SOUTHERN DAIRY HUB

Leading Innovation for
Southern farmers' propserity

SOUTHERN DAIRY HUB

July Field Day 2021

Thanks to the team at Ravensdown for supporting us today with lunch!

ravensdown

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Contents

Visitor Health and Safety Requirements

Entry onto property by permission and appointment only.

Contact either:

General Manager Louise Cook 027 564 5595 or

Farm Manager Charlie McGregor 027 207 6012

All visitors required to sign in and out accepting farm rules

A farm map will be provided showing any general hazards on the farm; the manager will instruct you of any new hazards

General Rules

- Communication – sign in and out
- Children on farm – must be under constant adult supervision and only with express permission of manager
- Reporting – Please notify manager immediately any accidents or near miss events/hazards
- Drive to the conditions – Max speed of 30km/hr 

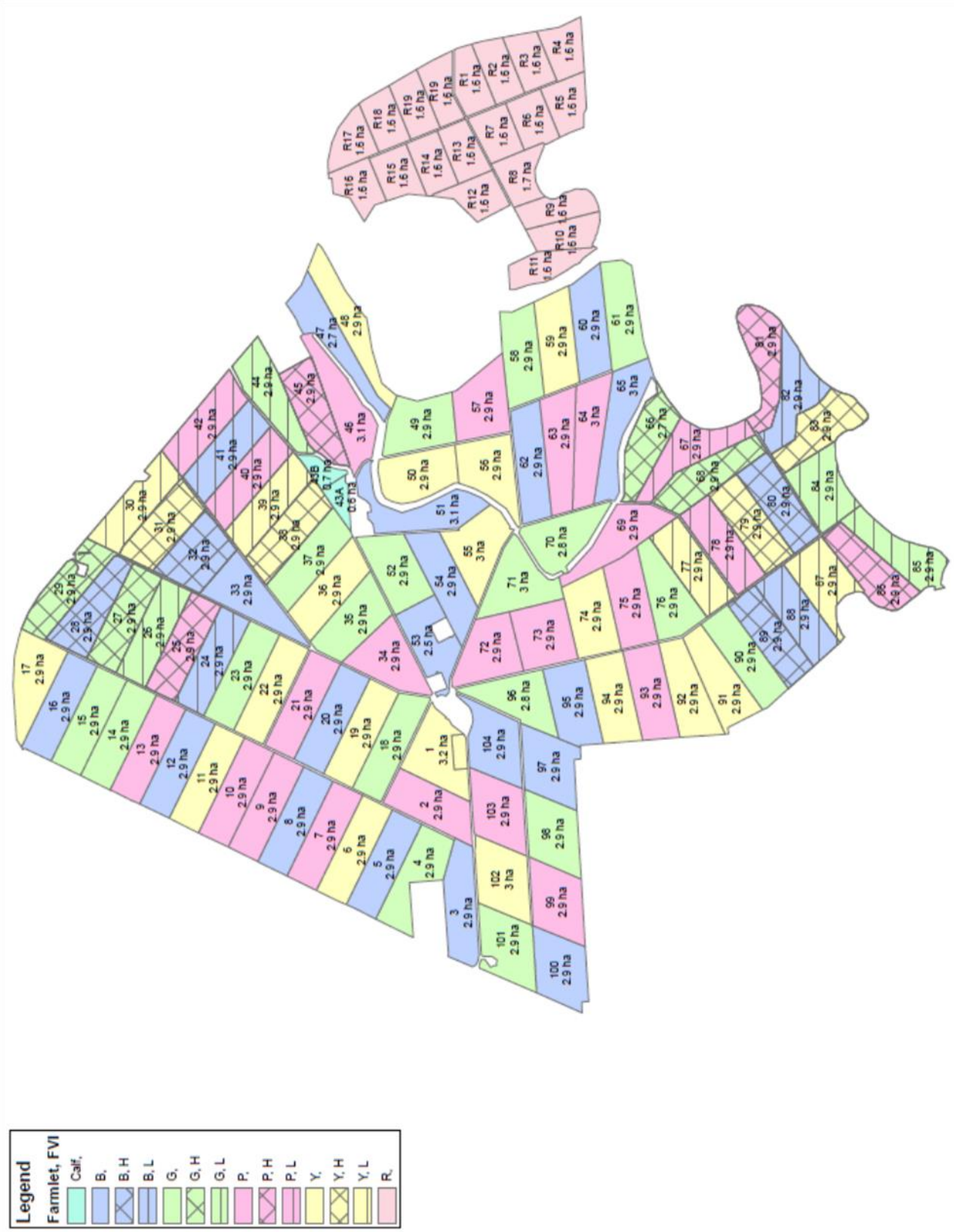
- Farm bikes – trained operators only, helmet with strap done up **at all times**, never operate if under 16 years' old
- Vehicles – no one to operate farm vehicles without manager's permission
- Water ponds/troughs – Keep a close eye on children around water sources – do not drink from farm taps, troughs, water ways
- In emergency – Please report back to farm manager at Assembly point in front of cowshed
- Fire extinguishers – found in farm houses, dairy shed, vehicles, and woolshed
- No smoking in cowshed, buildings, or vehicles
- Firearms – only with approval of farm manager, must hold current licence

Biosecurity Requirements for Southern Dairy Hub (SDH)

All visitors must comply with the Biosecurity Requirements when visiting the SDH

- All footwear must be disinfected with materials supplied, upon arrival at and departure from the SDH farm site.
- Protective footwear may be borrowed from the SDH upon request, and must be cleaned thoroughly before its return. People wearing inappropriate (or no) footwear will not be allowed onto the SDH premises.
- All visitors are expected to wear clean protective clothing, including wet weather gear if necessary when on the farm(s).
- No farm visits will be allowed, under any circumstances, from anyone within five days of their arrival in New Zealand from Central or South America, any part of Asia or any part of Africa. Further restrictions may be applied at any time, dependent upon international disease status.
- On farm, visiting vehicles must be parked in designated visitor parking areas. Approved vehicles may only access the farm after washing the undercarriage. This may be repeated prior to departure but this is up to the operator concerned.
- SDH retains the right at any time to refuse access to any person or persons deemed not to be complying with these requirements.

Farm Map



Southern Dairy Hub

SDH Purpose: Leading Innovation for Southern Farmers' prosperity

SDH Fundamental aims:

- To improve the performance and protect the viability of existing dairy farms in the southern South Island.
- To help develop and test new options for dairying in the southern South Island.
- To support the responsible and sustainable growth of dairying in the southern South Island.
- To promote the Dairy Industry Strategy.

SDH, owns the farm and buildings and other infrastructure. For simplicity, a second entity (SDRF): The Southern Demonstration & Research Farm leases these assets and carries out the activities of running a commercial size and scale farm, with all commercial expectations whilst delivering farm systems research information for the Research funders.

SDRF is operating a research farm at the hub, and within that there are strict controls on what can and can't be done within each of the four farmlets we are implementing. Demonstration is by way of comparison between research farmlets. In 2017 farmers told us that having systems with reduced nutrient loss was important for the region. SDRF is currently exploring what happens when you change just the Nitrogen Strategy from 200kg/ha to 50kg/ha of Nitrogen per annum to a paddock, alongside comparing the interaction with either Kale or Fodderbeet as a winter crop.

Research farms are a place where industry can take some risk on behalf of farmers and sometimes, as is currently happening at the Hub, we push the boundaries too far. Being a research farm, we can't always address these negative impacts without compromising the research. So, we follow the process through and record all the farm systems impacts including profit, animal performance and environment.

We are pushing the boundaries, so farmers don't have to. This means farmers can use our research as a springboard and can focus on the refinements required to re-stabilise a system.

***SDH Vision**: to be an internationally recognised, innovative and leading centre of excellence for dairy farming, comparative research, and extension*

In 2016 when the lease on the Southern Demonstration Farm ended, Southern farmers and Businesses committed an additional 1.2 million dollars towards establishing a dedicated Southern Dairy Hub (SDH) to facilitate dairying research and extension in the region.

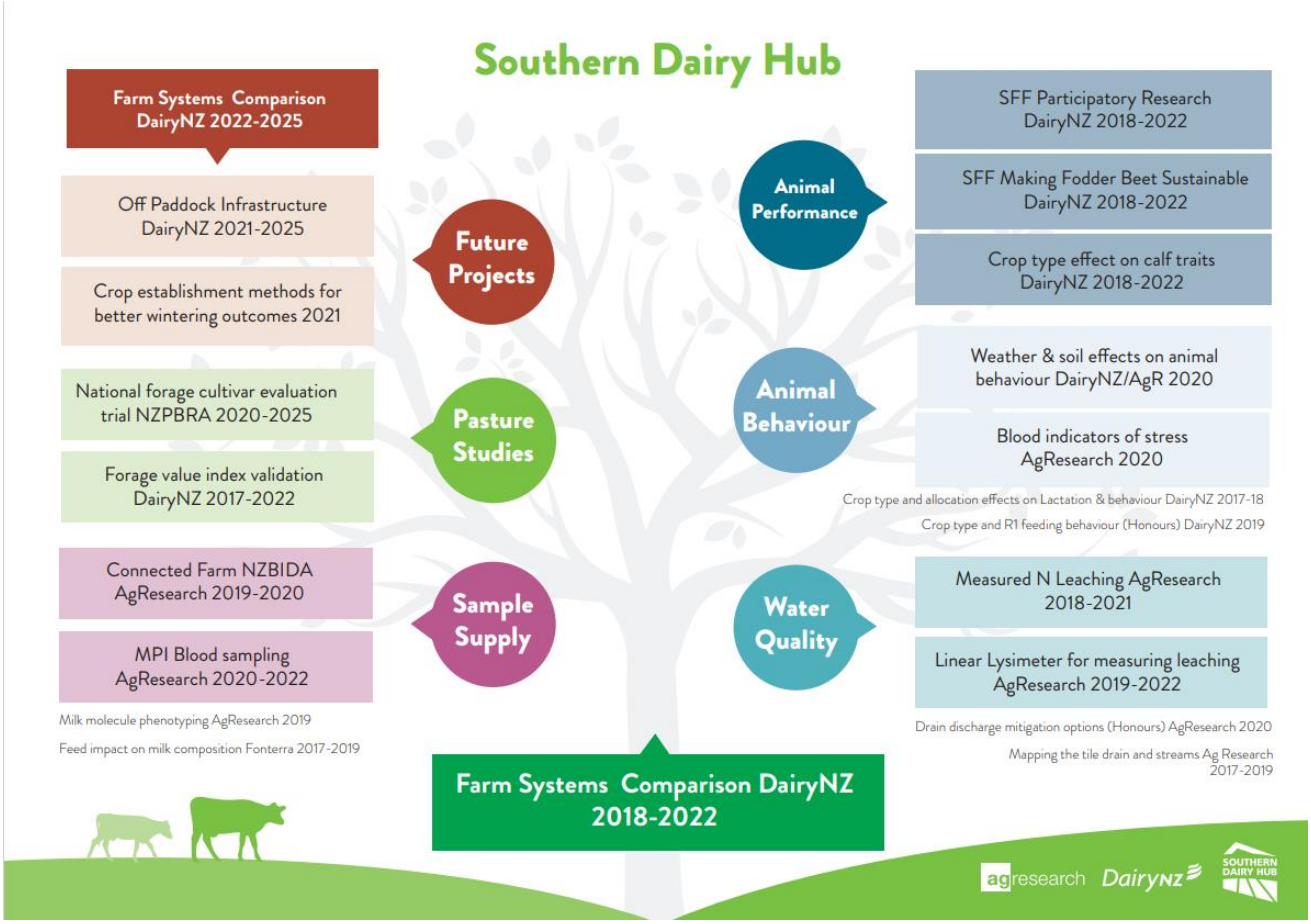
With investment from DairyNZ and AgResearch, the 349ha drystock property at Wallacetown was purchased and converted into what is probably the largest pastoral Agricultural Research facility on the planet. The Southern Dairy Hub is owned by the dairy industry and is here for the good of the dairy industry, particularly for Southern Farmers.

Current Research Activities at SDH

The farm systems comparison funded by DairyNZ forms the base research platform at the Southern Dairy Hub.

Other research projects led and funded by a number of organisations are using this platform to address key research questions relating to the systems that are being implemented or the issues currently facing dairy farmers in Southern regions.

The current suite of research projects is summarised in the diagram below.



Current Farm Systems Research Comparison

Objective:

1. To test the opportunity for crop choice and nitrogen management to reduce the N footprint 30% and improve profit compared to existing practices.
2. To engage farmers in experimenting on their own farms and building confidence to adapt their management

Figure 1*:* Pictorial representation of the current farm systems comparison at SDH

SDH Farm System profit comparison

Table 1: Key physical and financial data till 31 May 2021 for each farmlet

Data to 31 May 2021	Pink Std Kale	Blue LI Kale	Green Std FB	Yellow LI FB
Cows milked peak	197	165	195	163
Farmlet eff grass Ha	62.4	63.5	63.6	63.9
kgMS	82,742	68,580	80,772	66,967
kgMS/ha	1,326	1,080	1,270	1,048
kgMS/cow	420	415	412	402
Pasture accumulation (T DM/ha)	13.4	11.7	14.2	11.9
N fertiliser on pasture (kg/ha)	184	53	182	53
Effluent N (kg/ha)	17	16	16	15
Barley Blend (kg/cow)	572	333	74	54
PKE (kg/cow)	10	14	55	50
Baleage (kg/cow)	131	127	127	148
Fodder beet (kg/cow)	0	0	180	115
TOTAL Supplement	*713*	*474*	*435*	*367*
Net proft $/ha	$3,838	$3,271	$3,370	$3,009
Total Revenue $/ha	$10,525	$8,616	$10,098	$8,359
Total Expenses $/ha	$6,687	$5,346	$6,728	$5,350
Total Expenses $/kgMS	$5.11	$4.98	$5.27	$5.08

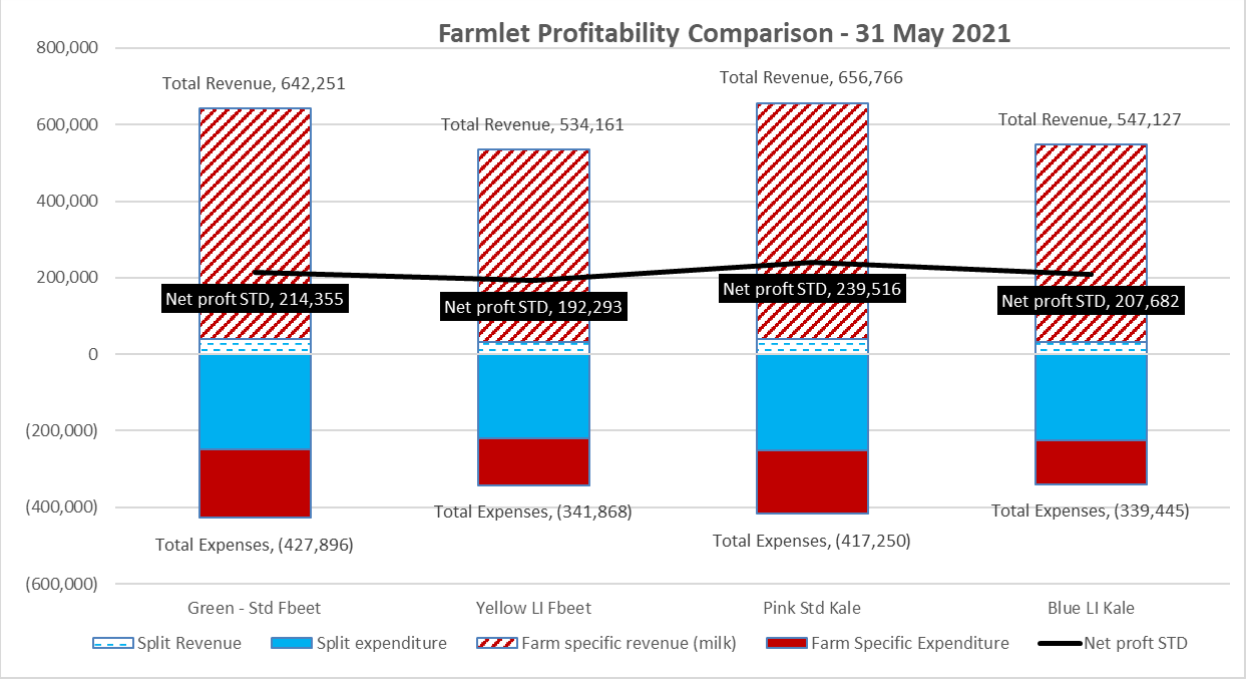
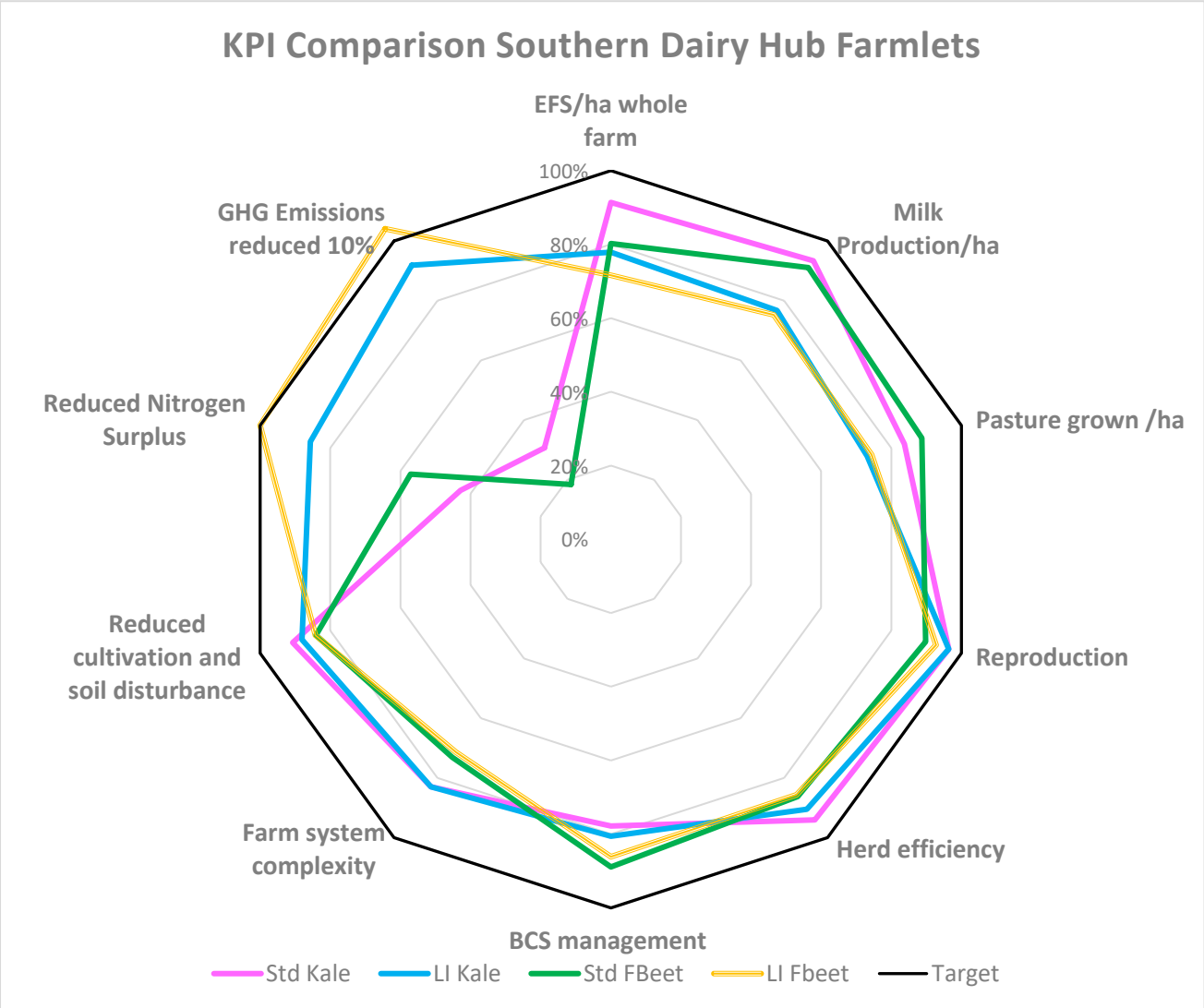


Figure 2*:* 2020-21 Season financial summary

Farmlet Farm System performance comparison

The wagon wheel chart below allows us to compare the farm systems in each of the farmlets. In this format, we can view each farmlet's score out of 100% in multiple areas at once.

- The closer to the outside of the graph, the better a farmlet did in each area.
- We can see some farmlets exceed in some areas but are less successful in other areas.
- Where the farmet score is outside the graph, we overshot the and exceeded the target.



SDH 2020-21 Season Summary

Feed supply and growth rates

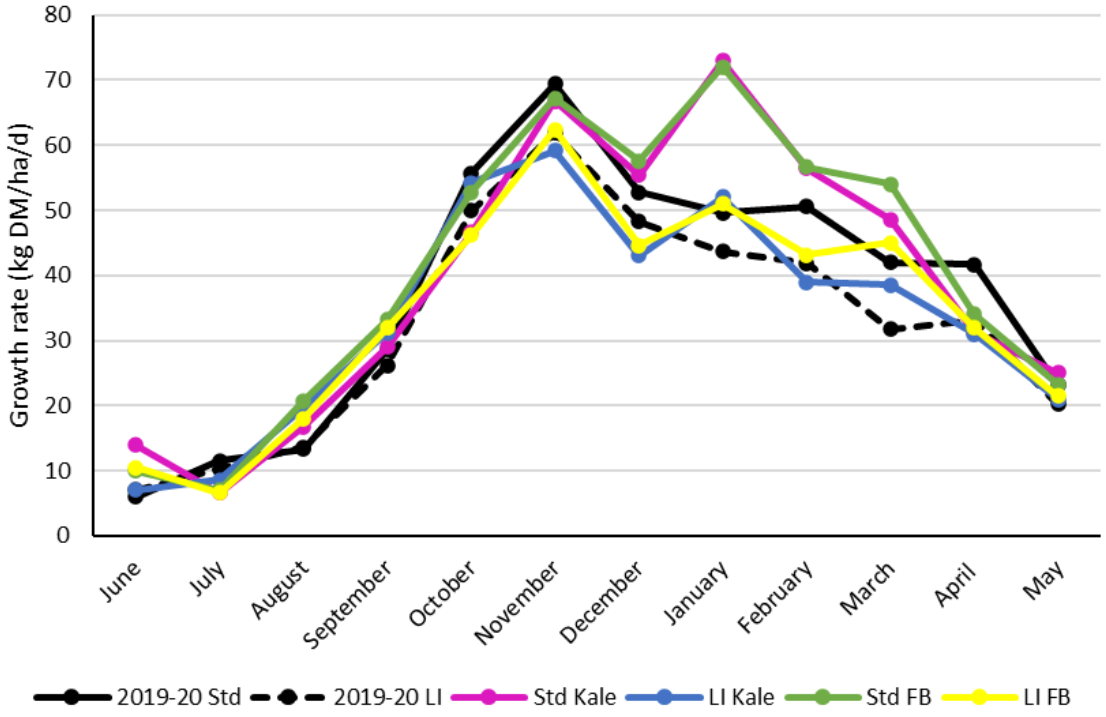


Figure 4: Average monthly growth rates compared with average Standard and LI growth rates from the 2020-21 season

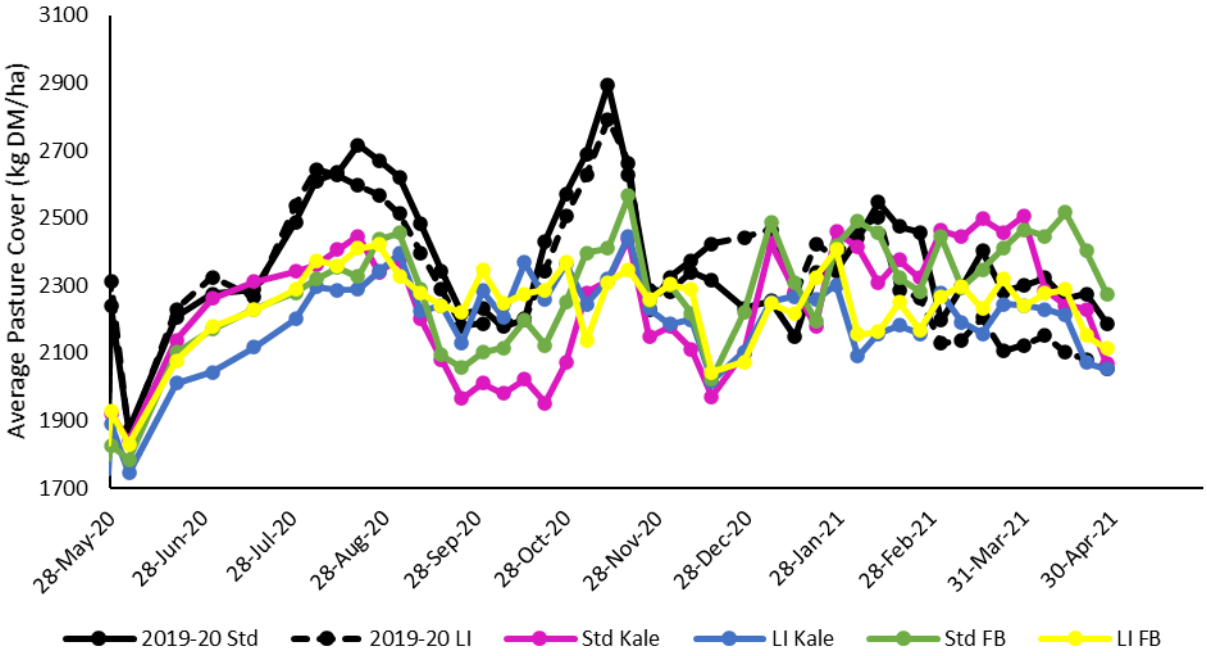


Figure 5: Average pasture cover (kg DM/ha) compared with average Standard and LI growth rates from the 2020-2021 season

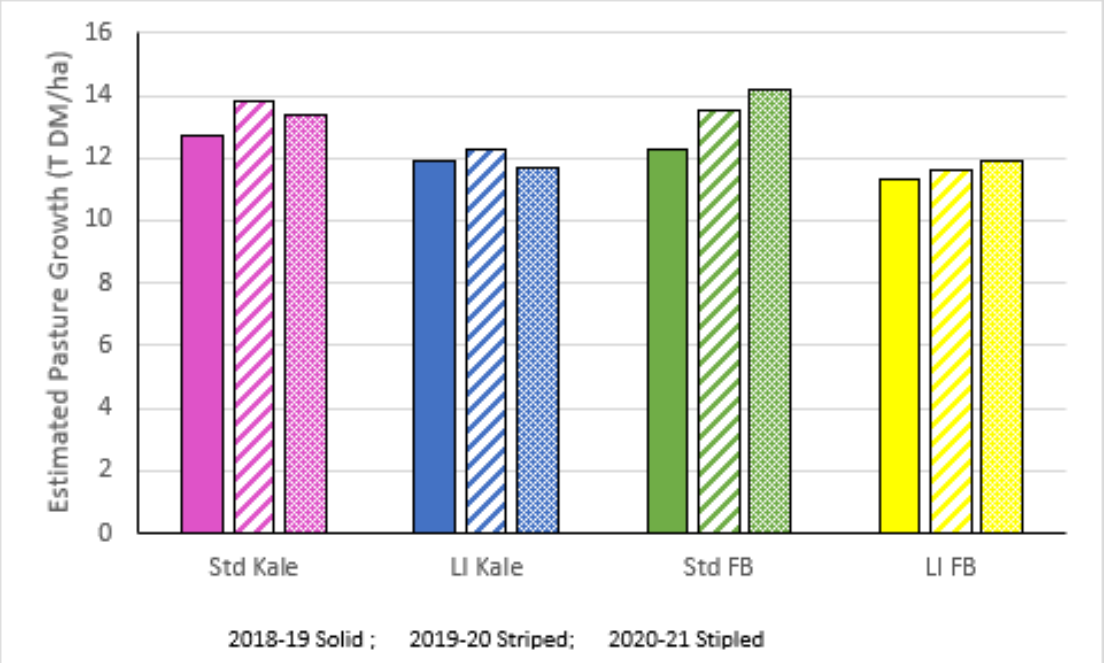


Figure 6: Average seasonal pasture growth (T DM/ha) for the 2018-19; 2019-20 and 2020-21 seasons (NB: all data is still undergoing quality control so 2020-21 results are preliminary.

While the 2020-21 season saw better pasture growth through the summer period this did not result in more total DM production for all farmlets for the season (Figure 3).
Drying off at a lower APC in autumn 2020 and more 'normal' winter growth rates meant we started the 2020-21 season with a lower APC which meant pasture quality and APC was maintained better into the second round for all farmlets (Figure 4).
Average pasture cover was maintained in a more consistent range this season through more timely removal of surpluses. Seasonal pasture growth has increased year on year for the fodder beet systems but there has been more variability between years for the kale systems (Figure 5).

Reproduction

We've compared the herds using the fertility focus reports (LI Kale example below) and collated the data into comparative graphs for easy reference.

This year has seen a clear split in FB vs Kale herds in 6-week in-calf rates, though the overall in-calf rate has closed up with some very active bulls in the last 4 weeks of mating.

Table 2: Reproductive parameters for each of the farmlets for the 2020-21 season

	Pink STD Kale	Blue LI Kale	Green STD FBeet	Yellow LI FBeet	Farm Average	Farm Numbers
Herd size	**197**	**162**	**196**	**164**	**719**	**719**
% herd submitted to AB	99.5%	98.8%	98.5%	99.4%	98.7%	
% CIDR	7%	7%	10%	9%	8.5%	61
% 3wk Sub rate	92%	91%	85%	93%	90.3%	
% 6 wk IC rate final	74%	74%	68%	70%	71.5%	
Not in-calf rate	7.0%	7.0%	11.0%	9.0%	8.5%	62

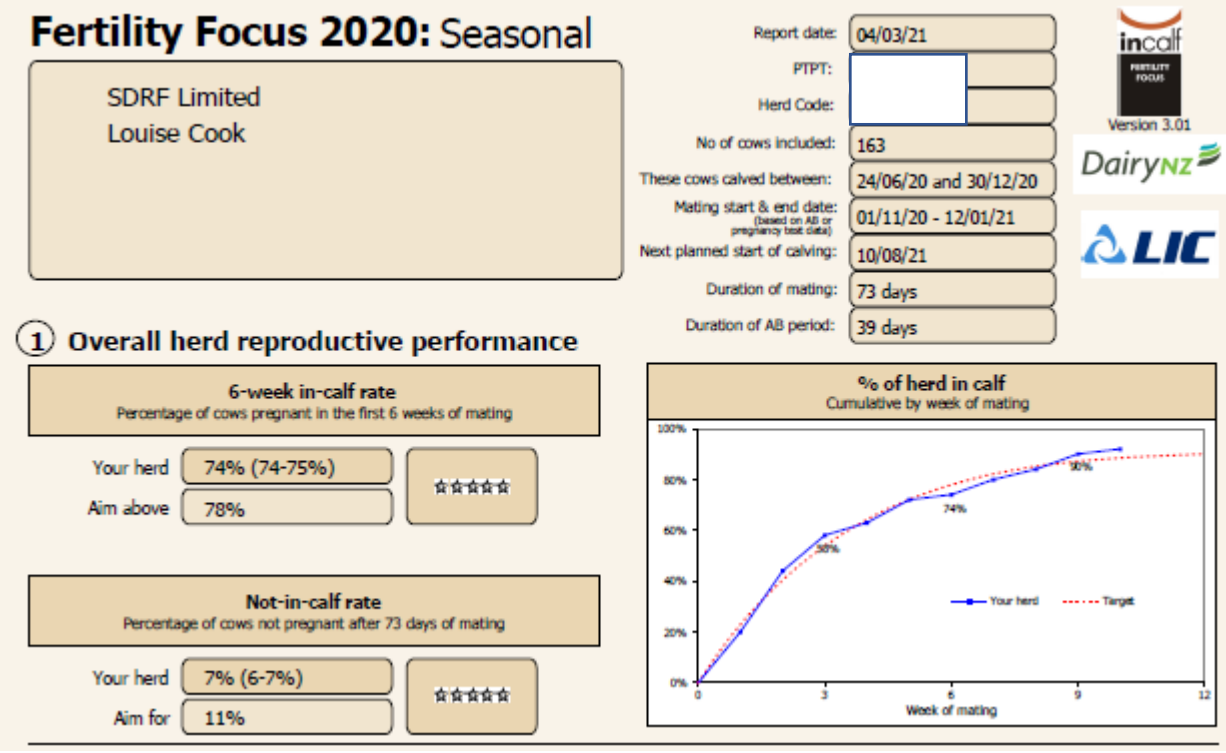


Figure 7: Fertility focus report for the LI Kale herds for the 2020-21 season

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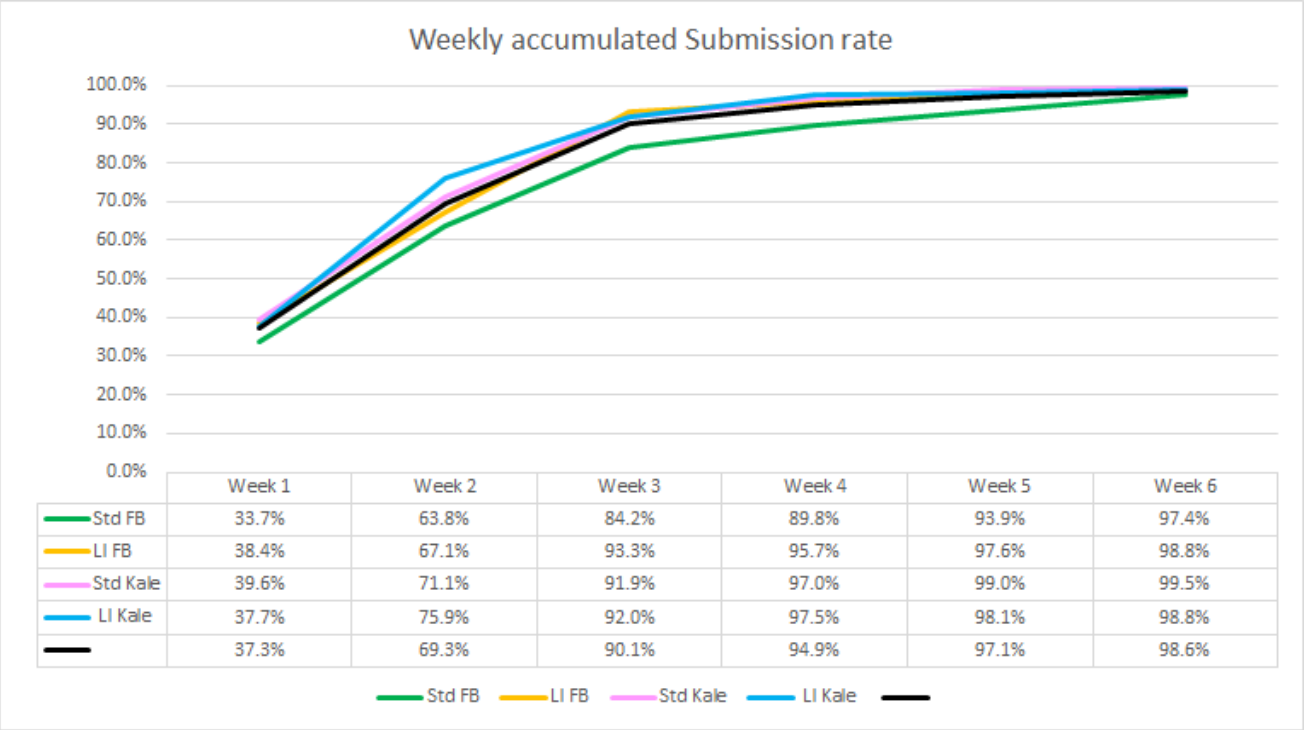

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Std FB	33.7%	63.8%	84.2%	89.8%	93.9%	97.4%
LI FB	38.4%	67.1%	93.3%	95.7%	97.6%	98.8%
Std Kale	39.6%	71.1%	91.9%	97.0%	99.0%	99.5%
LI Kale	37.7%	75.9%	92.0%	97.5%	98.1%	98.8%
	37.3%	69.3%	90.1%	94.9%	97.1%	98.6%

Figure 8: Weekly accumulated submission rates for the farmlet herds for the 2020-21 season

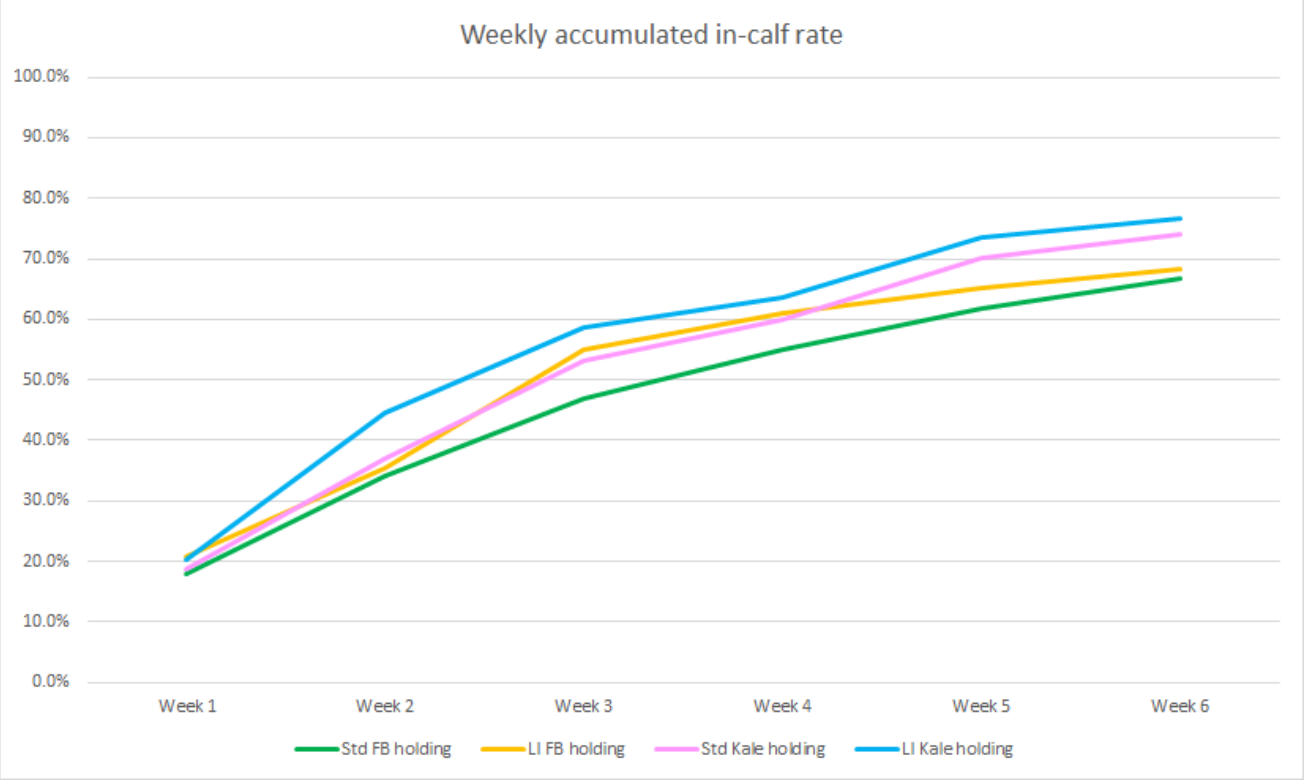

Figure 9: Weekly accumulated in-calf rate for the farmlet herds for the 2020-21 season

Animal Health

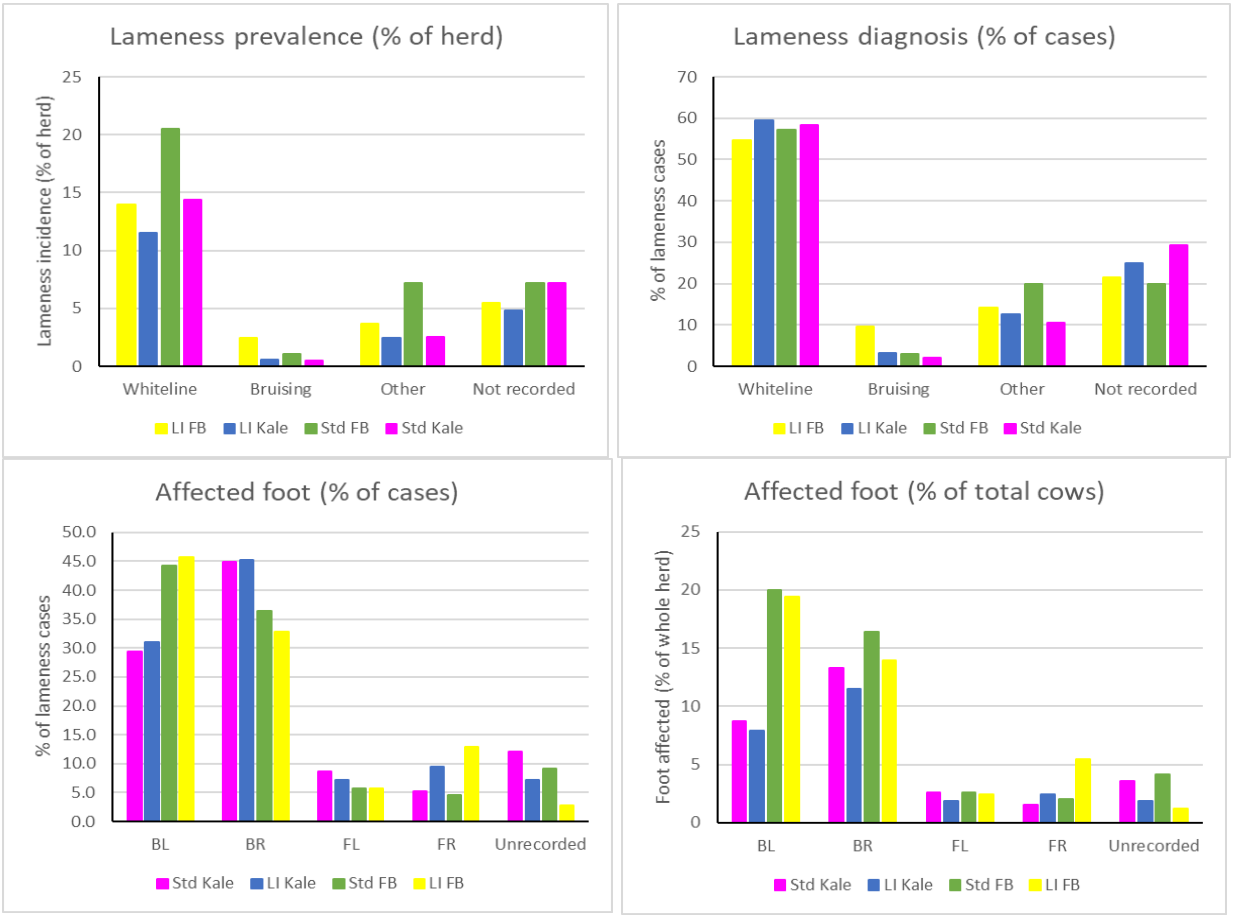

Figure 10: Lameness incidence, prevalence and affected foot summaries for the farmlets

Significantly more cases of lameness were recorded in the fodder beet farmlets and cows were more likely to go lame in the back feet, however the back left foot was more problematic with the fodder beet herds. Whiteline was the predominant cause of lameness in all herds.

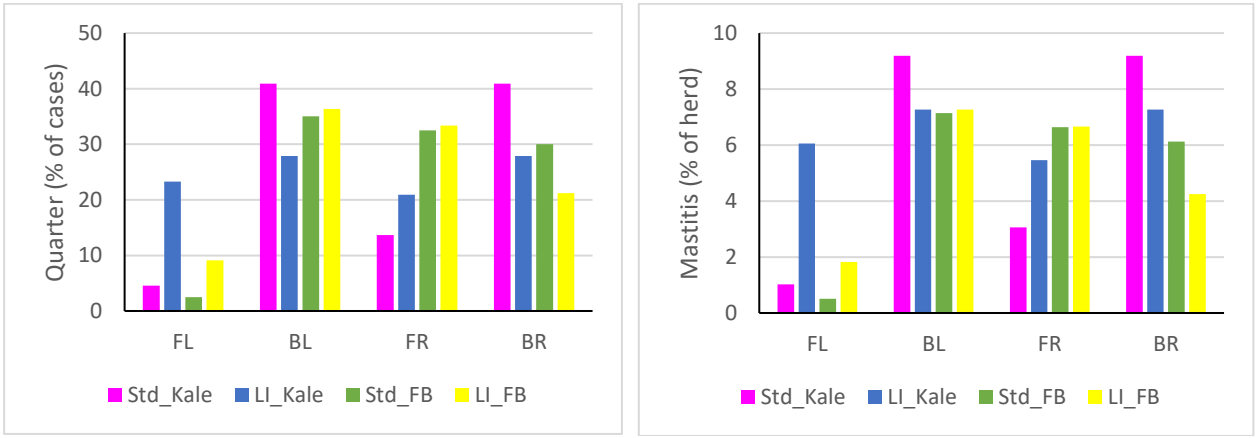

Figure 11: Mastitis incidence and affected quarter summaries for the farmlets

Mastitis prevalence ranged between 20 and 26% of the herds. With the exception of the LI Kale herd, the front left quarter had the lowest prevalence of mastitis.

Milk production

On average we were 16,176kg MS ahead of last season and totalled 298,360kg MS for the season; just shy of 300,000kg MS. You can see the seasonal year on year comparisons below and how we have managed to keep on increasing our overall milk solid production year on year.

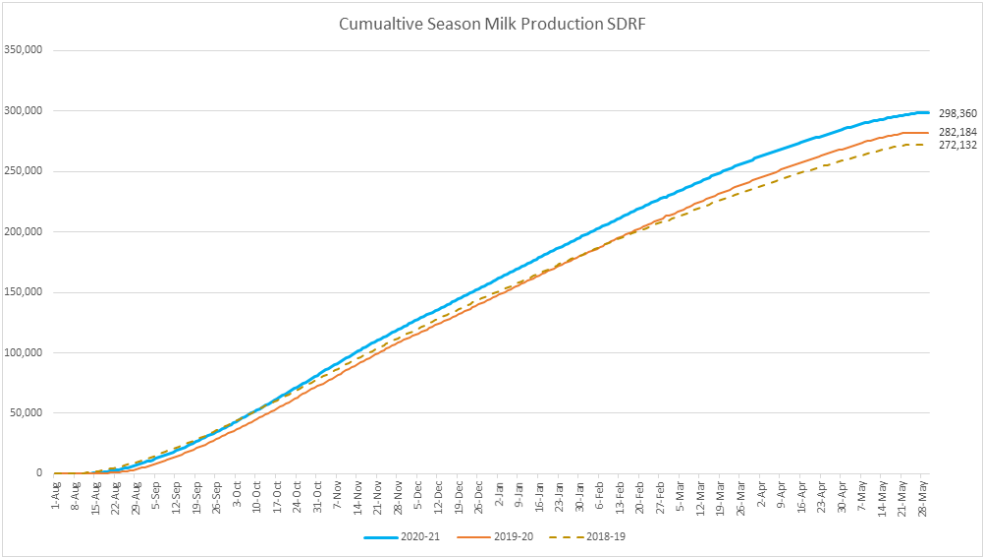

Figure 12: Cumulative milk solids production for each herd in 2020-21

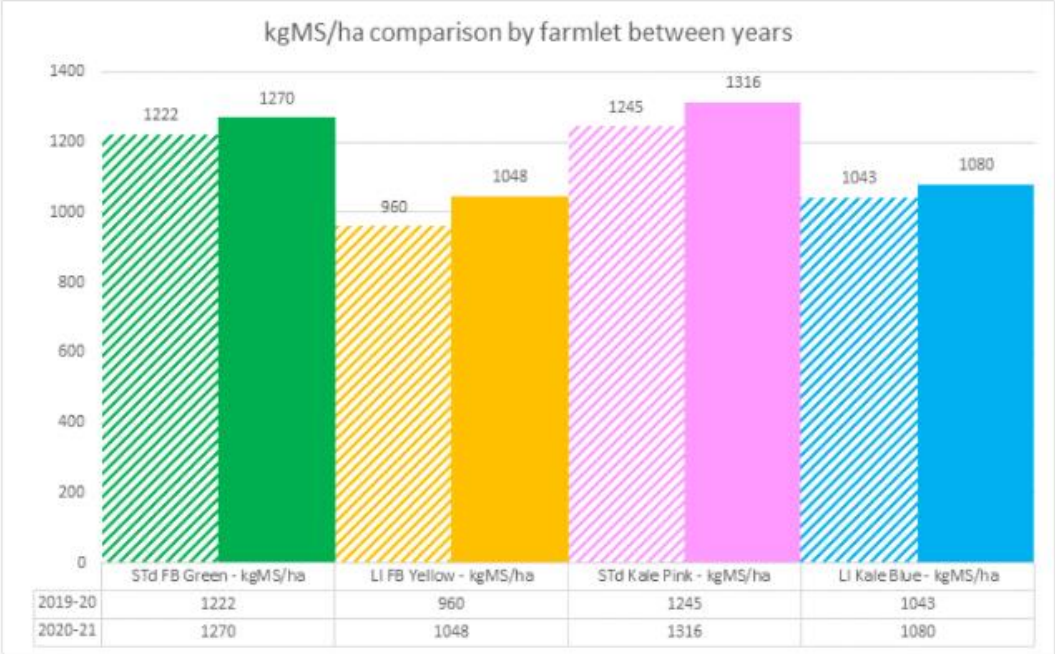

Figure 13: kg MS/ha comparison by farmlet between years

For the season kale cows peaked higher and had higher production through the summer than the fodder beet cows. The LI kale herd had the most consistent and highest kg MS/cow production for most of the season. Feed management in late November/December needs assessing as all herds dropped approx. 0.3 kg MS/cow between 11 November and 11 December.

Identifying farmer friendly visuals linking soil conditions to animal behaviour

Desired outcome
A suite of farmer friendly visuals linked to lying behaviour and soil conditions in kale and fodder beet crop paddocks.

Project objective
To determine how soil and weather conditions contribute to the risk of reduced lying time in dairy cows wintered on crop

Key soil measurements
Each day Gumboot scores (Figure 12) were measured at 26 sites across the break area. Pugging depth was also measured at each site by recording how far a 30 cm plastic ruler could be pushed into the soil before it met resistance. Photos of the breaks were taken every day from the same positions in the break. If there was any visible liquid (water or urine) pooling in the close vicinity of the sampling site (within half gumboot length), this was scored as 'Yes' for surface water pooling present. An example of surface water pooling is shown in Figure 13.

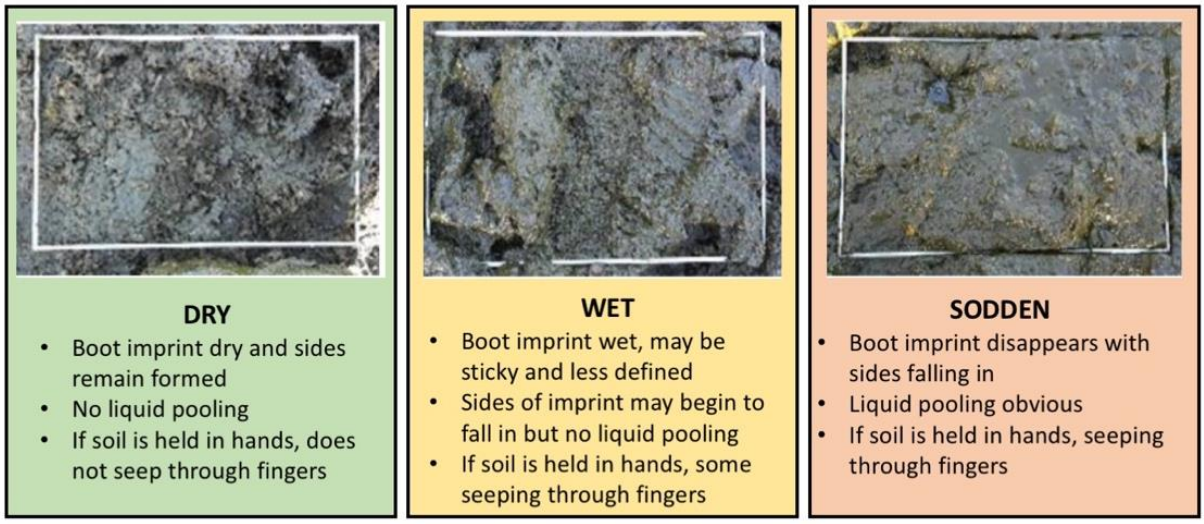

Figure 14: Gumboot score categories (from O'Connor 2016).

Figure 15: examples of surface water pooling present at a sampling site

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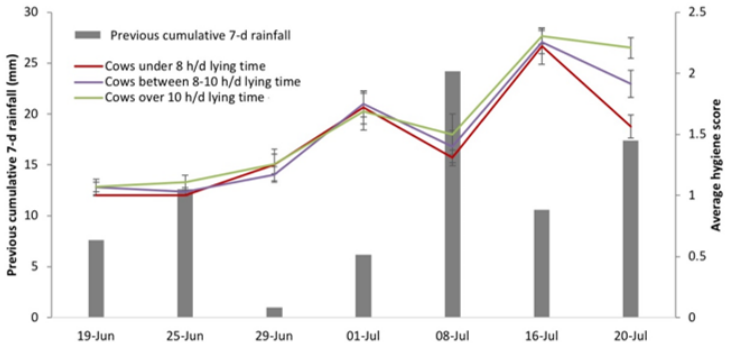
Cows lying for longer had higher dirt scores

Manure or mud in either of the focal areas is less than 25 cm in diameter

Manure or mud is >25 cm in diameter in 1 of the focal areas

Manure or mud >25 cm in both the focal areas



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A ruler, gumboot score and presence of water pooling are good measures to estimate true mud depth and paddock wetness

DRY
- Boot imprint dry and sides remain formed
- No liquid pooling
- If soil is held in hands, does not seep through fingers

WET
- Boot imprint wet, may be sticky and less defined
- Sides of imprint may begin to fall in but no liquid pooling
- If soil is held in hands, some seeping through fingers

SODDEN
- Boot imprint disappears with sides falling in
- Liquid pooling obvious
- If soil is held in hands, seeping through fingers

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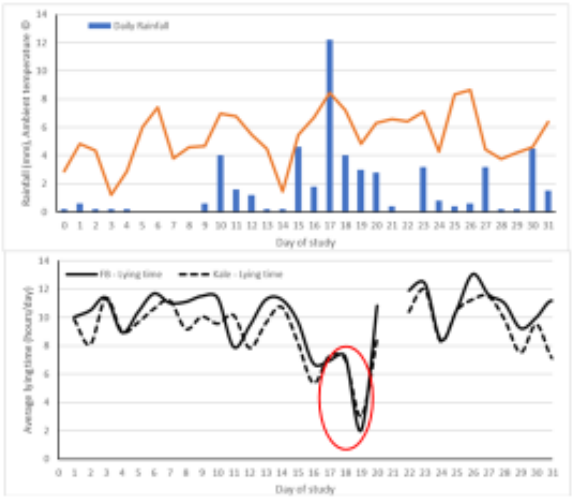
Lying time decreased on the day of rain & the day after but rebounded two days later



- On rainy days cows had fewer, shorter lying bouts
- 2 days after rain lying bout duration was longer

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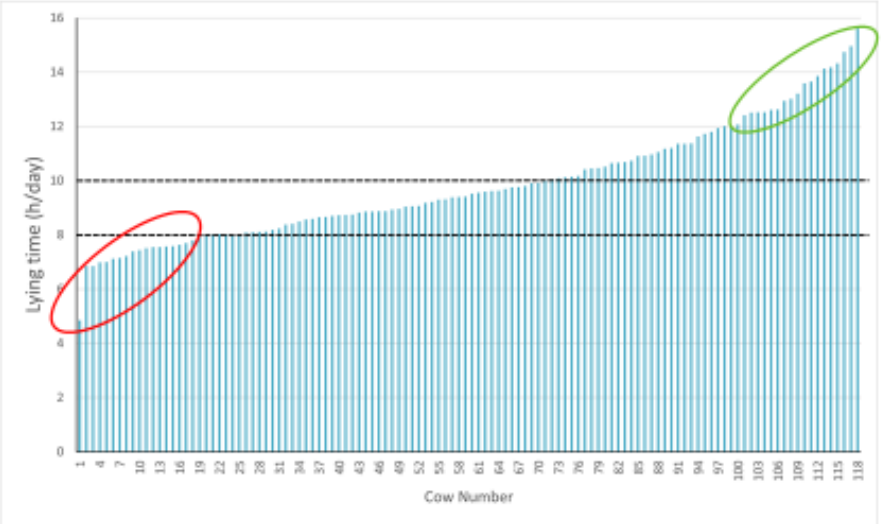
Not all cows achieved the minimum recommendation of 8 h/day lying



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Younger earlier calving cows were in the 'at risk' group

	Days pre-calving	Age	BCS
Less than 8 hrs lying	47	3.8	4.9
8-10 hrs lying	59	4.8	4.9
10-12 hrs lying	54	5.8	4.9
Greater than 12 hrs lying	58	7.1	5.0

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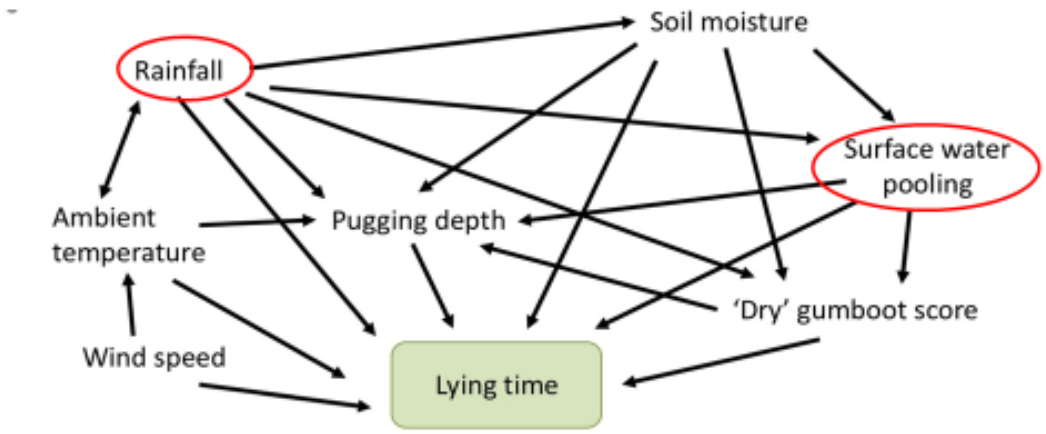
Many interacting factors affect lying but surface pooling appears most useful and this is closely linked to rainfall



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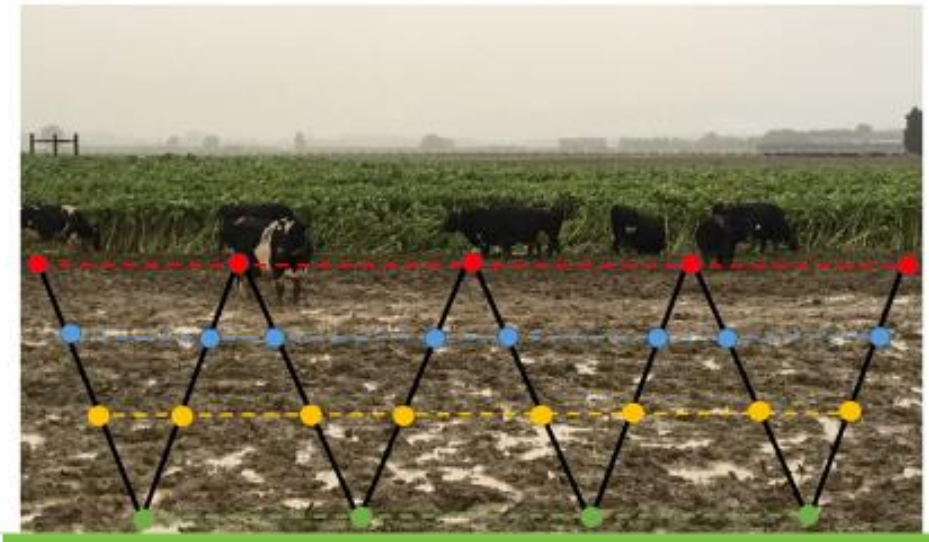
Area closest to the feed face was driest: set paddocks up to protect this area from pugging during weather events



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Indicators for implementing "Plan B"

- Amount and number of consecutive days of rain - > 2 days cows will be getting tired
- Proportion of the paddock with water pooling
  - >17% of available area ⟹ herd average lying less than 10 hrs/day
  - >80% of available area ⟹ herd average lying less than 8 hrs/day

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Conclusions:

- Cow lying needs were met on most days, with herd averages above 8 h/day
- Mob structure and daily management will be key to ensure every animal is fit for winter
- Public perception and environmental risk are still strong drivers regardless of the animal's needs being met
- An uncomfortable lying surface is consistent with a "sodden" gumboot score and significant water pooling
- We cannot control the weather so a risk-based approach to wintering is required. We now have practical indicators for implementing contingency plans
- Executing a contingency plan multiple times during winter is not a sustainable future, requiring investigation into alternative options e.g. cost effective infrastructure

agresearch ata mātai, mātai whetū

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Hedgehope/Makarewa Catchment Group: Investigating alternative crop establishment methods for better winter outcomes

Farmer Commitment
The initial concept for the project resulted from an experiment conducted at SDH in winter 2020 investigating grazing behaviour and soil surface conditions with the aim of developing farmer friendly visuals to identify paddock conditions that resulted in compromised animal welfare and to try and understand the implications of the Essential Freshwater pugging regulations on winter cropping in Southland. During discussions at a SDH farmer reference group meeting the idea of investigating alternative crop establishment options at SDH was proposed.

The Hedgehope Makarewa Catchment Group were very keen to work with the SDH and extend this pilot study onto commercial farms as it meets their goal of using observation to understand their catchment and develop practical solutions. It also provides tools and skills to help their community (one of their key communication objectives), as well as meeting other goals of collaborating with stakeholders, and helping to raise awareness and understanding of new regulations and opportunities.

Objectives of the pilot project
To observe whether utilising alternative crop establishment methods to conventional cultivation (e.g. direct drilling, strip tillage, air seeding, precision drilling etc), for fodder beet, swedes and kale, improves soil structure and strength, thereby reducing pugging and improving animal welfare during winter grazing.

Project description
Workstream 1 is being conducted on 10 commercial farms across Southland.

Workstream 2 is being conducted at the Southern Dairy Hub (SDH). A fodder beet was split in half and one third of each half of the paddock has been established using strip tillage, direct drilling or conventional cultivation. For the kale, half the paddock has been established using direct drilling, and the other half using conventional cultivation.

The following information is being collected for each farm and treatment across the study.

- Crop yields prior to the commencement of grazing in each treatment area and once during grazing
- Crop utilisation from each establishment method during the grazing period
- Crop quality once during the grazing period
- Pugging depth of each treatment during grazing – daily (SDH)
- Soil physical properties pre-grazing, post-grazing and when back in pasture/next crop if applicable
    - Bulk density
    - Penotrometer (compaction)
    - Infiltration rate
- Soil conditions during grazing
    - Gumboot score
    - Pugging depth
- Lying observations – area of the paddock/treatment cows are lying on first thing in the morning
- Climate conditions – rainfall and soil temperature
- Economics - costs, returns and gross margins for each establishment method

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What are our observations from the trial so far?

- We are well into the measurements on the two crop establishment paddocks at SDH and the commercial farms across Southland. Although there are no official results to report yet, there have been a couple of observations from the fodder beet paddock at SDH:
    - More bulb remaining in the strip till and direct drilled areas of the paddock. It appears these bulbs have broken off when the cows were grazing them rather than them being pulled out of the ground. Cows are trying to eat down through these as evidenced by the photo below.

Figure 16: Remnant of crop bulb in fodder beet paddock

    - Soil in the conventionally cultivated area appeared stickier on the bottom of gum boots when walking across the area on Friday last week.

Figure 17: Cows lying across the fodder beet demonstration paddock

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Based on the residual crop observations, residual measurements have been completed on each treatment in the kale and fodder beet paddocks a few weeks ago. Figure 18 below shows what was remaining after harvest and washing from each of the 1 m2 quadrats

Figure 18: Residual crop from 1m2 quadrats in our crop establishment demonstration areas

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SDH Future Farm Systems Discussion

The current 2x2 factorial farm systems comparison investigating wintering, fodder beet and nutrient loss reduction is due for completion on 31st May 2022. To prepare for a new comparison commencing on 1 June 2022 there are some fundamental questions that need to be answered.

1. What have we learnt from the current comparison?
2. What are the emerging sector issues that require farm systems experimentation to address?
3. What is the best scientific approach i.e. 2x2 factorial, optimized systems addressing a common research question, other?

What have we have observed from the current comparison (no statistics yet)

1. Fodder beet-based wintering systems have lower leaching losses than kale based systems
2. Leaching losses from autumn grazed or lifted fodder beet are greater than winter grazed fodder beet
3. Reducing N fertilizer from 190kg N/ha to 50 kg N/ha increased clover content from approx. 8% to 18%
4. It is easier to put BCS on cows on fodder beet over winter, allowing more days in milk because BCS does not trigger early drying off
5. Fodder beet maintains its quality better and can be stored for later use
6. More cows calved on the crop paddock when grazing fodder beet compared to kale despite using the same springer draft rules.
7. Meeting crude protein requirements of animals grazing fodder beet in winter is difficult, especially R1's
8. The nutritional risks (acidosis, mineral deficiencies) are higher on fodder beet wintering and cow losses can be high if the team is inexperienced and there is lack of attention to detail
9. Fodder beet herds had lower peak milk production
10. In years 2 & 3 years fodder beet herds had lower 6 wk incalf rate and higher not in calf rate
11. Not having access to inshed feeding with the fodder beet herds created challenges with feed management during mid season when fodder beet was not available, especially for the management of low BCS cows
12. Achieving desired residuals with the LI FB herd was a challenge; these animals appeared to have a lower hunger drive reducing grazing intensity but they were content
13. Increased milksolids per cow has not been achieved in the lower impact herds
14. Estimated profitability has been highest in the Std kale and lowest in the LI FB systems

What are the emerging sector issues

Farmers at the March field day completed a survey to help identify the major sector issues and potential research themes for consideration. They were asked to list current/pending sector issues they were not confident the sector had answers for and to select from 14 options the top 3 themes for a potential systems comparison (Appendix 1). The current/pending sector issues where then summarized into themes (Figure 19).

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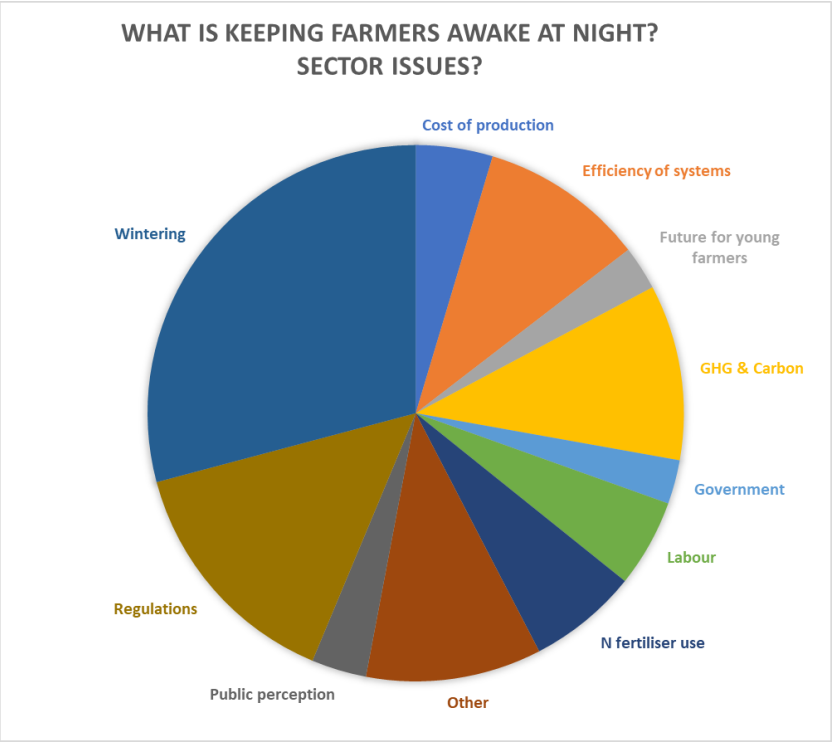

Figure 19: Sector issue themes identified at the SDH field day in March (151 responses)

Top 3 themes (in priority order)

1. Wintering cows well and achieving environmental and welfare outcomes
2. Optimising a low input, low footprint system by getting maximum benefit from N inputs (fertilizer, clover, feed)
3. Low cost off paddock infrastructure

Scientific Approach

There are several scientific approaches that can be considered when designing a farm systems comparison. For the current comparison, a 2x2 factorial design was chosen with crop type and level of intensity being the two factors. While this approach is strong statistically for the interpretation of the results as only 2 factors are changed it has limitations for the range of scenarios that can be investigated. Another approach is to have systems that change in a linear way eg 0, 50, 100 and 200 kg fertilizer. This allows response curves to be developed but again limits the number of changes that can be made between the systems. At the other end is the implementation of 4 potentially diverse systems that are all aiming to achieve a common goal eg. a farm systems comparison of alternative winter systems for example baleage & pasture, a specific crop, full off paddock or partial off paddock all of which aim to achieve environmental and welfare needs.

Things that will influence the approach include:

1. How bold we want to be in pushing the boundaries
2. The understanding of the principles of each component to be changed
3. Do we need to know the impact of individual components of the system
4. Are we wanting to optimize each system (i.e. this allows systems to be tweaked as the project progresses).

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Current Thinking following consultation with farmers and rural professionals

Main theme: Reducing GHG emissions – achieving 2030 through to 2050 targets
Sub theme: Understanding animal sentience

Potential Farmlet Attributes:

1. Control – optimised crop based system
    a. Minimum till establishment
    b. In paddock Plan B option
        i. crop plus pasture/oats area?
        ii. Other ????

2. Infrastructure
    a. Full wintering
    b. Worst 20 days

3. Alternative paddock wintering – less/no crop; less bare soil

4. Improved low impact - building on LI kale & FB treatments in current comparison
    a. Changed N timing
    b. Shoulder feeding alternatives

5. Plantain

6. Fully self contained
    a. Except calves before weaning
    b. Emergency brought in feed only

7. Flexi crop wintering
    a. Fodder beet for first 4-6 weeks to achieve BCS targets
    b. No till kale or oats/Italian/grass alternatives prior to springer draft to increase N intake in late gestation

8. Increased intensity
    a. High per cow and offsetting by retiring land for planting

Potential farm systems options are currently being modelled to identify how close we can get to future greenhouse gas targets with existing technologies. Modelling results and further conversations with farmers will be used to select the farm systems for implementation commencing spring 2022.

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SDH Participatory Research Project Update

Project Objectives:

Farmers across Southland and Otago will make more informed decisions by better understanding:

1. The impact of their current practices on the environment
2. The tools available to assess the sustainability of their businesses
3. The range of measures that are available to help protect water quality and reduce GHG footprints of a range of dairy farms
4. The fit of each of these measures to landscapes that have contrasting vulnerabilities (such as slope, soil type and wetness) and
5. The risks and opportunities associated with the adoption of management changes to improve water quality and reduce greenhouse gas emissions.

Northern Southland:
Rob & Rachel Dingle
Wendonside

Eastern Southland:
Jon & Birgit Pemberton
Brydone

West Otago:
Doug and Emma McLeod
Clydevale

Tairei:
Anne-Marie and Duncan Wells
Outram

Figure 20: Linkage between SDH and the Participatory research farms

Farmax and OverSeer modelling has been used to identify potential farm system change options that maintain profitability while reducing nutrient loss to air and water.

Following the completion of all the scenario modelling the data from all farms was summarised to generate relevant regional examples of the impact of mitigations on profit and footprint. This information will be used in developing messages for the DairyNZ Step Change Project and by the Southland South Otago regional team when discussing nutrient loss options with farmers across the region.

The change in profit (%) quoted in the tables below is valid for the milk price for the 2019-20 season of $6.35/kg MS. A different milk price will result in different answers for change in profit.

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Reduced N fertiliser (from a Base of around 200 kg N/ha)

a. Nitrogen fertiliser on pastoral blocks is reduced to 190 kg N/ha.
b. Assume a reduction in pasture eaten with less N fertiliser.
c. Import supplements to fill the deficit.
d. Farmax model and DairyNZ facts and figures N response rate assumptions for different times of the year was used to estimate the reduction in pasture production.

Mitigations	Change in N leaching %	Change in GHG %	Change in Profit %
Reduce N fertiliser	-7 (-7 to -8)	-2 (-1 to -2)	-2 (-1 to -3)

Pasture sward includes 30% plantain (from a Base of no plantain)

a. Assume pasture production, growth profile, N fertiliser, and pasture utilization are the same as perennial ryegrass-white clover when plantain is in the mix.
b. A third of the farm is re-stitched annually @ $150 per ha.
c. No consideration given to the practicality of achieving this on farm and the challenges farmers may face in achieving the targeted levels.

Mitigations	Change in N leaching %	Change in GHG %	Change in Profit %
30% plantain in the sward	-18 (-15 to -20)	-2 (-1 to -2)	-2 (-1 to -2)

Wintering all cows in a roofed off-paddock facility (from a Base of wintering on support block; all hectares counted)

a. $3,500/cow to construct free stall barn + $1,000/cow as associated costs including increasing effluent storage.
b. Depreciation and interest costs at 6% interest rate included.
c. $20/cow added as maintenance, which includes manure handling and spreading, plus general maintenance.
d. Barn used for 24 hours in winter and in autumn 5 hours/day during lactation.
e. N fertiliser reduced to account for extra effluent N collected from the barn.
f. Cows fed less in the barn to account for less walking and exposure to elements.
g. Stocking rate is maintained.

Mitigations	Change in N leaching %	Change in GHG %	Change in Profit %
wintering all cows in a roofed off-paddock structure	-25 to -40	Depends on intakes, stocking rate and effluent storage	-19 to -42

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Fodder beet cropped on approx. 4% of milking platform for wintering part of the herd and/or transition feeding, followed by an oat catch crop (from a Base with no catch crop)

a. Extra DM from FB allows for reduced autumn N fertiliser
b. The oats catch crop is sown staggered over time after grazing.
c. Imported feed reduced to accommodate home grown oats silage.
d. Assumed $600/ha oats growing cost and $560/ha harvesting and ensiling cost, crop direct drilled, and no fertiliser applied.
e. Oats yield estimated between 4 and 6 t DM/ha.
f. Oats silage fed to dry cows when they return to the MP in spring.

Mitigations	Change in N leaching %	Change in GHG %	Change in Profit %
Oats catch crop after fodder beet crop on approx. 4% of the milking platform for part wintering and/or transition feeding	-2 to -4	-1	0 to +2

Reduce reliance on imported supplement for a system 5 farm (from a Base of approx. 19% supplement imported)

a. Only feed imported supplements in the shoulders, June-September & March-May.
b. Stocking rate reduced by 6%, compared to the base to match feed supply to demand.
c. Spending on imported supplements reduced.
d. Baleage saved from wintering fewer cows. Baleage is fed on the milking platform and imported supplements are reduced.

Mitigations	Change in N leaching %	Change in GHG %	Change in Profit %
Reduce reliance on imported supplements	-5	-6	-13

Quadrant Graphs have been used to illustrate the impact of system change on profit, greenhouse gases and nitrogen surplus for each of the farms. We have also looked at how the SDH farm systems performed for the 2019-20 season.

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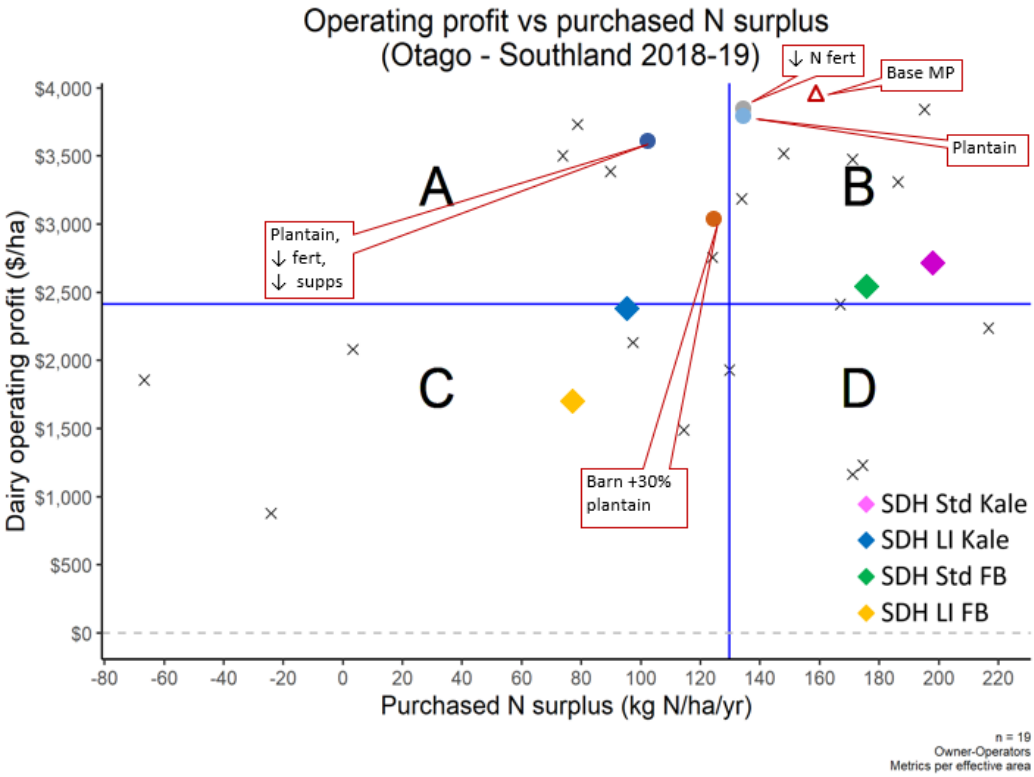

Figure 21: SDH farm systems operating profit vs N surplus relative to other Southland/Otago businesses

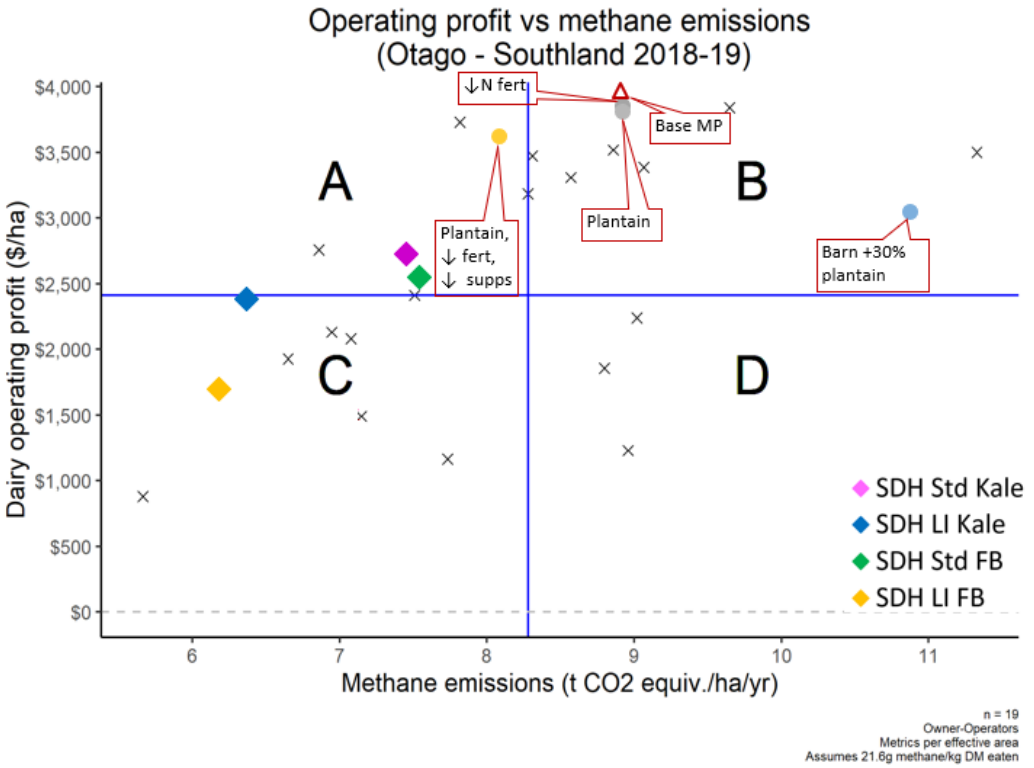

Figure 22: SDH farm systems operating profit vs N surplus relative to other Southland/Otago businesses

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The Farm

Farm Area
Milking platform: 309 ha
Support Block: 39 ha
Unproductive land: 2 ha

Milking infrastructure
60 bale rotary dairy with DeLaval plant and Delpro Herd Management software
Automatic cup removers and on-platform teat spray, Automatic drafting and weighing
Greenwash on the backing gate

Climate
Mean Annual Maximum Temperature - 17.7 ^{o}C
Mean Annual Minimum Temperature - 5.4 ^{o}C
Average Annual Soil Temperature – 11.0 ^{o}C
Average Annual Rainfall – 785.4 mm

Soil Types
Table 4: Soil types, locations and characteristics on farm

Soil type	Location	Characteristics
Edendale	Top terrace	Well drained, high WHC, seldom dries out
Pukemutu	Through centre of farm	Poorly drained due to sub surface pan between 600 and 900 mm deep. Vulnerable to waterlogging.
Makarewa	Bottom terrace	Poor aeration during wet periods due to poor sub surface drainage and slow permeability. Severely vulnerable to waterlogging in wet periods.

Staffing and management
Roster System – Year-round 8 on 2 off, 8 on 3 off
Milking Times – cups on at 5 am / 2.30 pm

Effluent System
Two receiving ponds with weeping walls, leading into a storage pond. Effluent applied by travelling irrigator. Solids cleared out November 2018. Some effluent applied by umbilical system in March 2019. Greenwash on the backing gate

Herd Details
Table 5: BW and PW as of 28 February 2021

		BW	PW
Pink – Std Kale	**Cows (195)**	116	144
Blue – LI Kale	**Cows (160)**	118	148
Green - Std FB	**Cows (193)**	113	129
Yellow – LI Kale	**Cows (158)**	127	158
Grouped	**Youngstock**	156	175

Mating Programme Spring 2021

The Southern Dairy Hub herd will use LIC semen over our herd this year, utilising a combination of the genomically tested bulls in the Forward Pack and the A2:A2 semen to open up options for our Research or supply in future years.

Mating Plans:

- Mating for the herd begins November 1st, for PSC August 10 2022.
- Our 720 MA cows – will be mated to mostly crossbred semen, some Friesian and a little Jersey as we try to breed to a consistent F10 Crossbred herd.
- Short gestation (SG) Hereford semen used over identified culls.
- After 5.5 weeks of AB 14 Jersey-Cross bulls with the herd for 5 weeks.
- R2s – Will begin mating October 26th, run with Yearling Jersey Bulls for 9 weeks.

Pastures

220 ha (71%) of the milking platform was resown at conversion in 2017.
Of this 160 ha was fully cultivated, 43 ha direct drilled and 17 ha undersown with annual; ~46.4 ha was sown in 5 star FVI pastures, and ~46.4 ha in 1 star FVI pastures.

The following cultivars were used across the remainder of the farm: Prospect, Excess, Rely and Platform.

Wintering

All mixed age cows and rising 2-yr olds wintered on kale or fodder beet on the milking platform
All rising 1-yr olds wintered on kale or fodder beet on the support block

Crop and Grass 2021

Item	Methods	Cultivars
Winter Kale sown for 2021	Direct drilled and conventional	Firefly KALE Cleancrop™ Brassica System
Fodder Beet 2021 winter	Conventional cultivation and alternatives experimented	Jamon Fodder Beet
Crop to Grass Spring 2021	Conventional cultivation	Platform PERENNIAL RYEGRASS performance bred® Base TETRAPLOID PERENNIAL RYEGRASS performance bred®

The Southern Dairy Hub Gratefully acknowledges the donations of our foundation sponsors and pledges, we are here with their support, and to support them in the future.

We would also like to recognise and thank the businesses who continue to support us, specifically: