fence or give double break size area (need to shift bales) ▪ Feed extra supplement ▪ Spread straw for drier lying surface
Wet and weather deteriorating	▪ Consider feeding extra crop/supplement	**Crop Paddocks:** ▪ Consider giving access to drier areas behind the backfence ▪ Consider feeding extra crop/supplement ▪ Consider spreading straw for drier lying surface **Grass Paddocks:** ▪ Consider giving access to drier areas behind the backfence or increase the daily area allocation ▪ Consider feeding extra supplement ▪ Consider spreading straw for drier lying surface	**All paddocks:** ▪ Cows should be given access to in-paddock breakout areas or removed from the paddock to a grass paddock or standoff area/facility ▪ Feed additional supplement

Source: DairyNZ

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