

LINCOLN UNIVERSITY DAIRY FARM

A Commercial Farm Incorporating Proven Science

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Introduction

Since its conversion in 2000, the Lincoln University Dairy Farm (LUDF) has been a catalyst for change on dairy farms. Farmers learn from the success of other farmers and LUDF has captured farmer interest because of its production and financial success.

Several things make LUDF different:

1. It has extensive monitoring and data collection and analysis systems, so that it can clearly identify what the problem, its scale and impact.
2. It applies proven science knowledge to the resolution of those problems
3. It applies Industry agreed 'Best Management Practices' to all aspects of its farm business operation
4. It uses a wide range of extension methods to allow other farmers to benefit from this learning.

The drivers of farm profitability are well known. In order of importance they are: pasture eaten, cost control and cow efficiency.

However, the disciplines of day to day farm management needed to maximise the beneficial impact of these three drivers are not as clearly understood and practiced even though the facts are well known.

The aim of this paper is to highlight the underlying science and management practices that underpin the management decisions that are made every day on LUDF, that result in high levels of pasture eaten, effective cost control and high levels of cow efficiency.

Pasture eaten

Every grazing decision has several facets:

1. Each day is about balancing today's cow needs with the need to utilise the pasture
2. Each day is also about doing the right thing, to have the right quantity and quality of grass available next time the cows come back to this paddock, to achieve high per hectare production.

The fundamentals of grazing management that maximise the harvest of ME used on LUDF are:

1. Maximising Pasture Grown

2. no pugging damage
3. allow grass to recover by grazing only once it has reached 2½ to 3 leaves
4. use a Spring Rotation Plan and keep the minimum average pasture cover above 2000 kg DM/ha.
5. Never let pastures get yellow at the base through shading due to high covers
6. strategic use of nitrogen and irrigation
7. fertiliser inputs determined by a nutrient budget
8. measure and monitor pastures
9. weekly measurement of the quantity of pasture in each paddock
10. graph farm cover into a Feed Wedge and through the use of a target pasture cover line make better daily pasture management decisions
11. manipulate the supply of pasture using rotation lengths that are closely related to pasture growth rates, ie, long rotation lengths when growth is slow and faster rotation lengths when growth is fast
12. keep the pasture distributed in an even feed wedge from recently grazed paddocks to the longest having the target pre-grazing herbage mass
13. calculate annual pasture yield for each paddock and use this to determine pasture renovation programs
14. Harvest Pasture (ME) Grown
15. graze to remove all of the new, highly digestible pasture at each grazing
16. keep grazing (or mowing) residuals at a constant height of '7 clicks' (7 half centimetres of compressed height as measured by a Rising Plate Meter) throughout the year
17. remove surplus pasture as frequent light crops
18. achieve feed budget average pasture cover targets for dry off date, Planned Start of Calving, and balance date
19. Herd Reproductive Performance
20. calve all R2 and R3 animals in Condition Score 5.5 and mature cows at 5.0
21. manage feed supplies so that all cows are on a rising energy intake leading up to and during mating

Notes:

22. identify anoestrus cows early and treat before mating so that they will be mated on the first day of mating of the herd
23. synchronise the yearling heifers (two PG injections) so mating begins one week prior to the start of mating of the milking herd.

The proven science facts used by LUDF

No pugging (treading damage)

Treading studies in the Waikato with dairy cows, (Figure 1) show that damage to pasture and soils from one pugging event can last several months before pastures recover. In this trial pasture growth was reduced by 600 kg DM/ha (AgResearch, 2003).

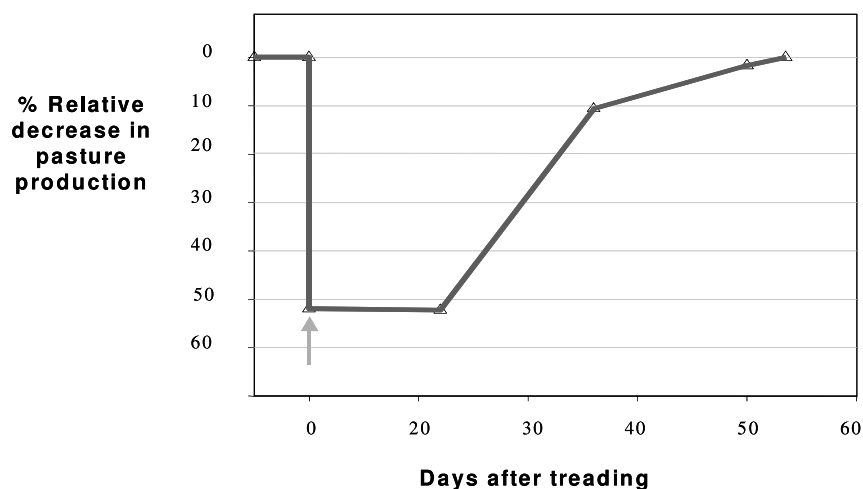


Figure 1: Pugging damage studies, Waikato

The Lincoln University Dairy Farm (LUDF) winters most of the herd off farm and uses on/off grazing when required with the cows stood on the concrete yards at the cowshed, or on an old railway, or in extreme situations will limit the damage to a sacrifice paddock.

Maintain consistent post grazing residuals of between, 7-8 clicks on a rising platometer for ryegrass clover pastures (few weeds and no pugging)

Achieving consistent grazing residuals is the key to offering the cows high ME, high protein feed at every grazing.

On ryegrass, clover swards with few weeds and no pugging are consistent, an even residual with few pasture clumps is achieved by grazing to a height of 7-8 clicks on the rising platometer (RPM). This is based on farm systems research at Ruakura No2 Dairy and in Taranaki that developed target grazing residuals which promoted pasture quality. In the past, target grazing residuals have been communicated to farmers in kgs/DM/ha with different targets

throughout the year, but as the solid black line in Figure 2 shows, the actual grazing height changed little. Therefore height is the preferred method to express grazing residual targets. It eliminates the confusion created from having different amounts of Dry Matter below the same grazing height depending on the month of the year and climatic variations.

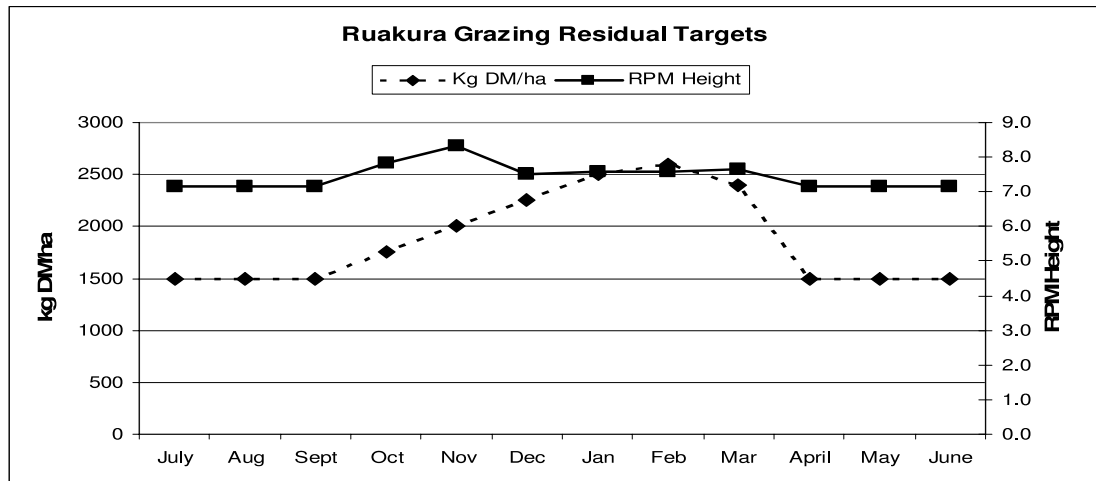


Figure 2: Ruakura No2 Grazing Residual Targets Expressed as kg DM/ha and Height (RPM clicks)

On the LUDF this constant residual of 7-8 clicks on the RPM is achieved directly by the cows and if required, the cows return to the paddock after milking to achieve this target. All surplus grass is also cut to this residual height.

Grazing a paddock to a low residual does not reduce pasture growth rates

The trial shown in Table 1 has been repeated several times and shows that cleaning out pastures on the first round of grazing results in higher growth rates. This also applies to every grazing throughout the year. The grazing interval was 52 days which is typical for paddocks at the start of the Spring Rotation Plan.

Notes:

Table 1: Spring Grazing Residual Trial, Ruakura 1979 (Total Herbage)

Post Grazing kg DM/ha July	1773	1425	1155	864
Pre Grazing kg DM/ha September	326	3030	3000	2916
Accumulated Growth (52 days)	1491	1605	1845	2052
Average Growth Rate Kgs DM/ha/day	28.7	30.9	35.5	39.0

Also refer to Figure 3.3 pg 39, Milk Production from Pastures: Principals and Practices – Colin Homes et al.

Monitoring Pasture Cover to Meet Targets at Key Times

Trials in the 1980s showed the importance of achieving target pasture cover at calving and at balance date, when feed supply equals demand (Bryant et al, 1983). LUDF monitors pasture cover weekly throughout the year. In the winter it manipulates pasture demand (changing cow numbers or using addition feed) to ensure that the average pasture cover has reached the Planned Start of Calving target. It then uses the spring rotation planner and manipulates pasture area allocations to achieve the target average pasture cover at balance date, keeping average pasture cover above 2000 kgDM/ha. This is key to maximising pasture growth as shown in Figure 3. Where average pasture cover dropped below 1900 kg DM/ha on farmlets on the same farm in the same season at Ruakura No2, pasture growth rates were depressed.

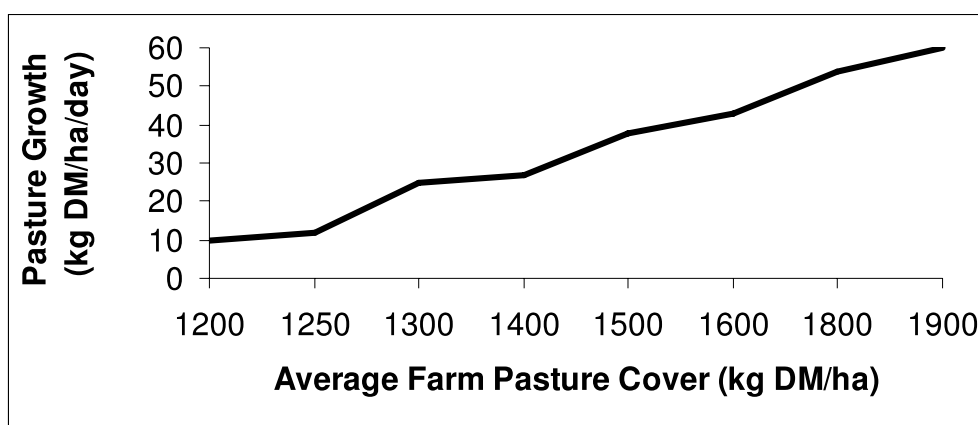


Figure 3: Average farm cover in spring and the effect on pasture growth

The main ways that average pasture covers drop below 1900 kgs DM/ha are:

- the PSC target cover was too low or not achieved
- the rotation lengthen was shortened to early and did not match growth rates

- the rotation length at balance date is less than 20 days thus re-grazing pasture before it has recovered after the previous grazing.

Improved pasture quality results in increased animal intake and performance

Energy is the main driver of intake and milksolids production. As the amount of effective fibre increases in the diet, the energy the cow can extract from the grass decreases. Therefore by increasing the ME per kg DM offered, the total energy intake is lifted as the cow will eat more. For every ME unit increase, the potential intake increases by about 2 kg DM/cow/day, increasing milksolids by about 0.5 kg MS/day as shown in Table 2.

Table 2: The influence of pasture quality on maximum intake and milksolids production (475 kg crossbred with no change in live weight)

Pasture quality		Effect on intake and milksolids	
ME (MJ/kg DM)	Fibre (% NDF)	Max. intake (kg DM/d)	MS (kg/d)
12.0	35-40	18.0	2.3
11.0	40-45	16.0	1.7
10.0	45-50	13.0	1.0
9.0	50-60	11.0	0.6

This principle of higher quality resulting in higher intakes also applies to all supplementary feeds, eg, silage

Pasture management can influence pasture quality

As shown in Table 3, pasture quality on LUDF has increased as they have adopted grazing to a consistent residual of 7 clicks on the RPM and only feeding cows green leafy pasture.

Notes:

Table 3: LUDF MJME/kg DM of pre-grazing pastures

	02/03	03/04	04/05	05/06	06/07
June	11.8	12.3	12.0	12.5	12.6
Oct	10.6	12.3	12.2	12.8	12.9
Dec	11.5	11.5	12.4	11.7	12.4
Feb	11.1	11.8	11.5	12.0	12.0
Average	11.1	12.1	12.2	12.5	12.6

Spring pasture management will impact on summer milksolids production

Several trials have shown that cleaning out paddocks in early spring results in more production in late spring/summer. Table 4 shows the results on subsequent milk production from a grazing intensity trial at Massey University where two grazing intensities, lax 2000-2500 kg DM/ha and intense 1000-1500 kg DM/ha were imposed for two rotations in the spring (Hoogendoorn et al, 1987). The trial emphasised the importance of maintaining green, leafy swards into late spring and summer to maximise milk production by leaving grazing residuals no more than 1500 kg DM/ha throughout the spring.

Table 4: Grazing management in spring and subsequent summer per cow production

Grazing Regime	Spring Lax	Spring Intense
Summer Production	1.51 kgs MS/cow/day	1.74 kgs /cow/day

This also shows that grazing to consistent residuals throughout the season not only applies to an irrigated farm like LUDF, but also to dry land dairy farms.

Cows grazing to 7 clicks (1500 kg DM/ha using the formula $x 140+500$) will achieve 95% of maximum intake

At LUDF 1500 kg DM/ha is the target grazing residual for the milking cows all through the year, with cows being offered pre-grazing covers of up to 4000 kg DM/ha. Cows are returned to the paddock until this grazing residual is achieved (as long as soil conditions allow). These grazing residuals allow 95% of maximum cow intakes to be achieved when cows consistently graze down to 1500 kgs DM/ha (7 “clicks”) as shown in Figure 5.

On LUDF per cow performance in 2002/03 was in the top 10% of herds in Canterbury, cows peaked at 1.9 kg MS/cow/day and produced 380 kgs MS/cow for the season. In subsequent years when the lower grazing residuals were targeted, per cow performance improved dramatically as shown in Table 6.

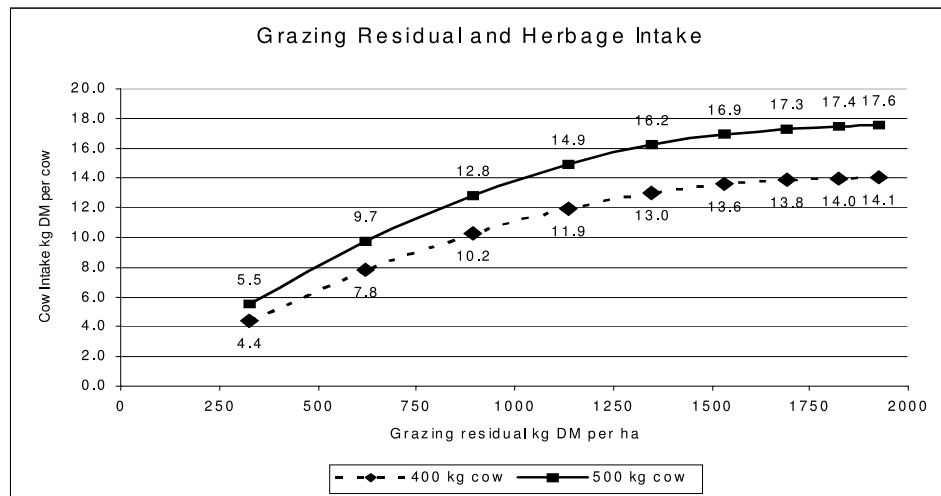


Figure 5: Grazing Residual and Herbage Intake (Glassey et al, 1980)

These curves will be displaced lower if poor quality pasture is presented to cows.

Comparative stocking rate should be between 80 & 90 for Systems 1-3

The optimum stocking rate to maximise operating profit (EFS) for predominately all grass systems is in the range of 80–90 kg Lwt/t DM offered (Penno, 1999). The profit on the LUDF has increased as the farm has lifted the stocking rate to 82-83 kg Lwgt/t DM due to increased ME harvested as shown in Table 8.

Table 5: LUDF Comparative Stocking Rate t DM/kg Lwt

Season	2002/03	2003/04	2004/05	2005/06
CSR	76	79	83	82

Also see Table 6 for the change in Cow efficiency as expressed as kg MS as a % of Lwgt.

Notes:

Use a nutrient budget to decide fertiliser inputs

To ensure that sufficient fertiliser is applied to maximise pasture growth LUDF performs annual soil testing. Samples are taken along the same 10 GPS transects and this information is used in three separate nutrient budgets. One for each of the effluent and non-effluent areas on the milking platform, as well as one for the 18ha support block. The non effluent area of the milking platform also only uses 200 kgs N/ha annually. The effluent area receives no additional N, P or K fertilizer.

Irrigation

During any part of the season when irrigation may be required, weekly soil moisture deficit readings are taken from the three main soil types on the farm.

In each case, irrigation is scheduled to maintain the level of soil moisture at about mid-way between soil capacity and stress point. In the area covered by the Centre Pivot, irrigation can be delayed because the return interval is less than 48 hours. In the areas covered by the K-lines and Long Line Lateral, where the return interval is between six and nine days, we run a more conservative policy and begin irrigating earlier and finishing later.

Cost control

Each year a detailed financial budget is agreed between the Business Advisory Group and the Farm Management Team. This budget is designed to match the requirements of the LUDF Business Plan. In preparation for the drafting of the LUDF Business Plan an analysis is done of the farm situation especially in relation to the availability, quality and price of additional feed. On this basis the Plan is developed with a particular Farm System in mind.

The Farm manager is held responsible, through performance criteria in the employment contract, to stick as closely as possible to budget, especially with costs. Within a week of the end of each month the farm manager must report variance to budget in his Farm Managers Report.

The results Lincoln University Dairy Farm

Table 6: Results for LUDF at \$4.00 payout

	2002/03	2003/04	2004/05	2005/06
Grazing Management	Lax	Ideal	Ideal	Ideal
Kg MS/cow	380	422	428	440
Kg MS/ha	1411	1684	1719	1772
Kg MS as % of Lwgt	78%	86%	88%	90%
Farm Working Expenses \$/kg MS ¹	\$3.12	\$2.64	\$2.64	\$2.68
Operating Expenses \$/kg MS	\$3.67	\$3.10	\$3.04	\$2.99
EFS \$/ha	\$1244	\$1669	\$1769	\$2240
Capital (no increase in land values or share value from 2002)	\$5,136,913	\$5,137,020	\$5,144,613	\$5,198,802
ROA (excl capital gain)	3.9%	5.2%	5.6%	6.9%
Actual Capital	\$5,136,913	\$6,196,900	\$6,465,081	\$6,872,011
ROA (excl capital gain)	3.9%	4.3%	4.4%	5.3%

Note 1: FWE are the cash costs, Operating Expenses include depreciation & adjustments for unpaid labour, owned runoffs and changes in feed inventory. For the LUDF the only increase in costs from FWE to Operating expenses is the inclusion of depreciation.

Notes:

Table 7: Other Details LUDF

	2002/03	2003/04	2004/05	2005/06
Cows wintered	631	671	675	672
Max. cows milked	604	644	650	651
% In-calf at 12 weeks	84%	83%	80%	84%
Kg N/ha	200	200	200	187
Cows wintered on farm	0	0.8 c/ha	1.08 c/ha	1.06 c/ha
Supplements fed to 30 Nov (kg DM/cow)	150	39	4	174
Purchased feed for milkers (kg DM/cow)	550	287	300	310
Silage made on effective milking area (kg DM/ha)	0	392	880	1484
Area regrassed	8 ha	18 ha	10 ha	8.5 ha
Kg MS/Full Time Equivalent	56,793	67,781	69,190	71,463

Table 8: Energy harvested from pasture LUDF

	2002/03	2003/04	2004/05	2005/06
Tonnes DM eaten/ha	14.3	15.3	16.1	16.2
Average MJME/kg DM	11.0	12.0	12.1	12.5
GJME eaten/ha	157	187	192	202
GJME eaten/cow	42.2	47.8	48.5	50.6

Table 9: LUDF Reproduction History

Season	02/03	03/04	04/05	05/06	06/07
PSC	1 Aug	1 Aug	1 Aug	1 Aug	31 July
Days to mid point (all herd)		22	23	12	11
Days to mid point (cows)		22	23	22	16
4 wk calving rate	64	63	61	69	76
% calving month pre calving	14	17	12	12.5	9
% treated as anoestrus		36.7	24.3	14.5	28
% In-calf to 12 weeks mating	84	83	79.5	84	86

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