THE ON-FARM COST OF MEETING N-LIMITS

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Abstract

Most of the analysis considering both the implications, and opportunities, to farm with lower nutrient losses is based on modelled datasets. Limited data is available from commercial size farms, or full system research whereby management practices have changed to farm within lower (estimated) nutrient losses.

Lincoln University Dairy Farm (LUDF) is an exception, having modified farm management part way through the 2013-14 production season, specifically to lower the predicted N-loss. Additional changes have been implemented for the 2014-15 season, seeking further reductions in N-losses while aiming to regain some of the profitability lost in the previous season.

The farm is a well-known, frequently visited commercial demonstration farm, operated by the South Island Dairying Development Centre (SIDDC) to showcase best practice sustainable, profitable farming. Annual benchmarking indicates the farm has historically operated in the top 2-3% based on profitability.

The self-imposed (2013-14 season) target to hold nitrogen losses within historical levels achieved the desired reduction in N-loss but eroded profitability by over $80,000 ($500/ha), providing a real example or case study of an option to reduce N-loss and its associated cost. If extrapolated across the Canterbury region's 1000 dairy farms, this impact would markedly change the local economy.

Uncomfortable with the impact on profitability, yet seeing potential legislative reductions in N-loss effective in its local catchment from 2017, LUDF has voluntarily changed its management for the 2014-15 season to operate with lower predicted N-loss. The farm is adopting research undertaken within the Pastoral 21 (P21) research programme whereby farm systems research with self-contained farmlets has shown an irrigated, nil-infrastructure, low input (N-fertiliser and supplement) system is

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theoretically as profitable as the previous system at LUDF, yet should further reduce the catchment nutrient loss.

Details of the 2013-14 season changes and forecast results for 2014-15 are presented, highlighting the actual costs and implications of farming within nutrient loss restrictions.

Introduction

New Zealand farmers deal continuously with change, uncertainty and volatility, and to date have developed farm systems to accommodate, or mitigate the major challenges typically occurring on farm. Increased awareness and interest in nutrient losses from farms, coupled with the related regulatory response (regulatory responses vary across NZ; in part reflecting the variation in current nutrient loads within) has added nutrient losses to the uncertainty associated with farm planning and forecasting probable future returns. A high profile Canterbury dairy farm provides the following case study to highlight management changes and considerations in response to the increasing focus on nutrient losses.

Lincoln University Dairy Farm (LUDF)

LUDF is a commercial demonstration dairy farm operated by the South Island Dairying Development Centre (SIDDC) on behalf of the university to showcase best practice sustainable, profitable dairy farming. SIDDC is a partnership between Lincoln University, DairyNZ, Ravensdown, LIC, Plant & Food Research, AgResearch and SIDE. LUDF attracts 3000 - 3500 visitors per year plus approximately 1000 visitors per month to its web-based weekly farm walk notes and Facebook page. Additional details are provided in Appendix 1.

The farms 2011 – 2015 objective is:

To maximise sustainable profit embracing the whole farm system through:

- increasing productivity;
- without increasing the farm’s total environmental footprint;
- while operating within definable and acceptable animal welfare targets; and
- remaining relevant to Canterbury (and South Island) dairy farmers by demonstrating practices achievable by leading and progressive farmers.
- LUDF is to accept a higher level of risk (than may be acceptable to many farmers) in the initial or transition phase of this project.

Whilst defining the farm’s total environmental footprint remains a work in progress, it quickly became evident the farm’s nitrogen loss to water as predicted by Overseer® would need to be held to the historical levels of 2010/11, and prior years as part of the farms total environmental footprint. The total land required for the milking platform, and support land for wintering dry cows, replacement stock and growing supplements is included in the farms reference to its whole farm system and its total environmental footprint.

A number of farm system changes, including the use of two herds to better manage young cows and cows with low body condition scores, and the enhanced use of nitrogen fertiliser were implemented in 2011/12 and resulted in improved productivity as the farm grew more pasture, increased the efficiency of conversion of feed to milk, improved profitability and held the milking platform N-losses through additional use of the mitigation technology ‘Eco-n’ (active ingredient DCD).

The temporary suspension of this mitigation technology in early 2013 required a review of the farm system for the 2013-14 season. Analysis of the potential yield of the farm indicated reduced N-fertiliser may provide sufficient pasture to maintain the farms productivity but result in a tighter N-cycle and therefore similar N-loss but without the mitigation technology Eco-n.

Constraining productivity to meet N-loss targets

Forecasting probable N-losses (Nitrogen losses referred to were generated at the time using Overseer® Version 6.1) part way through 2013-14 season indicated the LUDF milking platform was heading towards a full year N-loss 10% higher than the immediate past year. This was the result of a cooler and wetter than normal season coupled with less nitrogen fertiliser, no Eco-n use and the resultant higher use of imported supplementary feed. Unable to accept this impact (given the farm’s objective) LUDF sought the least cost means of staying within its historical N-loss.

LUDF’s decision to adhere to its previous N-loss was voluntary, in response to its objectives. Most farms (to date) have had weather and product prices as the key drivers causing mid – season changes in farm system. By responding to the additional driver of N-loss, the farm has provided a clear case study of the impact of changing the production system to meet environmental targets. This decision was endorsed by SIDDC and Lincoln University to highlight the significance of the farm’s environmental objectives.

A range of farm management changes (e.g. modifying stocking rate, supplementation strategies, N-fertiliser use, on-off grazing systems) were evaluated in terms of their impact on predicted N-loss, farm profitability and feasibility. Some changes were simply not feasible mid-way through the production year, including changing the type of imported supplementary feed (it had largely already been fed), or building any substantial form of facility to enable on-off grazing.

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Early culling of surplus animals

Decreasing the number of animals on farm through the autumn and thus the total feed intake and requirement for additional imported feed was feasible if those animals not required on farm in subsequent seasons (culls or empty cows) were sold early in the autumn rather than at the end of the season. A smaller autumn feed supply, consumed by fewer animals, would reduce urinary N load on the environment. The farm adopted this strategy and sold culls and empties in early March (Fig 1), managing the remaining cows based on the feed grown through the autumn period.

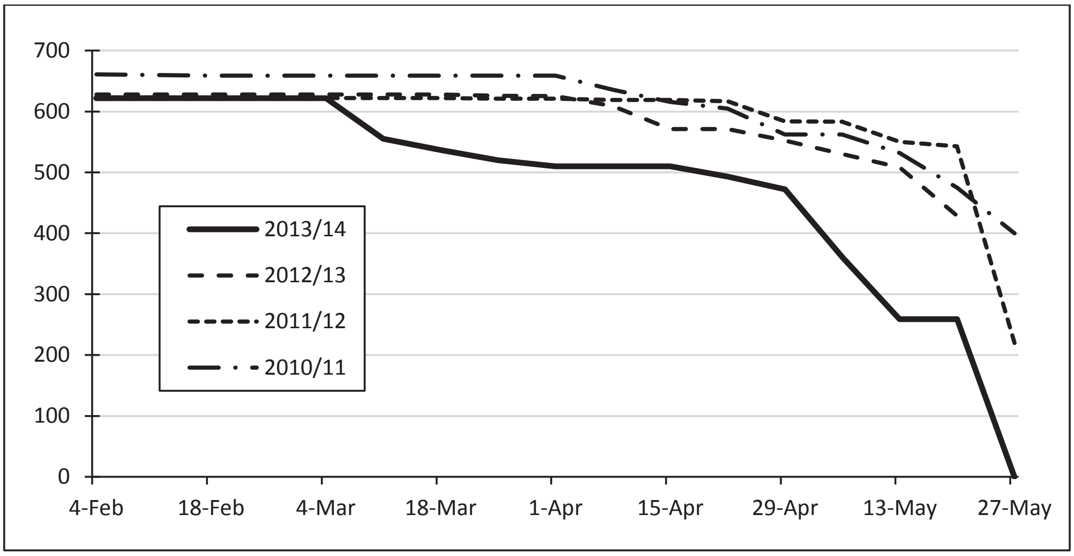

Figure 1. Calved Cows on Farm

This change was forecast to reduce milk production by 5-10%, reduce imported silage required (and therefore feed costs) and reduce net income by approximately $100,000. Asking farm staff to constrain production when the milk price was at a record high was viewed with caution by many farmers and onlookers who saw the lost profit as a missed opportunity to generate additional funds, to re-invest in additional or future on-farm mitigation.

Effects on milk production and profitability

Final year production (Fig 2) was 8% lower than budgeted, reducing gross income for the farm by $204,000. Reducing further imported silage use is estimated to have saved approximately $120,000 leaving a reduction in farm income of approximately $84,000. Given the farm is now smaller than the average size dairy farm in Canterbury, the losses for most farms would be larger than this if replicated across the region. This is less overseas income earned for NZ and less income circulating through the local economy.

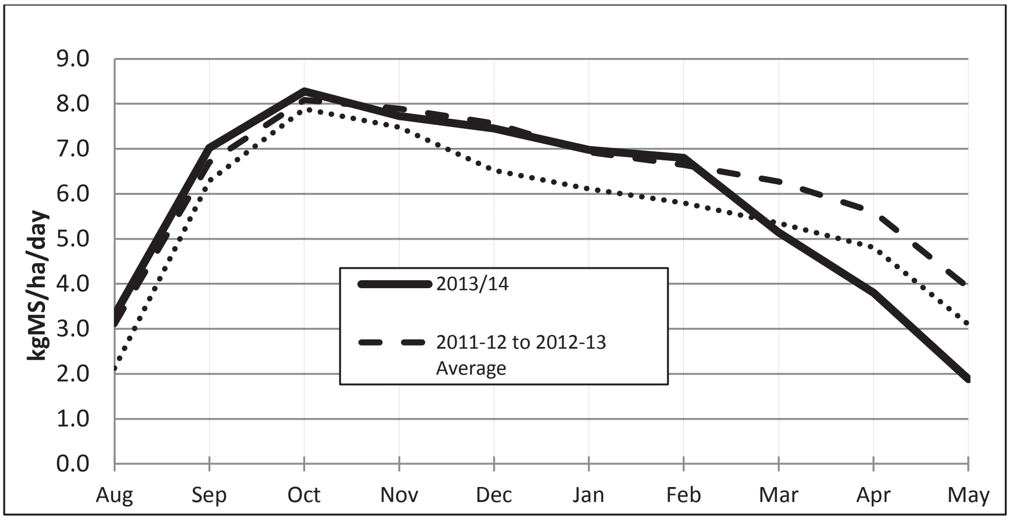

Figure 2. Average Monthly Production – (Milksolids per hectare)

Predicted N-loss to water

The full year predicted N-loss to water as modelled in Overseer (version 6.1) for the 2013-14 season was approximately 35 kg N/ha, less than the 38 kg N/ha predicted for the previous 2012-13 season and significantly less than the 42 kg N/ha initial forecast for the full season (Fig 3). The strategy, as modelled by Overseer, was therefore successful in terms of reducing predicted N-loss.

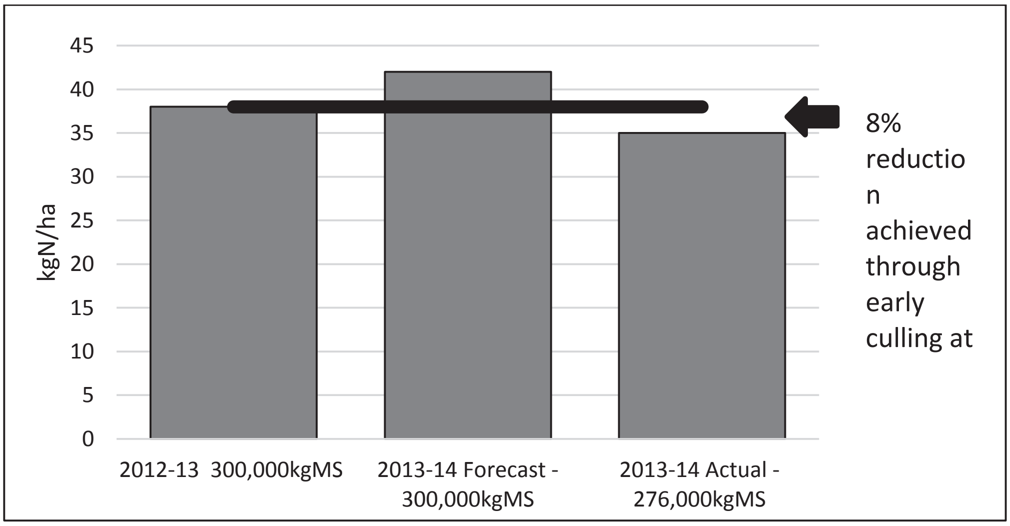

Figure 3. Overseer (version 6.1) Predicted N-loss to water – June 2014

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Note: LUDF N-losses above are modelled with the presumption of (free draining) Templeton soils across the whole farm. The actual soils on LUDF range from very free draining soils to poorly drained soils. Actual losses differ to those above but the relativity of management / farm system changes on N-loss is similar.

Changing drivers of farm performance

LUDF achieved its objective of farming within its historical footprint by choosing to focus on the predicted N-loss rather than respond to the clear (and proven) market signals for additional autumn milk production. Compromise was required in regard to the farm's overall objective, with profitability given away to achieve the farm's environmental goals. The farm was able to reduce N-loss by 17% (relative to what could have occurred), from approximately 42 kg N/ha to approximately 35 kg N/ha. Adding the opportunity cost of $84,000 ($525/ha) gives a mitigation cost of $75/kg N in the 2013/14 season.

Considering the alternatives

LUDF is located within the 'Selwyn-Waihora' zone within the Canterbury region. Farms in this zone/catchment have to adhere to Variation 1 of the Proposed Canterbury Land and Water Regional Plan. Variation 1 was released in February 2014 and has subsequently been through a hearing process with submissions from a number of parties. Most farms will have to operate at 'Good Management Practice' N-loss rates by 2017 and below this by 2022.

Given these changes are coming, both in LUDF's catchment and across other catchments in New Zealand, LUDF determined it would, in the 2014/15 season, operate at a lower N-loss than previously, to document how the farm can respond to these requirements, and the implications, costs and opportunities that may arise from this.

LUDF's objectives require it to consider the whole catchment effect of its business, not just the milking platform. This requires consideration of the effect of LUDF's decisions on its wider support land as well as the milking platform. Simply shifting the load from LUDF to another parcel of land is not an option for LUDF but may be a viable means of reducing total N-loss for farms with full control of their entire land area.

Two clear pathways were evident for LUDF to further reduce its total N-losses from the catchment:

1. Invest in infrastructure on-farm to reduce the grazing / standing time on paddocks. This has been shown to reduce N-loss if the effluent can be stored from the standoff facility and exported or re-applied to land at times of the season and rates that ensure plant uptake of the nutrients.
2. Reduce the number of animals farmed to reduce the annual volume of feed required for maintenance, while seeking higher production per cow to generate sufficient income and profit. This option has been operating nearby at the Lincoln University Research Dairy Farm (LURDF)

as part of Objective 3 of the Pastoral 21 (P21) Phase 2 research programme, "Next Generation Dairy Systems for Canterbury".

Three years of data from this farmlet study (see LUDF focus day handouts from July 2012, July 2013 and February 2015) showed milk production levels of over 500 kg MS/cow were achieved with 3.5 cows/ha, 150-160 kg/ha nitrogen fertiliser and less than 300 kg DM imported supplement/cow (Farmlet studies typically refer to small scale research, operating as much as possible as if the farmlet is simply a smaller scale of a commercial farm. This study occurred with 29 cows on 8.3 ha to achieve a stocking rate of 3.5 cows/ha). Profitability was calculated as comparable to LUDF with lower N-losses on the milking platform, and lower total losses for the catchment, in part influenced by fewer cows wintered, fewer replacements, and less supplementary feed.

The data to date for this farm system has shown the repeatability of the system within the research framework. Extending this onto multiple farms required scaling up of the research and further development of the decision rules to optimise grazing management and appropriately use the resources and inputs. Encouraged by the results from this research, LUDF chose to implement a nil-infrastructure, low input model for 2014-15, replicating the system employed in the P21 research and seeking to lower N-losses and return profitability to previous levels.

Nil Infrastructure / low input farming

The essence of this system is:

- Reducing the stocking rate as much as possible so that more of the total available feed is used in milk production (and less is required for maintenance of additional animals)
- Reducing the need for brought in feed and nitrogen fertiliser due to lower (total) animal demand for a similar level of milk production.

Note this is a lower input system, but not a zero input system. It is seeking to optimise the use of nitrogen fertiliser and imported supplementary feed inputs along with the farm's potential pasture production but without the use of any standoff / feeding pad / housing infrastructure.

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Accounting for LUDF across the Whole Farm System (the Catchment Effect)

As can be seen below (Fig 4), LUDF's requirement for additional land is reduced as the demand for land for wintering and replacements goes down with fewer animals farmed.

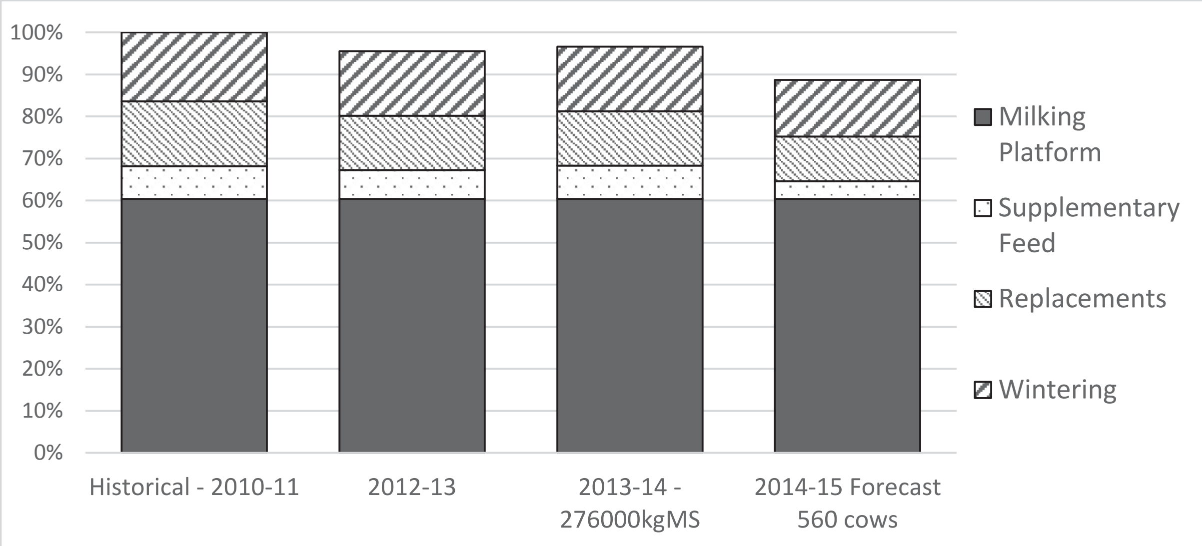

Figure 4. Total land required - relative to historical LUDF land use

Total nitrogen loss to water within the catchment is influenced by the average rate of N-loss per hectare in each parcel of land and the amount of land required. The graph below (Fig 5) (based on Overseer modelling (with Version 6.2) of each parcel of land) suggests a moderate decrease in N-loss at the catchment level occurred as the result of the 2013/14 decisions (relative to historical losses) whereas the combined effect of lower losses on the milking platform, along with fewer animals wintered and fewer replacements predicts total catchment losses are approximately 20% lower (than the historical N-losses), with the nil-infrastructure, low input system (2014-15). This should be considered alongside milk production, which again compared to historical milk production, results in a little more milk in total, from less land and less total N-loss to the catchment. The importance of considering the farms total land use and the significance of wintering and replacements is also evident in this graph.

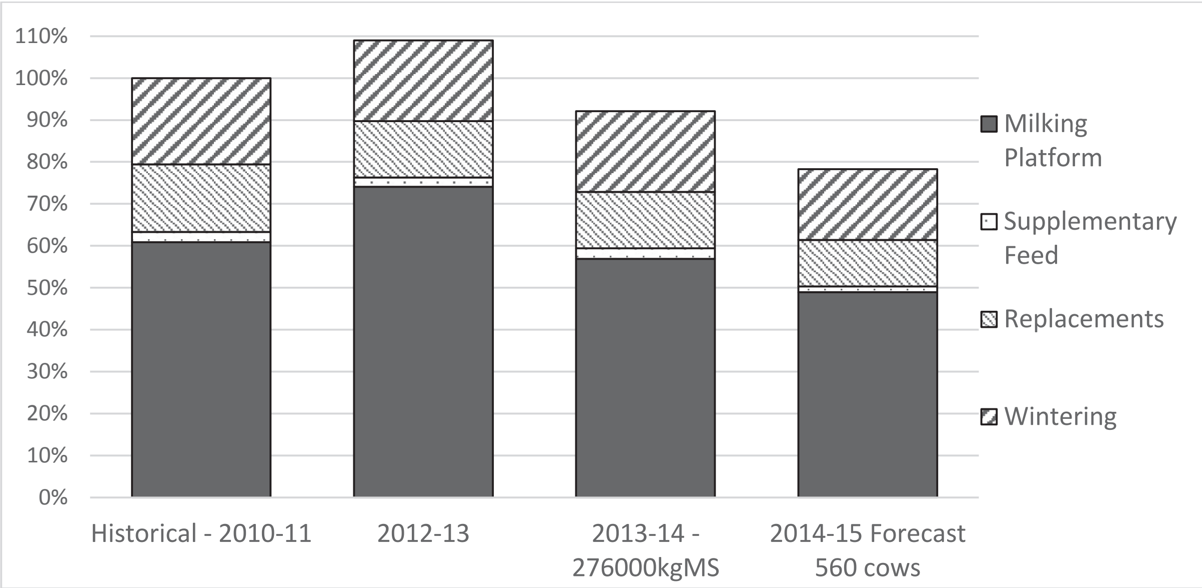

Figure 5. Total Nitrogen Loss to Water - relative to Historical LUDF losses

Caveat:

It is important to note the estimated Nitrogen losses to water for the 2014-15 season above (Fig5) and below (Fig 6) are as forecast in Mid May 2015 (Overseer version 6.2), with estimated full season production. The losses portrayed above are based on the farms use of 143 kgN/ha, 300kgDM imported supplement/cow, a stocking rate of 3.5 cows/ha and production of approximately 490 kgMS/cow.

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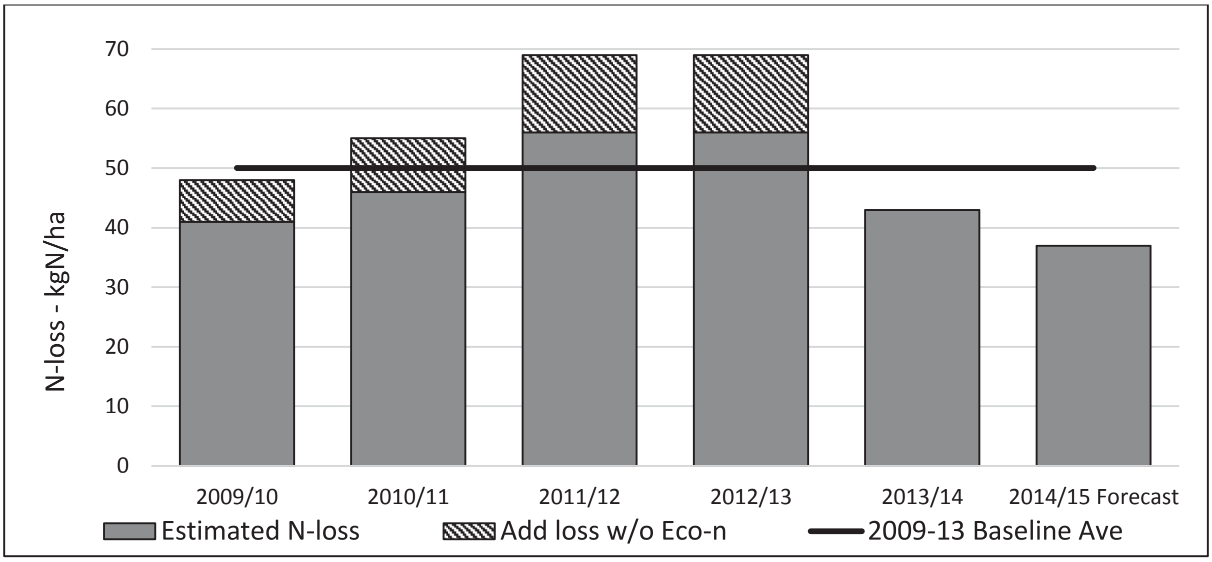

Figure 6. Estimated N-losses per hectare for the milking platform (only) at LUDF, with and without the impact of Eco-n, as predicted using Overseer v6.2.

Relative profitability

On-farm profitability is substantially driven by the combination of milk production, operating expenses and payout. Most farmers can influence or control the first two of these but have limited influence on the actual payout, making year to year comparisons of actual profit difficult given the variability in milk payout.

To assist in multi-year profitability comparisons, LUDF undertakes an annual benchmarking exercise with 4 other well respected highly profitable Canterbury dairy farms. This provides a measure of the relative profitability between these farms, as the costs, and management decisions are relevant to the payout at the time. As shown in figure 7 (below), LUDF had improved its relative position from 2011/12 to 2012/13, then eroded this again in 2013/14 as it constrained productivity to meet its N-loss target. The data for the 2014-15 season is not available at the time of printing but will be available in mid-July at www.siddc.org.nz.

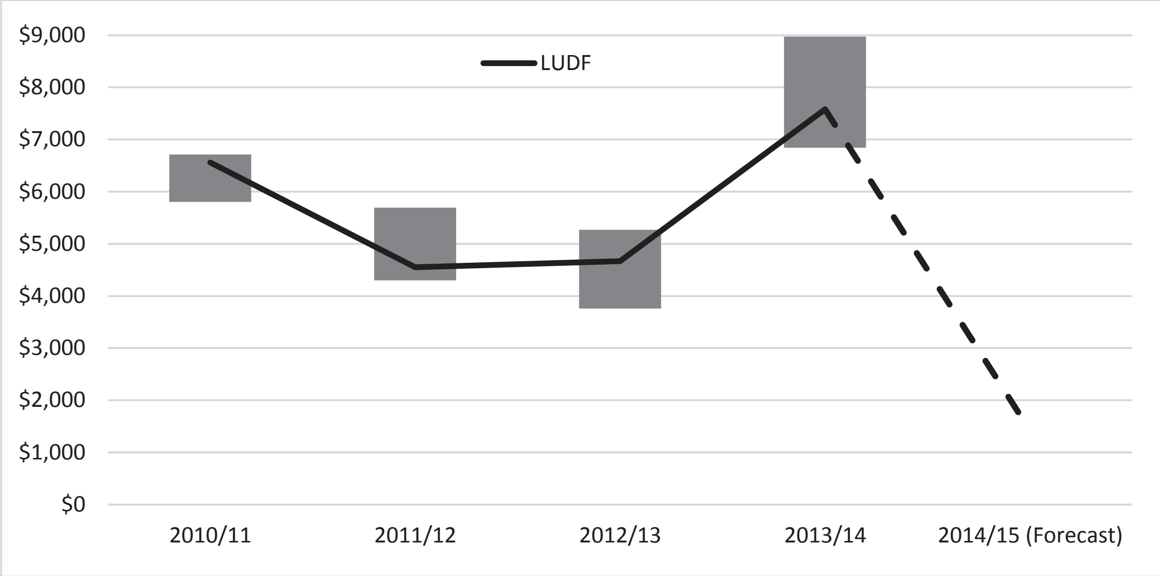

Figure 7. Range of Operating Profit ($/ha) of LUDF benchmark farms:

Note: the Grey box above for each year represents the range of profitability generated by the four farms used as an annual benchmark by LUDF. The black line represents the LUDF profitability per year.

The following table provides a relative comparison of the profitability of LUDF in the past two seasons, with the forecasted profit for the 2014-15 season (Table 1). Income has been standardised at a payout of $4.70/kgMS to provide some degree of relativity, though management and expenditure decisions are made each year relative to the expected payout, hence absolute comparisons should not be made between years. The forecasted cash farm working expenses for 2014-15 are approximately 9% lower than the past seasons, reflecting some of the potential cost savings from fewer cows on farm.

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Table 1. Comparison of the indicative profitability of LUDF over the past three seasons (using a common milk payout of $4.70/kg MS across all years)

Year ending May 31	**2012 -13 Actual**	**Actual 13-14**	**Forecast Mid May 2014-15**
Total Milk production (kgMS)	300,484	276,019	278,000
Gross Farm Revenue (assuming $4.70/kgMS all years)	$1,568,872	$1,471,721*	$1,418,381*
Cash Farm Working Expenses	$1,184,967 ($3.94/kgMS)	$1,182,117 ($4.28/kgMS)	$1,075,872 ($3.87/kgMS)
Total Operating Expenses	$1,289,967	$1,298,117	$1,191,872
Dairy Operating Profit	$278,905	$173,604	$226,509
DOP/ha	$1,743	$1,085	$1,416

*Note the lower stocking rate system of 2014-15 also reduces stock sales and thus stock income.

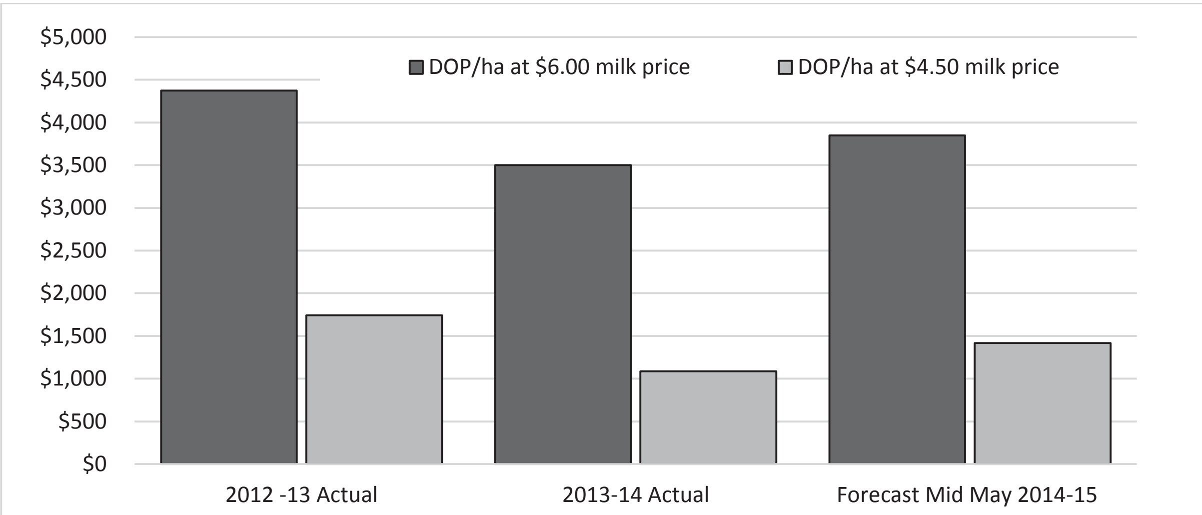

Figure 8. Comparison of the Relative Profitability of LUDF over the past three seasons, at two different milk prices

The actual profitability is very sensitive to production in this system, with little room to make savings in expenditure if production is below target as shown in table 2. This is exasperated at low payouts, whereby a 2% decrease in production for example decreases profit by 11%, while a 5% decrease in production decreases profit by over 25%.

Table 2. Sensitivity of Profitability to Production in the lower input farm system:

Production level relative to target	100%	98%	95%
Total Milk Production	280,000 kgMS	274,400 kgMS	266,000 kgMS
Milk production /cow	500 kgMS/cow	490 kgMS/cow	475 kgMS/cow
Net Revenue	$1,427,781	$1,401,461	$1,361,981
Cash Farm Working Expenses	$1,075,872	$1,075,872	$1,075,872
FWE/kgMS	**$3.84/kgMS**	**$3.92/kgMS**	**$4.04/kgMS**
Total Operating Expenses	$1,191,872	$1,191,872	$1,191,872
Dairy Operating Profit	$235,909	$209,589	$170,109
DOP/ha	$1,474	$1,310	$1,063

Discussion

Dairy farming systems, like most business practice evolves over time in response to increased knowledge and understanding, individual and industry innovation, market signals, relative profitability, alternative land uses, customer preferences and feedback, and local / central government regulation. This combination has led to seasonal supply milk production systems dominating in NZ. The increase in regulation, or potential regulation on nutrient losses from farms is driving substantial change in farm systems, or serious consideration of major on-farm changes.

Language and terminology also evolve as systems change and develop. Farm performance to date is described in relation to productivity or profitability per unit of land or unit of production (e.g. kg MS/ha, FWE/kg MS). Future farm performance may well be described in relation to purchased nitrogen over exported nitrogen or profit per kg N-loss, and include total land and catchment scale N-load per unit of milk production.

Whilst the timing and degree of change required on farms to meet possible regulations regarding nutrient losses is largely unknown at present, it’s likely a number of existing farms will in the future have to operate with much tighter (lower) N-loss than has been required of them to date. This may result in a few farms changing out of dairy farming to an alternative land use. In reality this

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always occurs to a varying degree, particularly on smaller farms where less intensive land use may allow semi-retirement for an owner-operator.

Many other dairy farmers, faced with changing nutrient losses will adapt in whatever means they can, or is required, to meet the nutrient loss targets for their farms. The use of stand-off type infrastructure (from simple feedpads / stand-off areas to partially or fully housed systems) is likely to significantly change the operation of these farms, potentially moving them away from seasonal supply grazed farms to much more like Northern Hemisphere farm systems (at least for part of the season). Imported feed for lactation and the dry period, coupled with nil or limited grazing during / immediately prior to major (potential) leaching periods could result in a much higher percentage of the diet from a 'cut and carry' type system. The high capital cost of these systems will require high yields per cow (as more of the infrastructure will be driven by the number of cows milked) and high total production to dilute operating costs and provide a return on the total assets invested (enabling interest and principal repayments).

Other farms may further develop systems requiring no infrastructure, choosing instead to run less intensive, low N-loss systems with much lower capital costs. The need for high lifetime productivity, and very high business efficiency with low unit costs may also result in high production per cow, but driven by the grazed forage intake not total feed intake. Preliminary analysis of total productivity - that is total milk production from the total land area supporting milk production - is often similar for high infrastructure intensive or less intensive, nil-infrastructure systems if the land required for all feed crops is included. This will become clearer over time, once data is available for well-run farms in both systems. If total productivity is similar, and total catchment losses can also be held to similar levels from each system, farmers will be able to choose higher or lower intensity systems based on their own preferences, available capital, and values. In either case, the systems may look markedly different to dairy farming as we currently know it.

On-farm management aspects of the reduced input farm system

The following graphs provide a pictorial view of the use of N-fertiliser (Fig 9), supplements (Fig 10), total area mown (Fig 11) and resultant milk production (Figures 12 and 13) over the past seasons, while Table 3 below details some of the changes in farm practice that have occurred to implement the Nil-infrastructure, lower input farm system. LUDF has identified changes that it believes can be improved to further enhance the operation of this system, which it seeks to implement in the coming season.

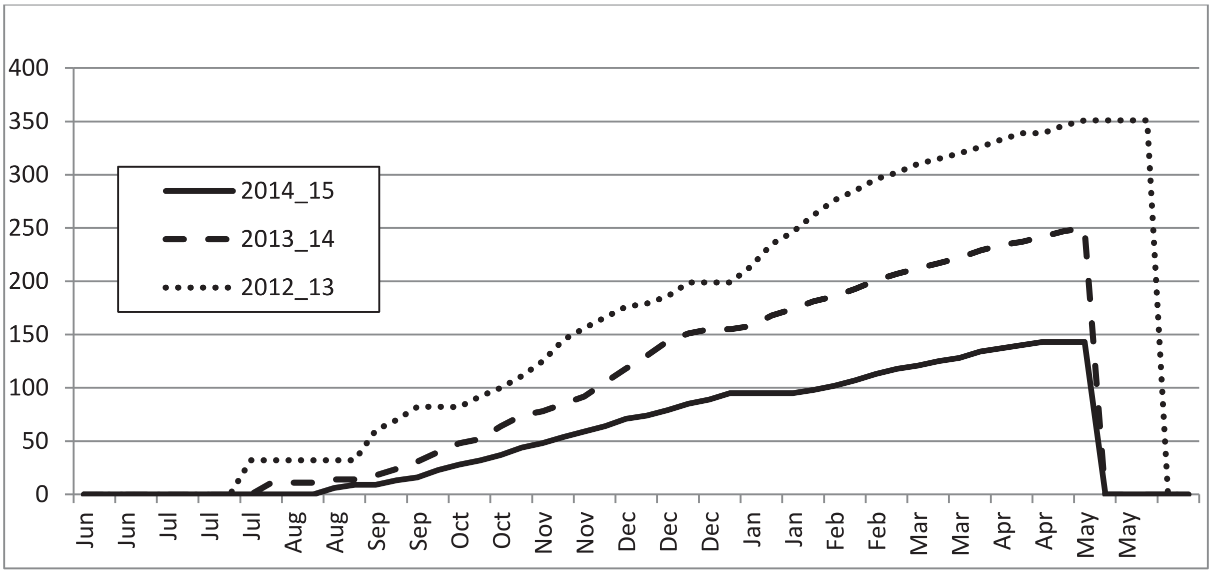

Figure 9. Cumulative N Fertiliser Use

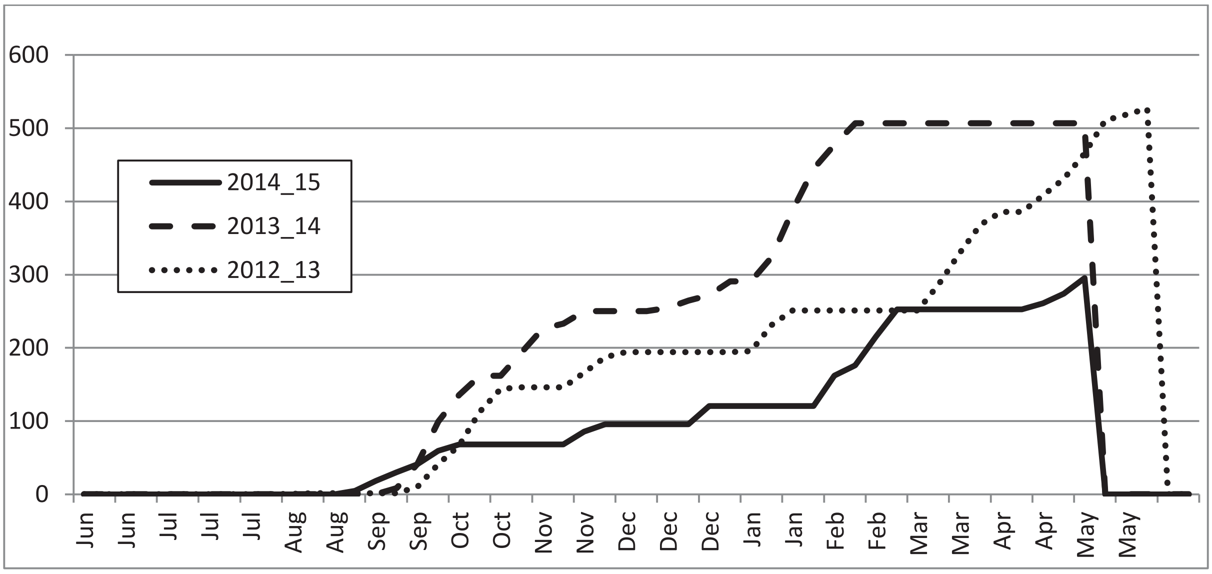

Figure 10. Imported Supplements fed (kg DM/peak cow)

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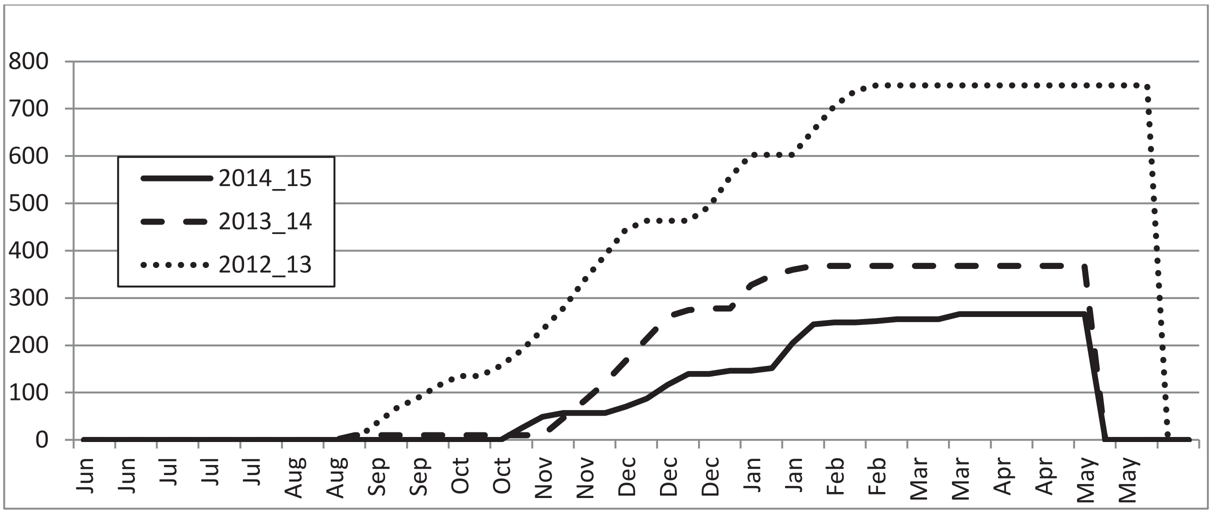

Figure 11. Total Area mown (includes silage and mowing of new pasture for weed control)

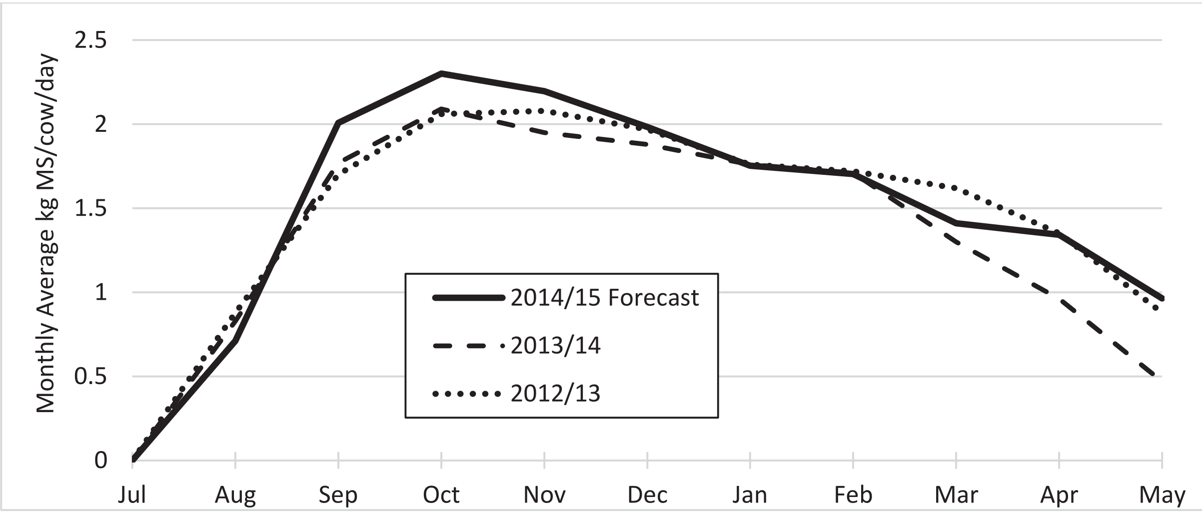

Figure 12. Average milk production per cow (kg MS/peak cow)

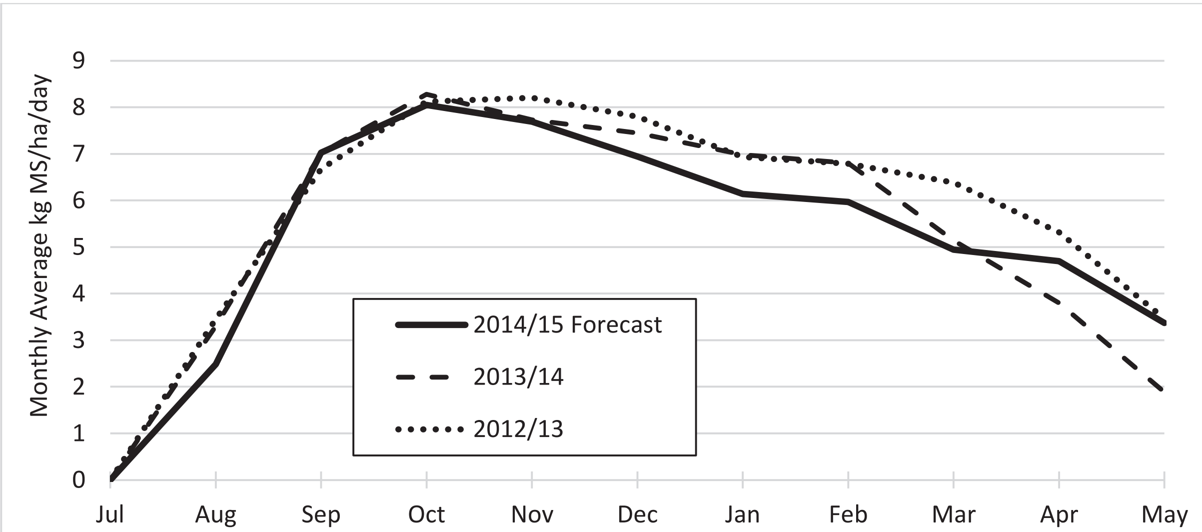

Figure 13. Average milk production per hectare (kg MS/ha)

Table 3. Summary – Changes to Management at LUDF

	Historically	2014/15 Season
1. Spring Rotation Planner (SRP)	Used in conjunction with silage, N fert and GA, typically finishing mid-September	Proactively managed SRP and held out end first round to 23 September.
2. Rotation Length	Average 22 days Sept – Jan 27 days Sept 22 days Oct - Nov 19 days Dec – Jan 22 days Feb 22 days March 33 days April 11 grazing rounds since beginning September	Average 26 days Sept - Jan 39 days Sept 23 days Oct – Nov 21 days Dec – Jan 23 days Feb 33 days March 38 days April 9.5 grazing rounds since beginning September (14% fewer grazings)
3. Average Pre-Graze Cover	3118 kg DM/ha (average Sept – Jan) 3435 kg DM/ha (average Feb – April)	3328kg DM/ha (average Sept – Jan) 3625 kg DM/ha (average Feb – April)
4. Average Post Grazing Cover	1607 kg DM/ha till end Jan 1690 kg DM/ha Feb – April	1652kg DM/ha till end Jan 1676 kg DM/ha Feb - April
5. Nitrogen Fertiliser Use	200-350 kg N/ha year	143 kg N/ha/year (intention was no more than 150kgN/ha
a. Frequency of N-fertiliser application	Before calving on paddocks with less than 2200 kg DM/ha, then after every grazing, limited use mid-Summer	No N pre-calving, Following each grazing till end December, start again end January. Slower Grazing Rotation means less frequent N applications (14% decrease)
b. Rate	25-40 kg N/ha/application	25 kg N/ha/application

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6. Regrassing	Typically 3 paddocks	3 paddocks regrassed. With hindsight this put too much pressure on the farm and the plan is to reduce this to 10% regrassing in the coming season.
7. Gibberellic Acid	Apply immediately following grazing from late August till late September / early October and again in the March / April period based on suitable conditions.	As previously used, except that slower grazing rotations result in less ability to apply in a timely manner following grazing.
8. Tight Cost Control	Good cost control to keep total expenses low without eroding the future profitability of the farm. High and efficient production from pasture then offsets farm working expenses to produce a lower than average operating cost and a sustainable profit (depending on payout).	
9. Weekly Farm Walk	Actively measure pasture cover weekly, calculate APC, predict future cover, plan and respond to surplus / deficits	
10. Pasture Allocation	Allocate daily area /cow based on Farm walk / APC, milk production, cow response, grazing residual	
11. Split Herd	Split herd based on 1/3 - 2/3 split with small herd initially comprising heifers and light CS MA Cows. Through late spring some well-conditioned heifers were moved into the main herd and replaced with light MA cows. Following the early pregnancy scan, light BCS, early calving cows have replaced later calving and / or better BCS heifers. At the end of lactation the small herd may become a group of higher BCS / later calving cows or be merged with the main herd based on rotation length / desired grazing pressure.	
12. BCS based drying off protocol	Frequent BCS including adhering to BCS targets for drying off based on current CS and days remaining till calving. Milk production is not / will not be chased at the expense of BCS targets (per individual cow) at calving.	
13. Herd Test to identify cow performance and disease risk such as Johnes	Routine herd testing allows identification of low producing cows, particularly important when considering drying off low producing cows.	
14. Heifer mating 2 weeks prior to MA cows	Mating heifers early at LUDF has become part of the successful lift in 6-week InCalf results – as this allows the freshly calved heifer more time to cycle and get back in calf in a timely manner.	

Appendix 1

Further background information on LUDF

History:

The 186 hectare irrigated property, of which 160 hectares is the milking platform, was a former University sheep farm until conversion in 2001. The spray irrigation system includes two centre pivots, small hand shifted lateral sprinklers, and k-lines. The different soil types on the farm represent most of the common soil types in Canterbury.

Stage 1: 2001/2 and 2002/3

The farm initially wintered approximately 630 cows, peak milking just over 600 and producing about 1400 kg MS/ha from 200 kg N/ha and up to 550 kg DM/cow of imported feed. The milk payout (income) in 2002/3 was $4.10/ kg MS.

Stage 2: 2003/4 through to 2010/11

The stocking rate increased to between 4 and 4.3 cows per ha or 654-683 cows peak milked. Production averaged 1700 kg MS/ha and 411 kg MS/cow. LUDF ran a single herd, the focus was simple systems, low and consistent grazing residuals.

Stage 3: 2011/12 to 2013/14

The strategic objective (below) was implemented in a move into 'Precision Dairying'. This focused on minimum standards not averages, two herds, higher productivity and initially higher profitability from a similar environmental impact. Production lifted to 1878 kg MS/ha or 477 kg MS/cow from 630 cows. The temporary suspension of Eco-n (DCD) in 2013 required a change in farm practice in 2013/14 in the attempt to hold nitrogen losses without the mitigation effect of Eco-n.

Stage 4: 2014/15

LUDF is adopting a 'Nil-Infrastructure, low input' farm system emerging from the P21 (Pastoral 21) research programme, in partial response to the tightening environmental requirements of some catchments across NZ. Targeted milk production is 1750 kg MS/ha or 500 kg MS/cow from 3.5 cows/ha with up to 150 kg N/ha and 300 kg DM/cow imported supplement.

Notes: