SIDDC

South Island Dairying Development Centre

Partners Networking To Advance South Island Dairying

Lincoln University
Te Whare Wānaka o Aoraki
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Plant & Food RESEARCH
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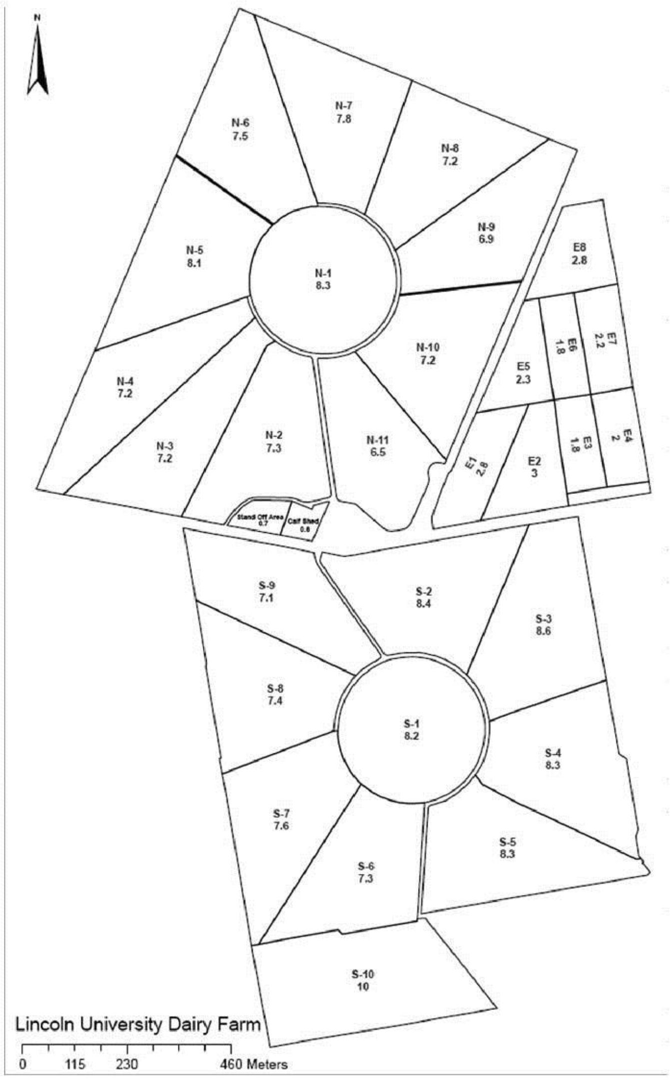
Lincoln University Dairy Farm Focus Day 10 May 2012



Staff

Peter Hancox – Farm Manager
Richard O'Brien, Joshua Grant, Adam Vollebregt and Glen Trayner – Farm Assistants

LUDF Hazards Notification

1. Children are the responsibility of their parent or guardian
2. Normal hazards associated with a dairy farm
3. Other vehicle traffic on farm roads and races
4. Crossing public roads
5. Underpass may be slippery

Please follow instructions given by event organisers or farm staff

Contents

Key Results / Statistics:

Comparison of 2010/11 and forecast results for 2011/12 (as at 1 May 2012)

Inputs	**Units**	**2010/11**	**2011/12**	**Difference**
Milking Platform Area		160	160	
Stocking rate	cows/ha	4.17	3.95	-5.2%
Stocking rate	kg LW/ha	1960	1911	-2.5%
Cows wintered		694	662	-4.6%
Cows at peak		667	632	-5.2%
Winter spring cow wastage		3.9%	4.5%	
Replacements R2's entering the herd		161	141	-12.4%
Replacements as % of cows wintered		23%	21%	
Whole Herd Average Liveweight at Dec 1st		452	471	4.2%
Whole Herd LW at mid April		488	501	2.7%
First Calvers Liveweight – mid April		424	458	
Silage fed	t DM	308	327	6.2%
Bought silage fed	t DM	204	227	11.3%
Winter feed purchased - cow grazing days	days	46,670	43,500	-6.8%
Total N fert - applied to the milking platform	t N	41.6	56.8	36.5%
	kgN/eff ha	260	355	36.5%
Eco-n used - Number applications		x 2	x 4	
Gibberellic Acid - Rounds applied		0	2.1	
Irrigation mm		597	311	-47.9%
Rainfall – August - April		473	476	
Staff		3.6	3.6	
Area Mown pre grazing		0	162	
Area Mown post grazing		0	35	
Silage Area Mown		56	46	-17.9%
Diesel - Ute and Tractor	litres	6,744	6,780	0.5%
Location of wintering was further from home in 10/11				
Tractor Hours			+ 100 hrs (mowing)	

Key Outputs	**Units**	**2010/11**	**2011/12**	**Difference**
Milksolids	kgms	264,460	294,000	11.2%
	kg ms/cow	398	465	16.8%
	kg ms/ha	1,653	1,837	11.1%
Days In Milk		271	270-275	
Percentage Peak Cows in Milk 1 May		84%	92%	
Reproduction				
6 week in calf rate	%	72	73	1.4%
In calf at 10 weeks	%	87	87	0.0%
Death rate		16 cows	10 cows	
		2.3%	1.5%	
Key ratios - use of inputs				
Pasture				
kgDM eaten/kgms		11.4	10.7	-6.1%
Pasture eaten	t DM	15	16.1	7.3%
MJME/ha estimated		180,000	194,000	7.8%
Staff	kgms/FTE	73,461	81,667	
	Cows/FTE	185	176	
Grazable time (Ave for whole herd)	Hrs per day	18	20	

Assumes 3 hours out of the paddock each milking as a single herd, vs 2.5 hours each milking for 2/3 herd and 1 hour each milking for 1/3 herd

Forecast Production, Income, Expenses and Profit.

Season	2011/12 *Forecast at 1 May 2012 -*	Budget 2012	*2010/11* *Adjusted to 2011/12 income*	Variance 2011/12 actual less 2010/11 actual
Land area	160.0ha			
Peak Cow Numbers	632cows	640cows	*667cows*	
Total Milk Production	294,000 kgMS	281,600 kgMS	*264,460 kgMS*	29,540 kgMS
Milk Production per ha	1,838/ha	1,760/ha	*1,653/ha*	185/ha
Milk Production per cow	465kgMS/cow	440kgMS/cow	*396kgMS/cow*	69kgMS/cow
Income				$ change
Milksolids $6.35/kgMS	$1,866,900	$1,788,160	*$1,679,321*	$187,579
Dividend $0.30/share	$88,200	$84,480	*$84,300*	$3,900
Livestock sales	$178,200	$133,967	*$161,177*	$17,023
Less Stock Purchases	$21,600	$21,600	*$21,600*	$0
Gross Farm Revenue	**$2,111,700**	**$1,985,007**	***$1,903,198***	$208,502
Expenses				
Administration	$20,000	$24,050	*$20,170*	-$170
Animal Health	$59,313	$55,341	*$59,577*	-$264
Breeding Expenses	$52,394	$43,905	*$49,310*	$3,084
Electricity - Farm	$22,208	$19,500	*$19,802*	$2,406
Employment	$223,384	$229,494	*$228,011*	-$4,627
Grass silage purchase	$65,830	$73,950	*$57,358*	$8,472
Silage making & delivery	$11,902	$26,880	*$12,014*	-$112
Replacement grazing & calf feed	$164,738	$133,343	*$133,743*	$30,995
Winter grazing - Herd incl. Freight	$106,687	$122,687	*$126,678*	-$19,991
Eco-n & GA	$74,763	$51,200	*$31,000*	$43,763
Nitrogen	$109,324	$76,344	*$68,158*	$41,166
Fertiliser & Lime	$44,005	$38,197	*$32,262*	$11,743
Freight & Cartage	$580	$800	*$23*	$557
Irrigation - all costs	$54,874	$68,000	*$63,806*	-$8,932
Rates & Insurance	$19,020	$19,020	*$16,262*	$2,758
Re-grassing	$26,130	$26,130	*$22,490*	$3,640
Repairs & Maintenance	$56,500	$45,500	*$52,109*	$4,391
Shed Expenses excl. Power	$12,000	$8,200	*$5,535*	$6,465
Vehicle Expenses	$23,139	$20,000	*$22,140*	$999
Weed & Pest	$972	$500	*$1,639*	-$667
Cash Farm Working Expenses	**$1,147,763**	**$1,083,041**	***$1,022,087***	$125,676
FWE $/kgMS	$3.90	$3.85	$3.86	
Depreciation est	$116,000	$116,000	$105,000	$11,000
Total Operating Expenses	$1,263,763	$1,199,041	$1,127,087	$136,676
Dairy Operating Profit	$847,937	$785,966	$776,111	$71,826
DOP/ha	$5,300	$4,912	$4,851	$449
Cash Operating Surplus	$963,937	$901,966	$881,111	$82,826
Cash Operating Surplus /ha	$6,025	$5,637	$5,507	$518

Notes:

1. Revenue has been adjusted to current milk price and stock values for both years.
2. 2011/12 production, income and expenses are forecast to the end of the season.
3. Depreciation estimate includes addition of Automatic Cup Removers at the beginning of the 2011/12 season and other adjustments to the depreciation schedule.
4. Nitrogen application costs ($13,000) were unintentionally excluded from the budgeted N costs in 2011/12.

Summary of changes from last year:

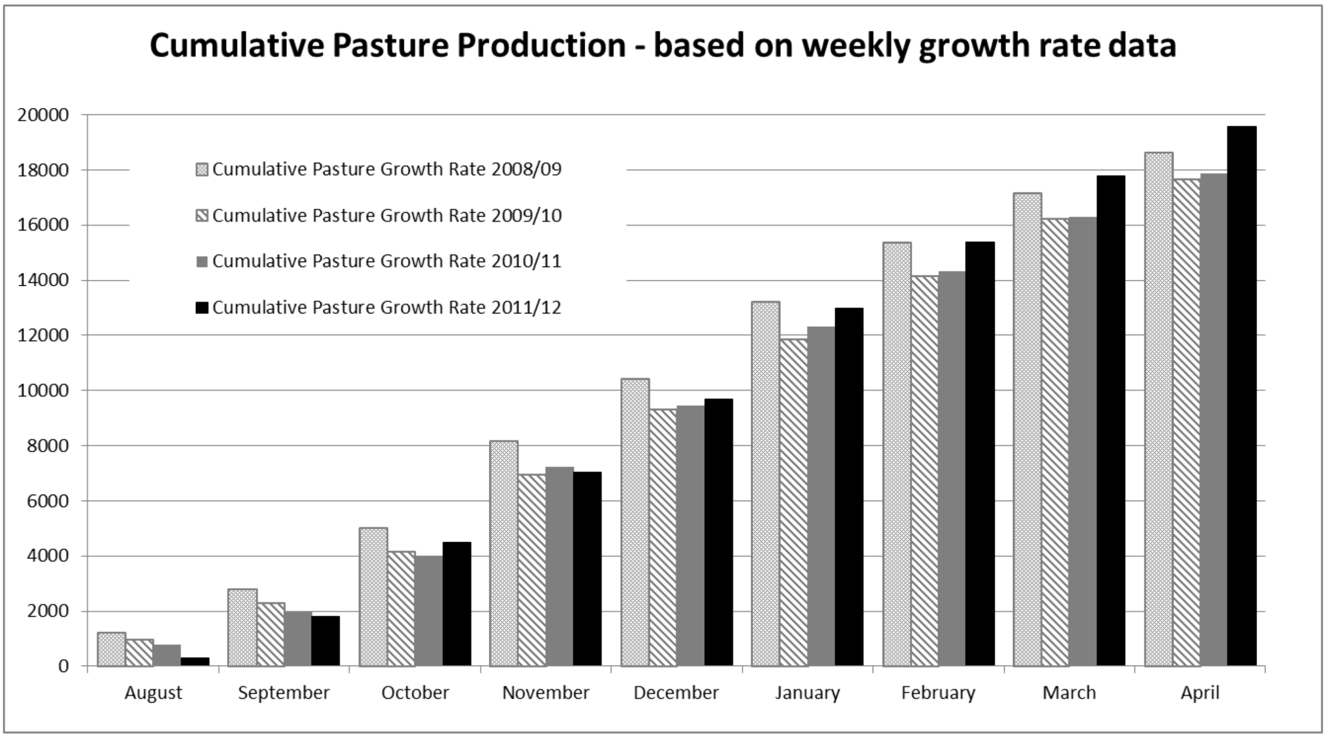
Milk Production is forecast to be 29,540 kgMS higher, giving additional income of $196,441.
Actual costs are $125,000 higher than last year. Cash Operating Surplus is nearly 10% higher than 2010/11 on the same income basis.

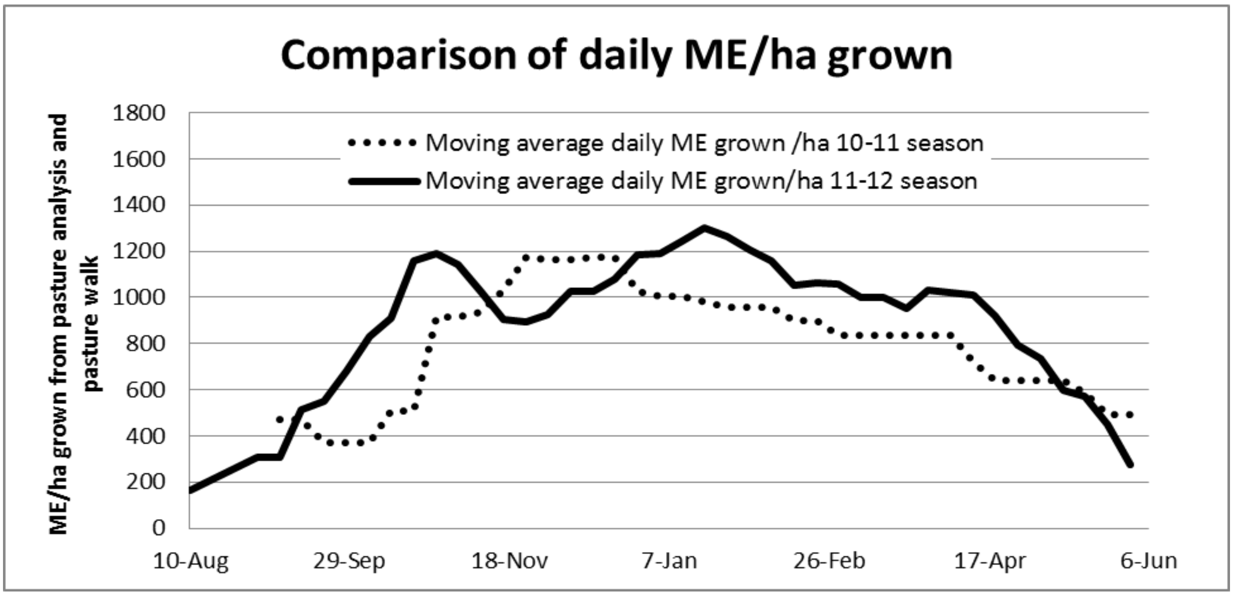
Further analysis, however, shows the changes in cost above include both changes to the volume of inputs as well as cost changes; it is likely that about half of the above variance would have been incurred without any change to the farming system. Adjusting for these changes indicates LUDF has spent approximately $63,700 more this year, to produce a forecast additional 29,540 kgMS, resulting in additional profit of $132,740 (17% increase in profit compared to last years farm system).

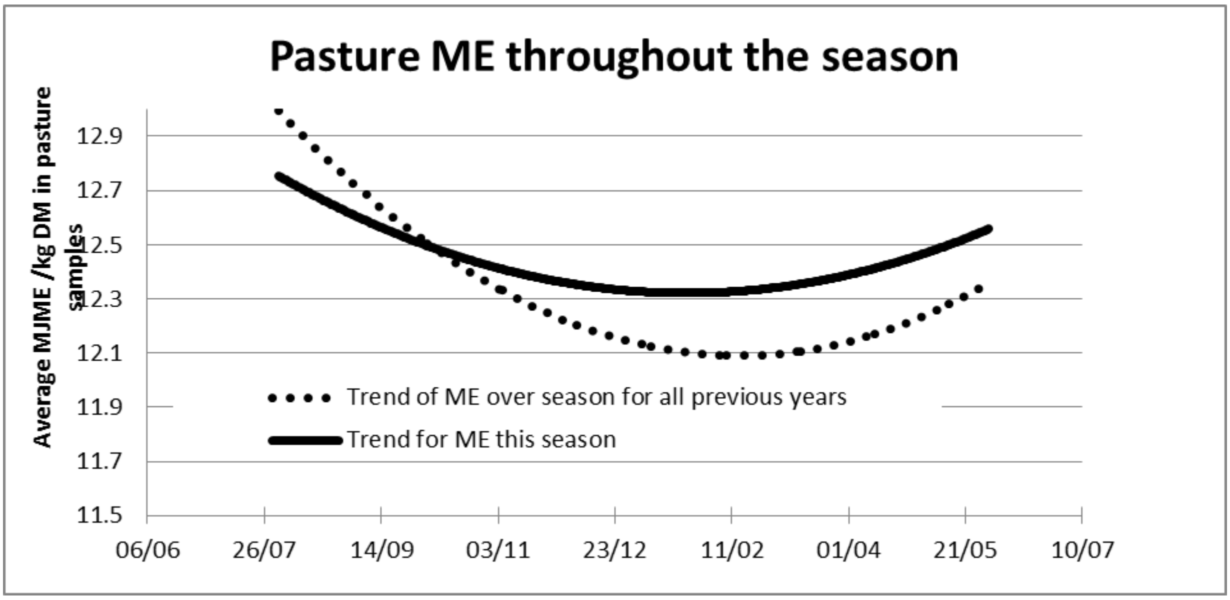
Expense changes directly related to change in LUDF system compared to last year:

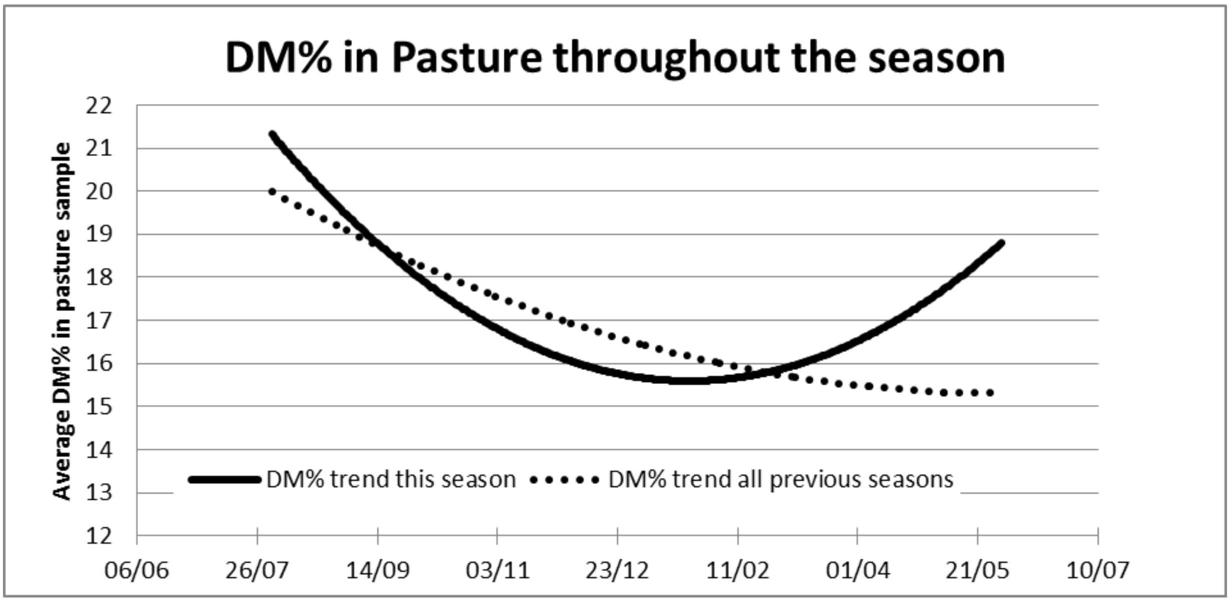
Grass silage purchased	$7,130	3 cents more /kgDM, 11% more silage purchased
Winter grazing - Herd incl freight	-$19,991	Fewer cows wintered
Eco-n & GA	$32,000	Additional 2 applications eco-n
Nitrogen	$29,184	Additional 100kgN/ha applied, 24c/kgN increased cost
Fertiliser & Lime	$11,743	Add Capital fert and spreading and lime
Regrassing	$3640	3rd paddock but less oversowing in spring
Total	$63,706 / $398/ha	

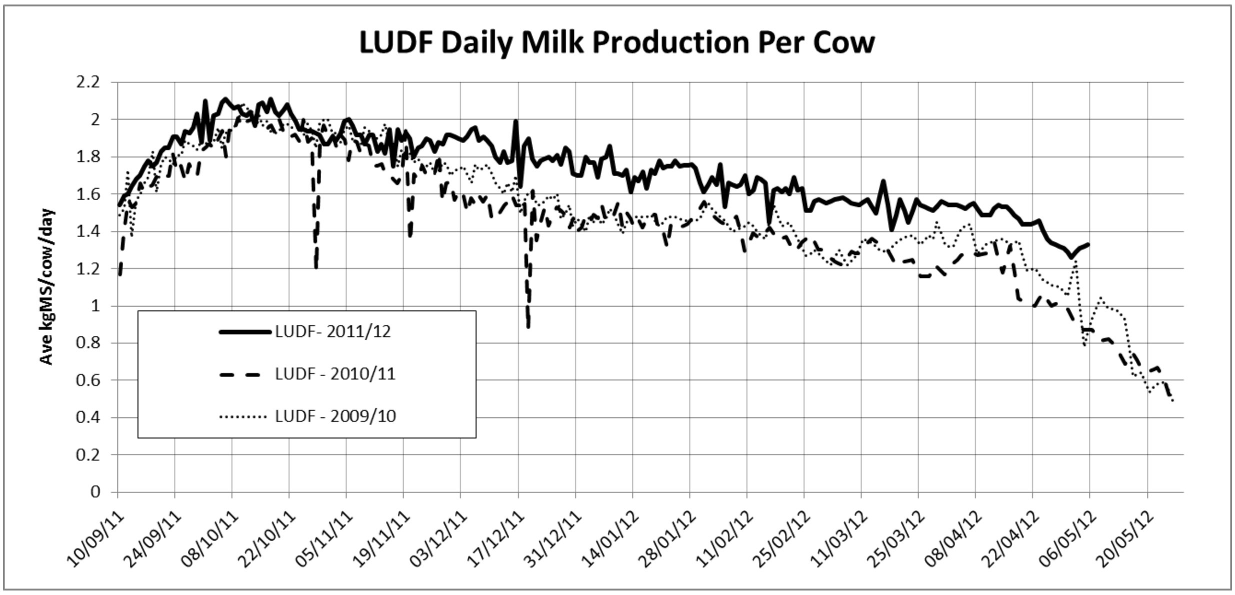
It is estimated the extra N provide feed at a similar cost to buying in alternative feed of the same yield and energy.

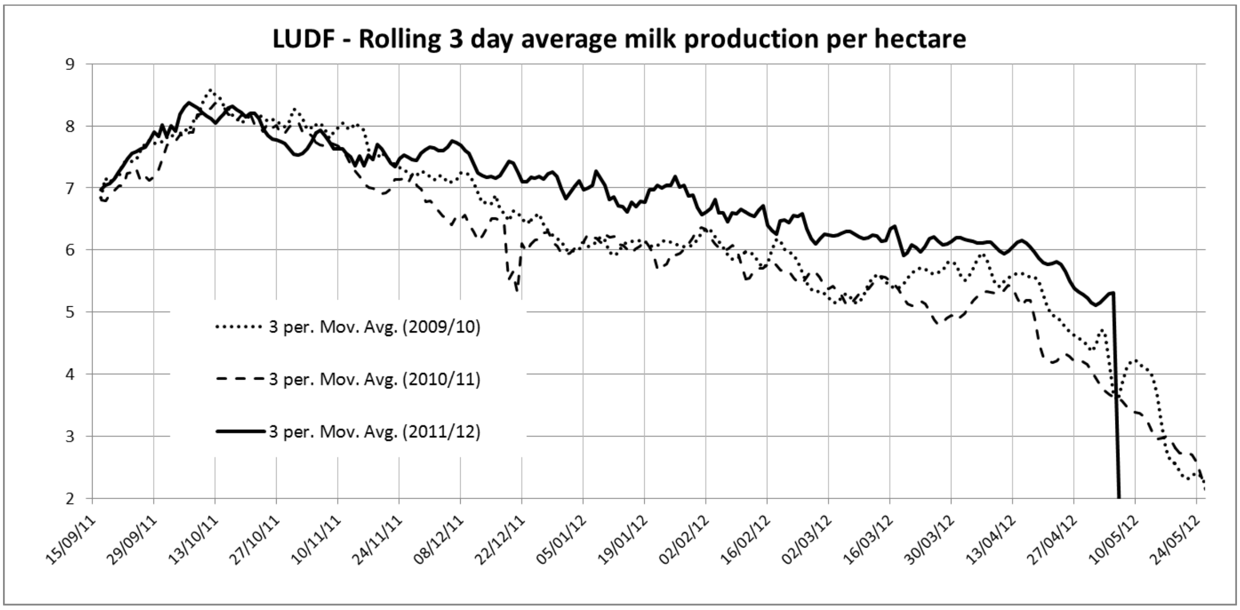



Comparison of daily ME/ha grown
ME/ha grown from pasture analysis and pasture walk
Moving average daily ME grown /ha 10-11 season
Moving average daily ME grown/ha 11-12 season
0
200
400
600
800
1000
1200
1400
1600
1800
10-Aug
29-Sep
18-Nov
7-Jan
26-Feb
17-Apr
6-Jun


Pasture ME throughout the season
Average MJME /kg DM in pasture samples
Trend of ME over season for all previous years
Trend for ME this season
11.5
11.7
11.9
12.1
12.3
12.5
12.7
12.9
06/06
26/07
14/09
03/11
23/12
11/02
01/04
21/05
10/07


DM% in Pasture throughout the season
Average DM% in pasture sample
DM% trend this season
DM% trend all previous seasons
12
13
14
15
16
17
18
19
20
21
22
06/06
26/07
14/09
03/11
23/12
11/02
01/04
21/05
10/07


LUDF Daily Milk Production Per Cow
Ave kgMS/cow/day
LUDF- 2011/12
LUDF - 2010/11
LUDF - 2009/10
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
10/09/11
24/09/11
08/10/11
22/10/11
05/11/11
19/11/11
03/12/11
17/12/11
31/12/11
14/01/12
28/01/12
11/02/12
25/02/12
11/03/12
25/03/12
08/04/12
22/04/12
06/05/12
20/05/12


LUDF - Rolling 3 day average milk production per hectare
3 per. Mov. Avg. (2009/10)
3 per. Mov. Avg. (2010/11)
3 per. Mov. Avg. (2011/12)
9
8
7
6
5
4
3
2
15/09/11
29/09/11
13/10/11
27/10/11
10/11/11
24/11/11
08/12/11
22/12/11
05/01/12
19/01/12
02/02/12
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02/03/12
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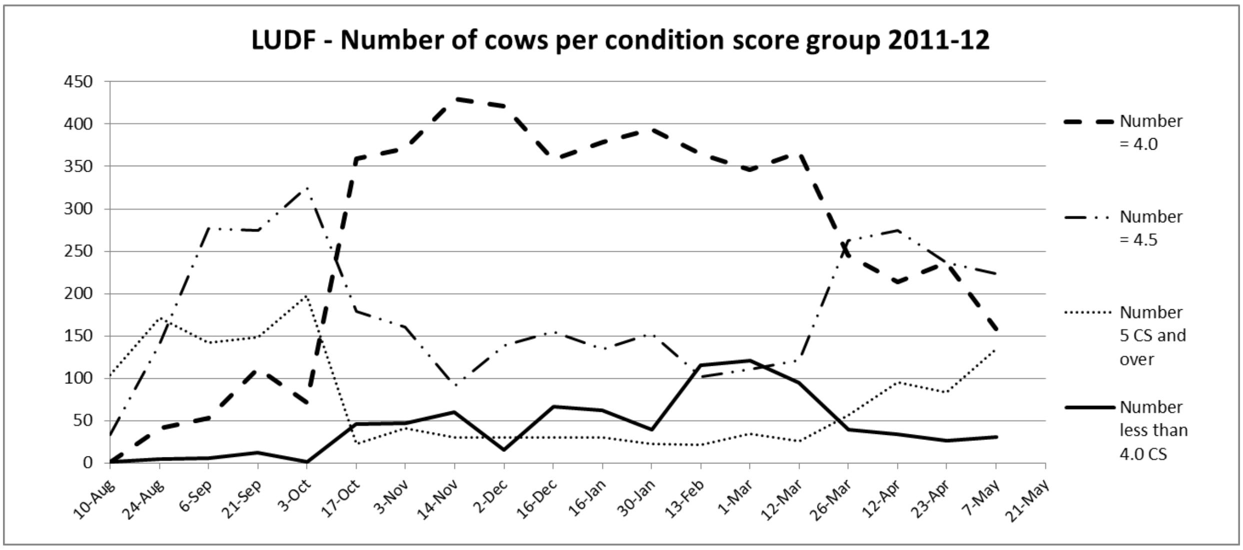
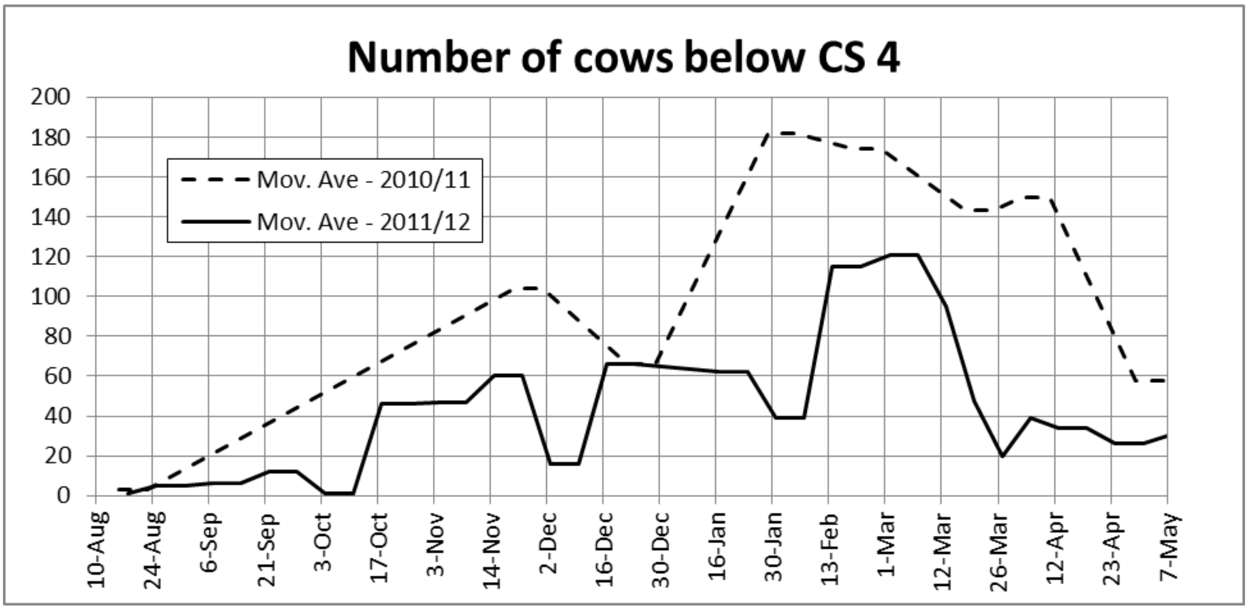
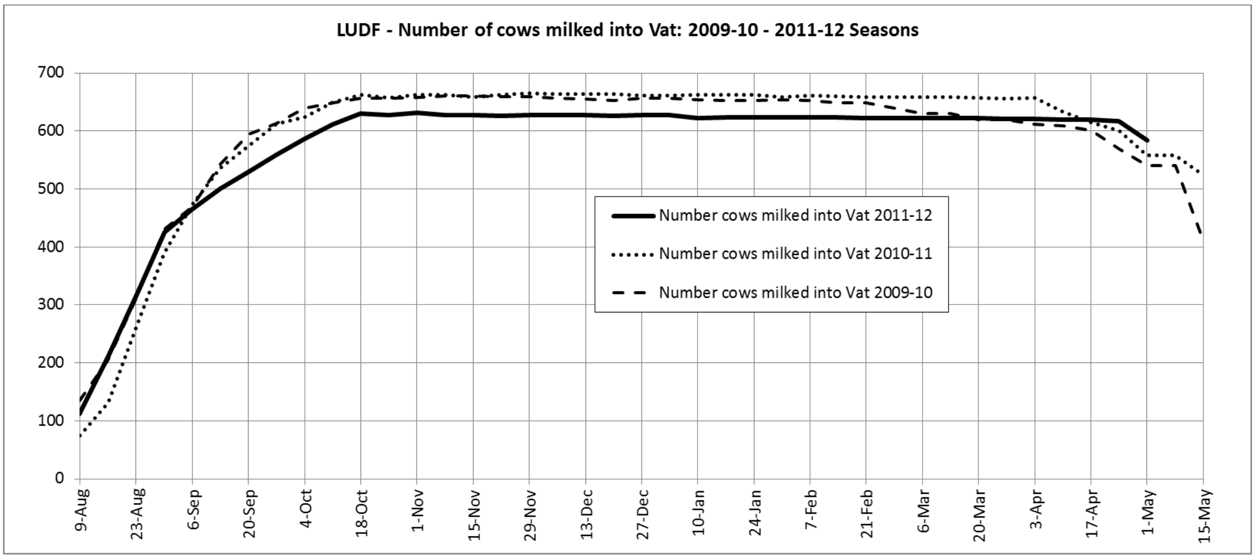
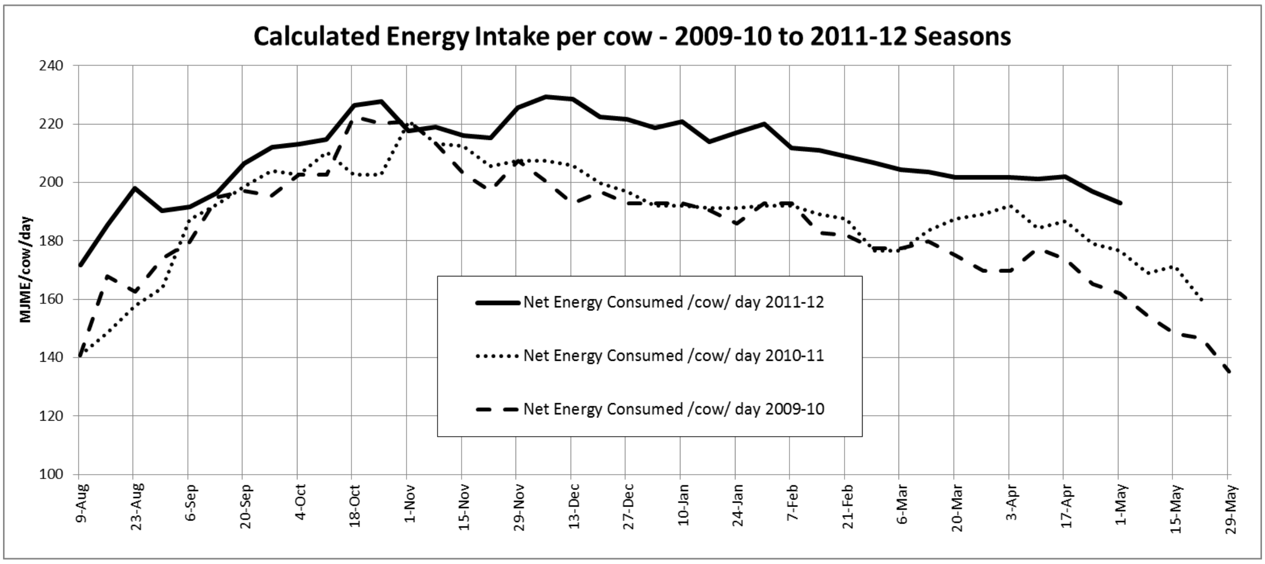
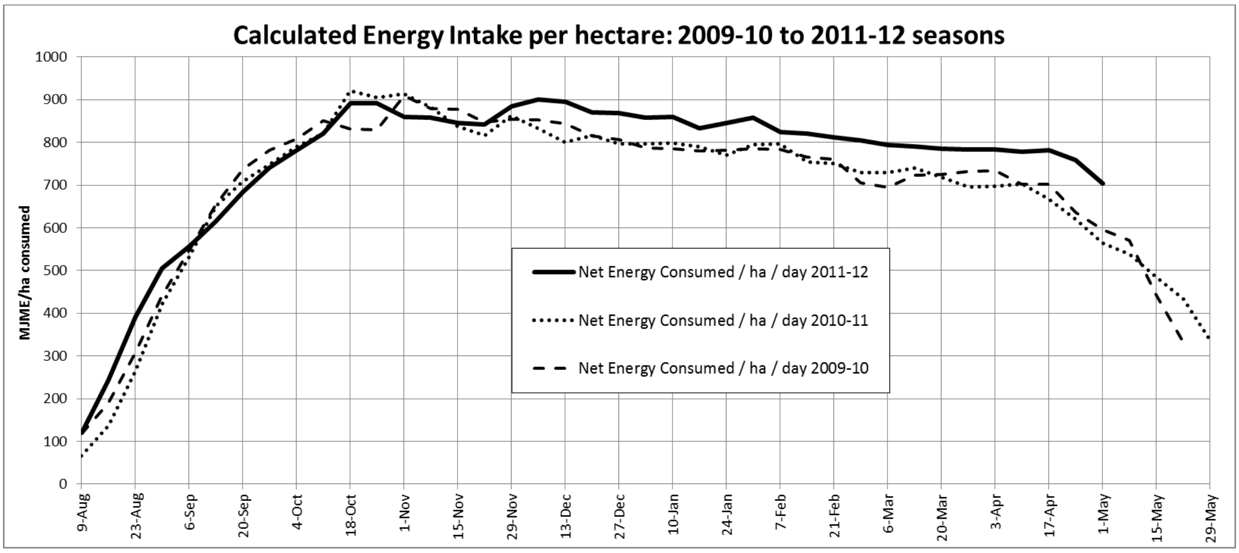
30/03/12
13/04/12
27/04/12
10/05/12
24/05/12


LUDF - Number of cows per condition score group 2011-12
Number = 4.0
Number = 4.5
Number 5 CS and over
Number less than 4.0 CS
450
400
350
300
250
200
150
100
50
0
10-Aug
24-Aug
6-Sep
21-Sep
3-Oct
17-Oct
3-Nov
14-Nov
2-Dec
16-Dec
16-Jan
30-Jan
13-Feb
1-Mar
12-Mar
26-Mar
12-Apr
23-Apr
7-May
21-May

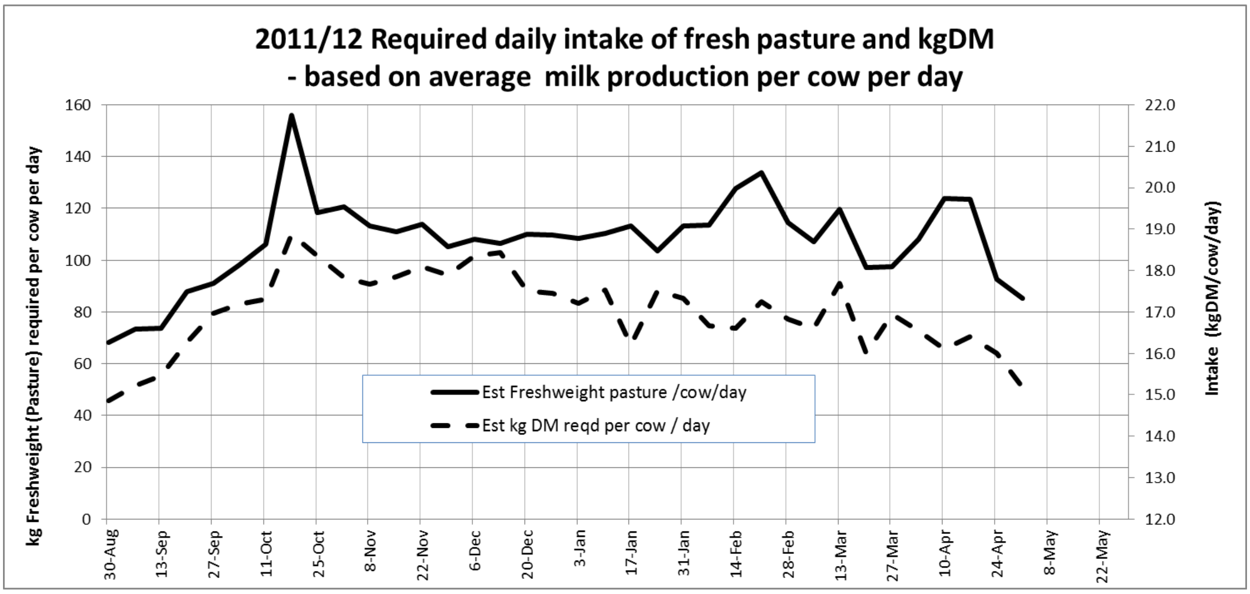

Number of cows below CS 4
Mov. Ave - 2010/11
Mov. Ave - 2011/12
0
20
40
60
80
100
120
140
160
180
200
10-Aug
24-Aug
6-Sep
21-Sep
3-Oct
17-Oct
3-Nov
14-Nov
2-Dec
16-Dec
30-Dec
16-Jan
30-Jan
13-Feb
1-Mar
12-Mar
26-Mar
12-Apr
23-Apr
7-May


LUDF - Number of cows milked into Vat: 2009-10 - 2011-12 Seasons
Number cows milked into Vat 2011-12
Number cows milked into Vat 2010-11
Number cows milked into Vat 2009-10
0
100
200
300
400
500
600
700
9-Aug
23-Aug
6-Sep
20-Sep
4-Oct
18-Oct
1-Nov
15-Nov
29-Nov
13-Dec
27-Dec
10-Jan
24-Jan
7-Feb
21-Feb
6-Mar
20-Mar
3-Apr
17-Apr
1-May
15-May


Calculated Energy Intake per cow - 2009-10 to 2011-12 Seasons
MJME/cow/day
Net Energy Consumed /cow/ day 2011-12
Net Energy Consumed /cow/ day 2010-11
Net Energy Consumed /cow/ day 2009-10
100
120
140
160
180
200
220
240
9-Aug
23-Aug
6-Sep
20-Sep
4-Oct
18-Oct
1-Nov
15-Nov
29-Nov
13-Dec
27-Dec
10-Jan
24-Jan
7-Feb
21-Feb
6-Mar
20-Mar
3-Apr
17-Apr
1-May
15-May
29-May



Calculated Energy Intake per hectare: 2009-10 to 2011-12 seasons
MJME/ha consumed
Net Energy Consumed / ha / day 2011-12
Net Energy Consumed / ha / day 2010-11
Net Energy Consumed / ha / day 2009-10
0
100
200
300
400
500
600
700
800
900
1000
9-Aug
23-Aug
6-Sep
20-Sep
4-Oct
18-Oct
1-Nov
15-Nov
29-Nov
13-Dec
27-Dec
10-Jan
24-Jan
7-Feb
21-Feb
6-Mar
20-Mar
3-Apr
17-Apr
1-May
15-May
29-May



2011/12 Required daily intake of fresh pasture and kgDM
- based on average milk production per cow per day
kg Freshweight (Pasture) required per cow per day
Intake (kgDM/cow/day)
Est Freshweight pasture /cow/day
Est kg DM reqd per cow / day
0
20
40
60
80
100
120
140
160
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
30-Aug
13-Sep
27-Sep
11-Oct
25-Oct
8-Nov
22-Nov
6-Dec
20-Dec
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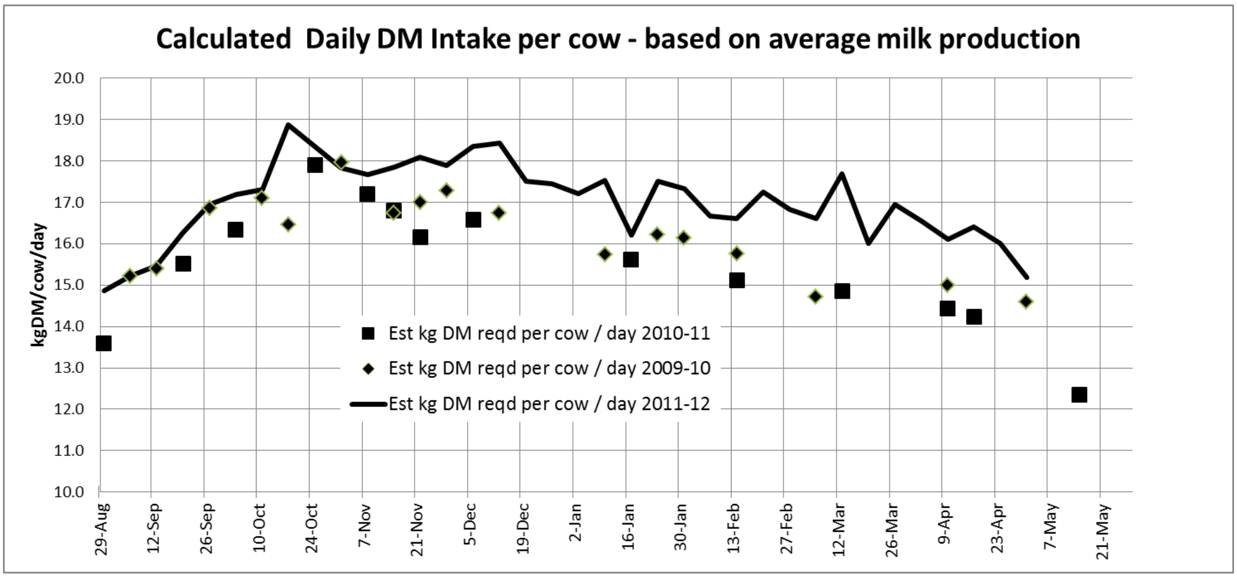
31-Jan
14-Feb
28-Feb
13-Mar
27-Mar
10-Apr
24-Apr
8-May
22-May



Calculated Daily DM Intake per cow - based on average milk production
kgDM/cow/day
Est kg DM reqd per cow / day 2010-11
Est kg DM reqd per cow / day 2009-10
Est kg DM reqd per cow / day 2011-12
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
29-Aug
12-Sep
26-Sep
10-Oct
24-Oct
7-Nov
21-Nov
5-Dec
19-Dec
2-Jan
16-Jan
30-Jan
13-Feb
27-Feb
12-Mar
26-Mar
9-Apr
23-Apr
7-May
21-May

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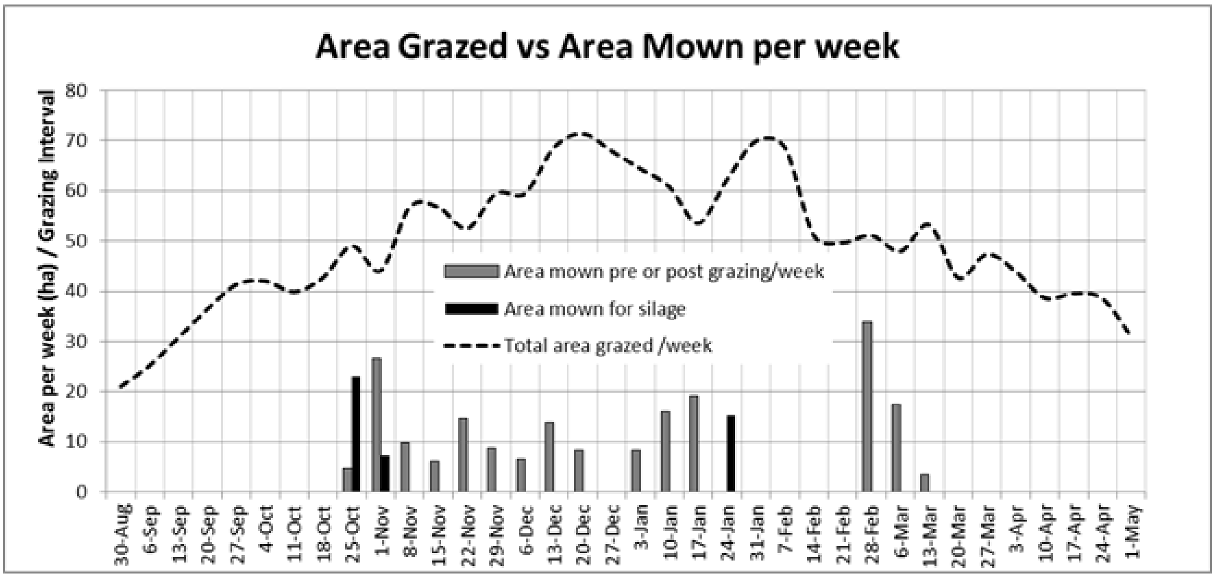


Top Ten Changes at LUDF this season:

1. Focussed on Intake AND Residuals
2. Run two herds with small herd of younger / thinner cows (until late April)
3. Increased pasture produced with additional N and GA
4. Used mowing pre-grazing to aid daily energy intake and assist with managing residuals
5. Started season with intent to feed cows and risk pasture damage, not solely protect pasture
6. Considered cows, grazing appearance, milk volume, rotation length and pre-grazing cover in allocating feed
7. Fewer total cows but emphasis on producing more milk per cow – less cows wintered reduces winter footprint
8. More use of eco-n to retain N in the soil for future pasture production
9. Focus has changed from looking at averages to minimum targets and a more precise approach, identifying low performers [eg. low BCS cows] and putting changes in place to remedy low performance.
10. Planned and regrassed 15% of the platform.

Changes to LUDF – Expected results and Results to date

Changes	Expected results	Results to mid-October	Results to End April
Herd Dynamics			
1. Herd size	Increased productivity resulting in increased production per cow, per hectare and in total	Higher production per cow, giving better or same production per hectare	Per cow production: 445kg/cow at 1 May 2012 vs 381 kg per cow at 3 May 2011. 1758 kg MS/ha this year vs 1585 kgMS/ha last year
2. Culling to achieve lower herd size	Low producing cows (negative $PW) and high SCC cows were culled	Will be contributing to above	Fewer poor performing cows in herd.
3. Cows with recurring / problem mastitis culled at end of last season	Less milk production lost to mastitis, less infection into rest of herd	Treated 38 cases Mastitis this year compared to 32 at the same point last year. SCC lower than past years	SCC av season to date 152, last year 222.
4. Herd Age Structure	Dropping replacement rate from 25-27% (last 2 seasons) to 22% this year should increase total milk production.	Not yet quantified in milksolids production – first herd test delayed till 17 October	Part of above per cow production average.
Feed Production			
5. Soil testing of individual paddocks	Vary fertiliser application according to individual paddock soil test levels, including applying capital fertiliser as required (and reducing maintenance where appropriate)	Whole farm average Olsen P test (last year) was 32. This year's paddock testing gave a range from 23 – 48. Targeted Olsen P is 35-40. Different rates of P fertiliser are being applied to achieve the target. Four paddocks have pH less than 6 and will receive some lime	During the season a visual soil assessment was carried out which will assist in formulating soil management strategies in the future. This may be of particular relevance on the heavier soils which we know tend to have lower pasture persistency
6. More Nitrogen Fertiliser	LUDF has reliable water, sunshine, fertility and productive pasture species, but was affected by CRW damage last year. As a high yield environment often appearing N limited, additional N has the potential to increase home grown pasture production	Actual application to end September similar to previous years but lower than last year	Shoulder applications were the same or lower than past years, but increased use of N during summer [high potential growth period]
7. Use of Gibberellic Acid (Express)	Additional pasture production on the shoulders of the season, additional feed from the platform reducing bought in feed	75% of the farm has had an application of Express. The control strip without Express was visible for 2 weeks post application. At grazing estimate was about 300kgDM yield gain	226 ha applied in spring and 108 ha in Autumn. GA appeared to grow extra pasture in shoulder periods. Decided not to apply to pastures less than 1 year old.
8. Increased Pasture Renovation (from 10% to 15% per year	Tetraploid Species have proven to be easier to manage (at higher pre-grazing levels), and	First paddock has been sprayed out and should be drilled before the end of October. This is 3-4	This worked out well with the last paddock, N10, well and truly back in

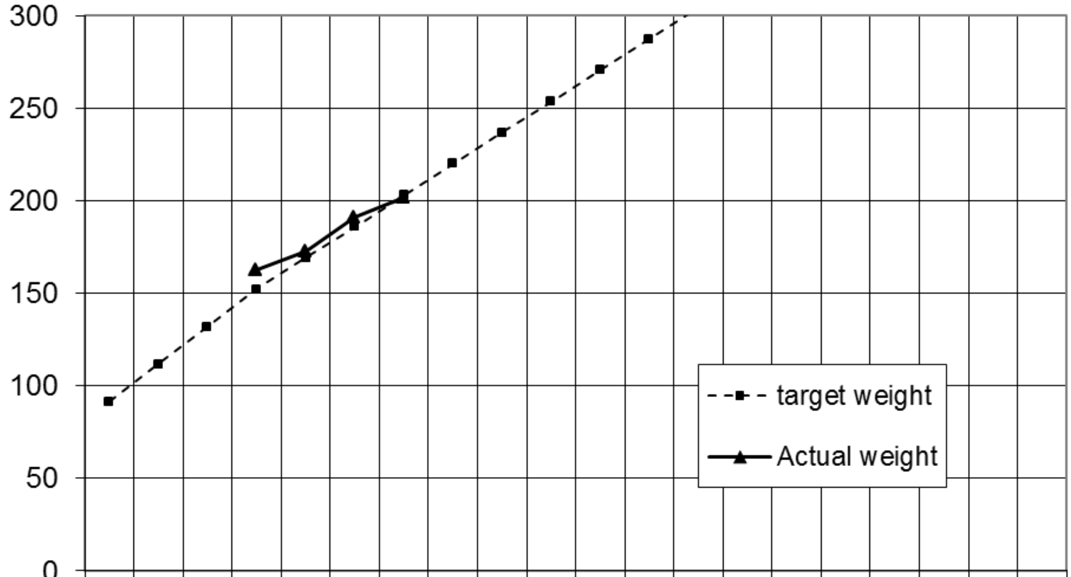
– 10 year cycle to 7 year cycle)	give high yields of DM and ME. Increasing pasture renovation potentially allows more energy production and consumption. Also 'direct drill' into existing pasture to patch any areas damaged by pugging, overgrazing etc	weeks earlier than normal. Better spring conditions have only required 2-3 ha of direct drilling this season. Direct drilled N11 with Bealey and Clover to attempt increasing production of this paddock	production by early March when we needed it.
9. Overdrill clover seed - CRW removed much of the clover on farm last season with buried seed testing indicating little residual clover seed	Clover contribution to the diet restored to pre CRW levels (or similar). Pasture N supply from clover increased	Clover appears to be emerging this season with little apparent CRW effect at present. CRW monitoring last month indicated CRW larval populations remain very low but this is probably a reflection of low levels of white clover.	Difficult to gauge success of oversowing clover seed. Clover population has certainly recovered but still a long way to go to pre CRW state.
Feed Management / Feed Offered			
10. Ensure feed offered / intake meets demands	Cows producing over 2kgMS/cow/day require approx. 210 MJME/day – allowing for a small amount of weight loss. Offering less than this reduces milk production or increases loss of condition score Net energy gained from requiring the whole herd to graze the last 100-200kg DM/ha may not benefit productivity. Slower drop from peak milk prod'n leading to more total milk More cows in milk in later part of season (ie avoid early drying off based on low BCS)	Production holding over 2kgMS, BSC acceptable, intake matches expectation / back calculation on feed offered, Pasture quality samples confirm energy concentration Research is underway measuring pasture disappearance during grazing events to aid understanding of the 'cow costs' of grazing	We have been able to maintain cows DM intake through the whole season. Recovery of BCS has been slower than expected but LWT gain has been considerably better with whole herd producing 1.47/cow/day on 1 May 2012 vs 1.1 kg MS/cow/day on 3-May 2011. Cow LWT for same dates [whole herd]: 506kg vs 482kg
11. Running two herds	• Higher intake (especially in young cows) • less cow condition loss • higher milk prod'n per cow • more days in milk • longer productive life • less time on yard (out of paddock), less stress from large herd dynamics, other cows etc	CS of individual cows shows range of CS better than normally observed at this point The small herd is typically only in the shed for 45 minutes per milking, vs up to 2.5 hours if in a single herd	In February 2011, 182 cows were below CS 4 vs 115 this February. At end April last year 58 cows were still below CS 4 whereas only 26 are below 4 this year. First Calvers Liveweight – mid April 2011 was 424kg (ave) vs 458 kg (ave) this autumn.
12. Weekly pasture quality samples / on-farm DM assessment	More frequent and faster analysis will assist allocation of adequate pasture to meet energy demands / and pre-graze mowing if required to increase intake	Weekly quality samples confirm allocation providing adequate energy – confirmed by BCS and milk production	This has been useful and shown us how pasture quality follows a seasonal pattern and potentially impacts on cow intakes
13. Ensure intake acceptable if standing cows off pasture	Grazing time can be severely restricted when standing off to avoid pasture damage. Had planned to feed silage to increase intake	Had very limited time standing off	

14. Increased range of tools to achieve grazing residuals (pre-grazing mowing, silage, 2nd herd etc)	Pasture quality and desired intake achieved leading to increased milk production with little additional cost – resulting in overall benefit (not net cost)	Post grazing pasture quality achieved in all but a small number of cases. BCS and production on target	These tools have been effective, we will look to be a little more proactive with them next season
Environmental Management / Footprint Impacts			
15. More Eco-n	To further minimise the farm's impact on the environment, more eco-n will be used. No increase in nitrogen losses even as production per hectare increases.	The eco-n application rate was doubled for the July application Modelling shows no change (July 2011 focus day handout). Data to be collected over time.	An additional, March application of eco-n applied to target more autumn urine deposition. More results below
16. Less / no increase in purchased feed	Total land area required to support LUDF holds or decreases	Not yet available	Additional 23 tonnes DM purchased and fed this season – as baled silage
17. Fewer cows wintered, less replacements	Lower costs for wintering, replacement grazing, lower environmental footprint due to fewer total animals / higher lifetime productivity per animal		32 less cows wintered, 20 less replacements. Effects of reduced numbers still to be quantified
Other Impacts			
18. Lameness / sore feet	Less time on the yard / less pressure in the races MAY aid lameness		Lameness is still an issue, both white line and footrot. We have done a Healthy Hoof assessment and training. Also filled around water troughs, reviewed backing gate management and identified an issue with the unloading area in the dairy which we will expand to give cows more space to turn on.
Profitability			
19. Herd structure, numbers, feed production, feed allocation etc	More milk income Less replacements and less cows wintered (reducing wintering costs and environmental effects from wintering cows) Increased on farm feed production costs Less bought in feed	Season started well, to be reported as season progresses	Reported elsewhere in these notes

What's not changing at LUDF:

1. Milk production from pasture:	LUDF is seeking higher production from pasture, through growing more pasture and achieving higher productivity (efficiency) in conversion of pasture to milk.
2. Consistent Grazing Residuals:	Consistently grazing to the same residual is well proven contributor to profit. How LUDF achieves a consistent residual may vary, but the focus on consistent grazing residuals does not.
3. Back fencing to minimise over grazing – especially early in the first rotation.	With 2 herds, this has been more of an issue this year. Avoiding re-grazing of paddocks is an important part of getting high annual pasture DM production.
4. Number of staff on farm	ACR have been installed – allowing one person to milk and the other person previously milking to retrieve the other herd.
5. Focus on tight calving period, healthy animals, good farm management etc	

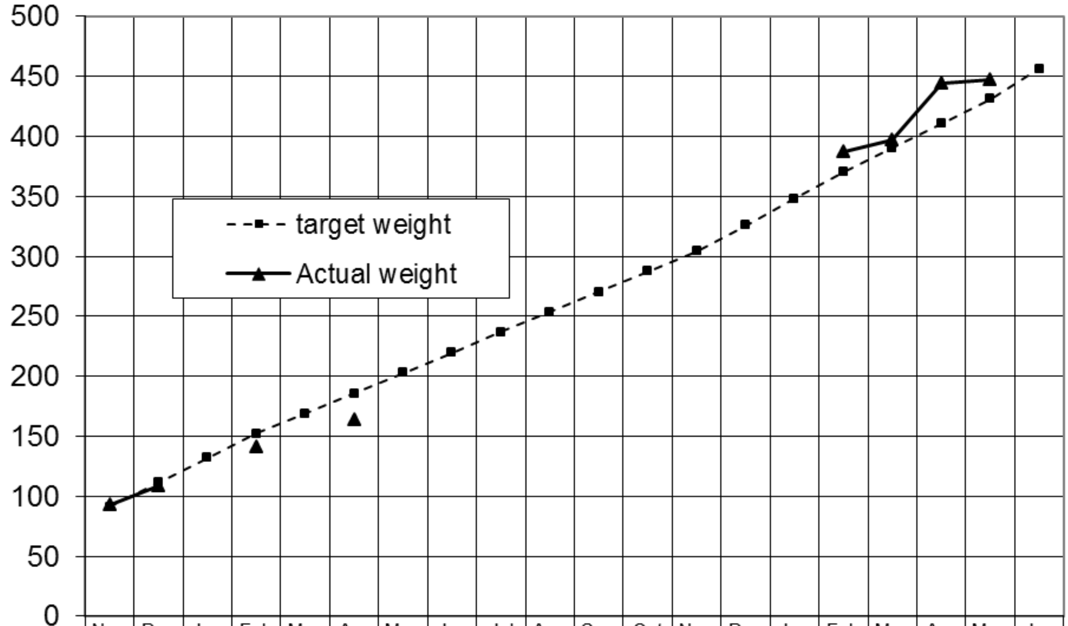
LUDF Replacement Heifer liveweights 2011 born



	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
target weight	91	112	132	152	169	186	203	220	237	254	270	287	304	326	348	370	391	411	431	456
Actual weight				163	173	191	202													

Mid month Liveweight

LUDF Replacement Heifer liveweights 2010 born

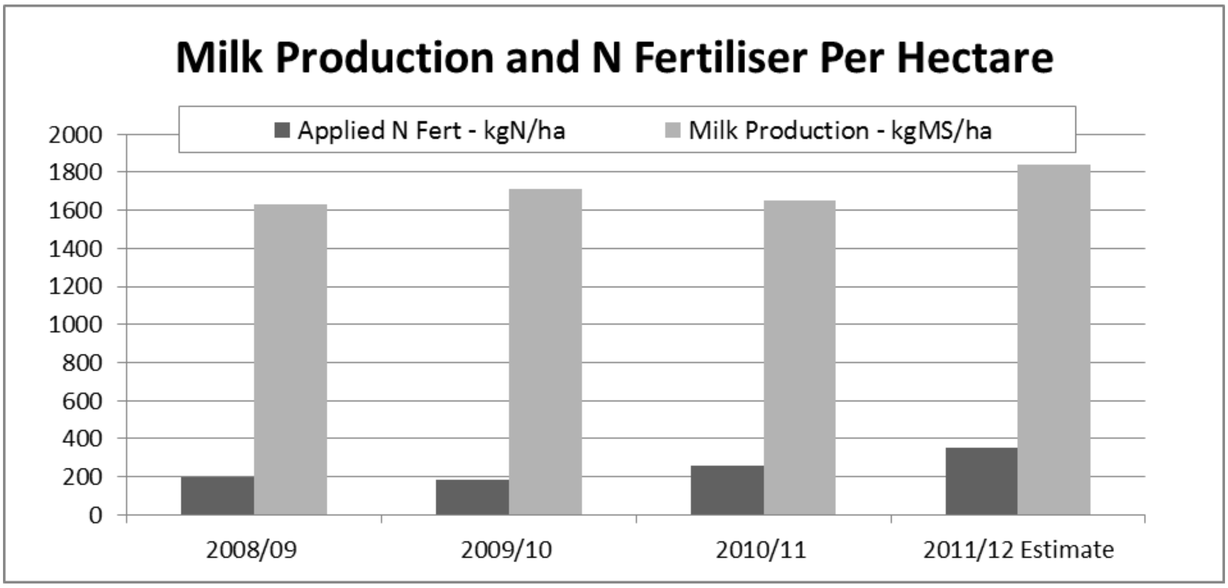


	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
target weight	91	112	132	152	169	186	203	220	237	254	270	287	304	326	348	370	391	411	431	456
Actual weight	93	109		141		164										387	397	444	447	

Mid month Liveweight

Nitrogen Use and Mitigation at LUDF

Milking platform use of Nitrogen has deliberately increased in the last two years to overcome the effects of Clover Root Weevil and to increase pasture production at LUDF. (See LUDF focus day notes – February and May 2011, for analysis of the value of clover and effects of the weevil at LUDF).



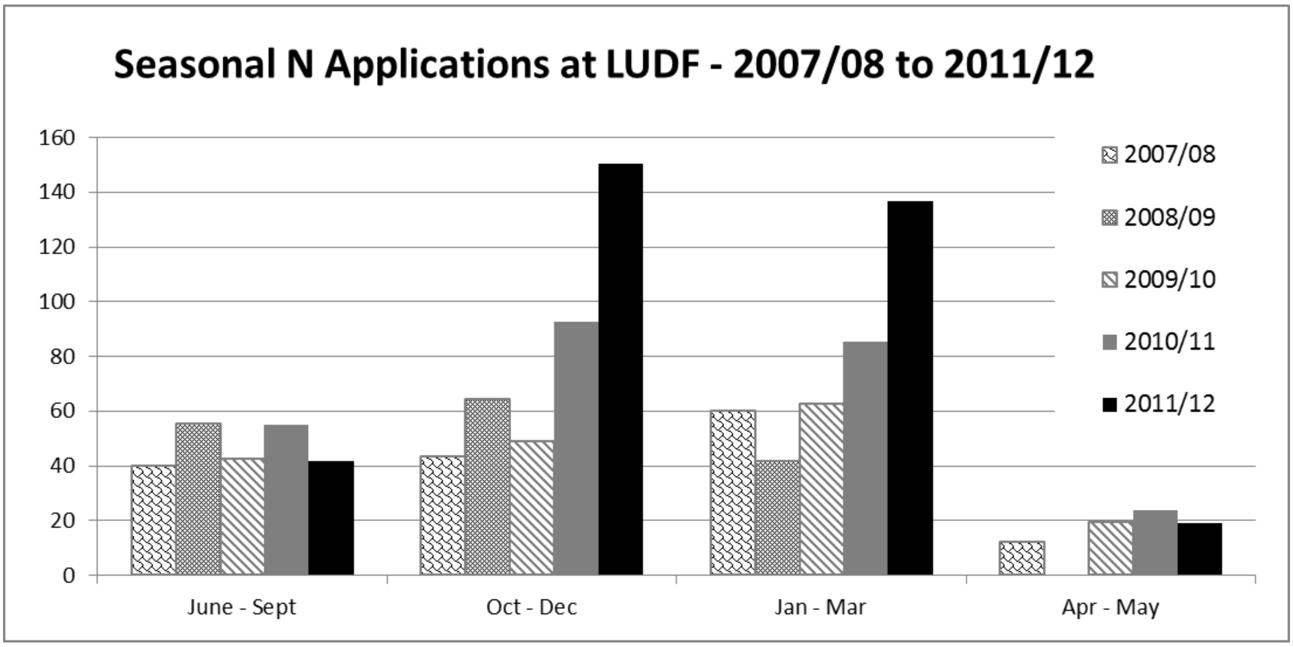
Coupled with the increase use of N fertiliser is LUDF's intent to ***increase productivity to increase profitability without increasing its total environmental footprint***.

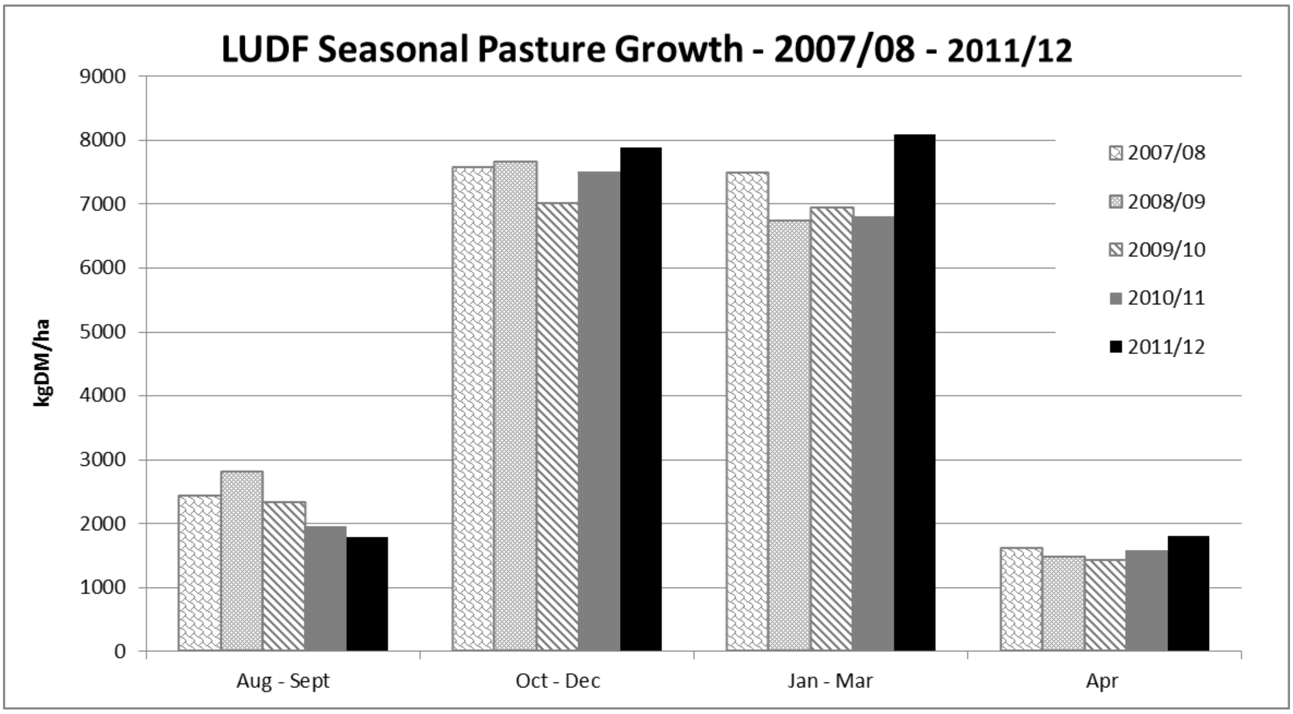
This means taking account of a number of aspects **on and off** the milking platform, including:

- Total number of livestock; because reducing the replacement rate and number of cows wintered will reduce the nitrate leaching and greenhouse gas emissions
- Type and volume of supplement used; because the N imported in these feeds will add to the N leaching losses and gas emissions
- Wintering system, including location and soil type, crop yields and winter feed volume required
- Pasture and crop yields and thus area required for a given volume of feed
- Irrigation availability and efficiency
- Milk Production per hectare and efficiency of feed conversion into milk (kgDM/kgMS)
- Mitigation of nutrient losses (including inhibitors, stand-off facilities and as below)
- Nutrient application rates, timing and responses

Approximately 100kg/ha additional N fertiliser has been used at LUDF this season compared with pre-2010/11. It is important to note that most of the additional N was applied through the October – March period when growth rates averaged 88kgDM/ha/day). This deliberate use of additional N through the active growing period was to ensure that the additional nitrogen had the highest opportunity for conversion into pasture and the least risk of losses. Using Gibberellic Acid from late August to early October and again in March was also part of the planned approach to maximise pasture production from additional N fertiliser.

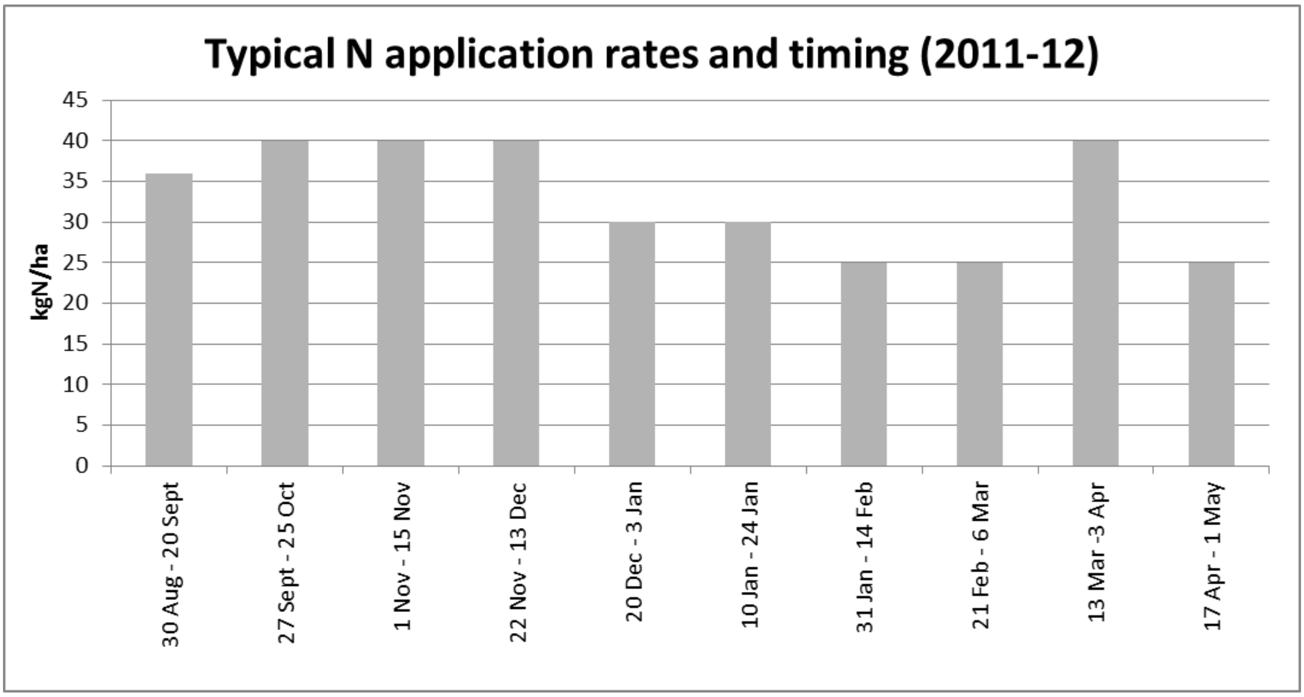
The following graphs identify seasonal N use and pasture production at LUDF, over the past 5 seasons. Analysis of the pasture grown over the October – March period vs N use suggests an additional 105kg N was applied and an additional 1645 kgDM/ha was grown, however this does not account for any variation due to seasonal differences.





Approximately 10 applications of N were applied at LUDF this season, starting with rates of 40kgN/ha through the spring, reducing to 30 then 25kg/ha in mid-summer and then one round of 40kgN/ha again in the autumn, primarily in conjunction with the autumn Gibberellic Acid application. N applications typically occur just prior to, or immediately following, grazing in order to maximise the timing between N uptake in the plant and the following grazing.

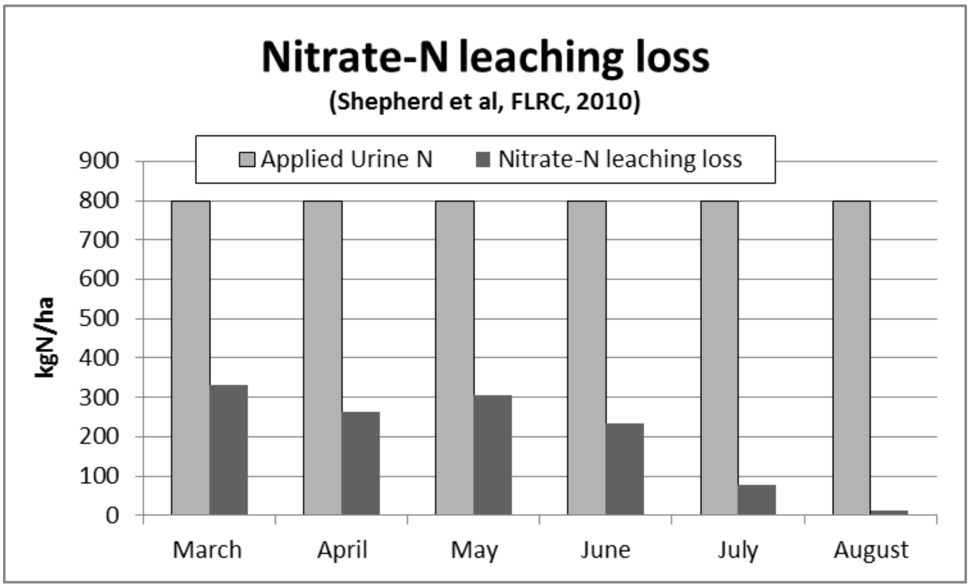
Using higher rates of N in the spring and more moderate rates in the summer and autumn is aimed at ensuring adequate N is available in the soil for pasture growth, but reducing amounts as the farm heads towards the winter drainage period and time of higher risk of N loss from the profile.



Nitrogen losses:

It is well established that most N leaching losses from dairy farms comes from the urine that is deposited by the grazing cows rather than from the N fertiliser that is applied. Therefore the major N losses of concern to LUDF are from cow urinary N deposited in the autumn on the milking platform (and also winter urine as a consequence of winter grazing). Hence the interest in total number of livestock required for the farm, and total cows wintered. LUDF has previously applied two applications per year of the nitrification inhibitor 'eco-n' to the milking platform to reduce losses of urinary N through the late autumn, winter and early spring.

Research by AgResearch (in a Waikato environment) compared N losses from autumn and winter urine depositions and observed that March, April and May urine deposition was the most vulnerable to leaching in the subsequent drainage period (between June and early-September on LUDF).



Reducing N losses at LUDF

Research starting this winter will better enable LUDF to calculate the influence of wintering on LUDF's total leaching losses, and thus the effect of the reduction in cow numbers. While awaiting this information, LUDF determined they would also aim to further mitigate the risk of autumn urinary N losses on the platform by adding an additional application of eco-n to the farm in March, to help capture and retain March / early April urine N.

Starting earlier however, increases the risk of merely delaying the loss unless additional applications of eco-n are applied. Landcare Research have reported that the 'half-life' of the nitrification inhibitor is about 6-8 weeks for March applications, versus 10-12 weeks for mid April applications – as the soil temperatures drop from 14°C to below 10°C.

Combining this research and LUDF's focus on productivity, profitability and sustainability has resulted in LUDF applying eco-n to the whole platform in early March. A second application occurred in mid-April; while a third will be applied in early/mid-July, on the expectation the additional application(s) will assist LUDF meet its environmental goals. This results in 6 weeks between the first and second applications, 10 weeks between the second and third applications, and a further 8 weeks likely efficacy after the third application. These application dates therefore cover the critical period for urine deposition and winter leaching.

The following graphic outlines the timing of the standard two application regime, and the timing of an additional third, or potentially an additional third and fourth application of eco-n.

Month	Week	2 Applications	3 applications	4 applications
March	1		1st	1st
	2			
	3			
	4		(6 weeks)	(6 weeks)
April	1			
	2			
	3	1st	2nd	2nd
	4			
May	1			
	2			
	3			
	4			
June	1	(11 weeks)	(10 weeks)	(10 weeks)
	2			
	3			
	4			
July	1			
	2		3rd	3rd
	3	2nd		
	4			
Aug	1			(6 weeks)
	2			
	3		(8 weeks)	
	4	(8 weeks)		
Sept	1			4th
	2			
	3			
	4			
Oct	1			
	2			

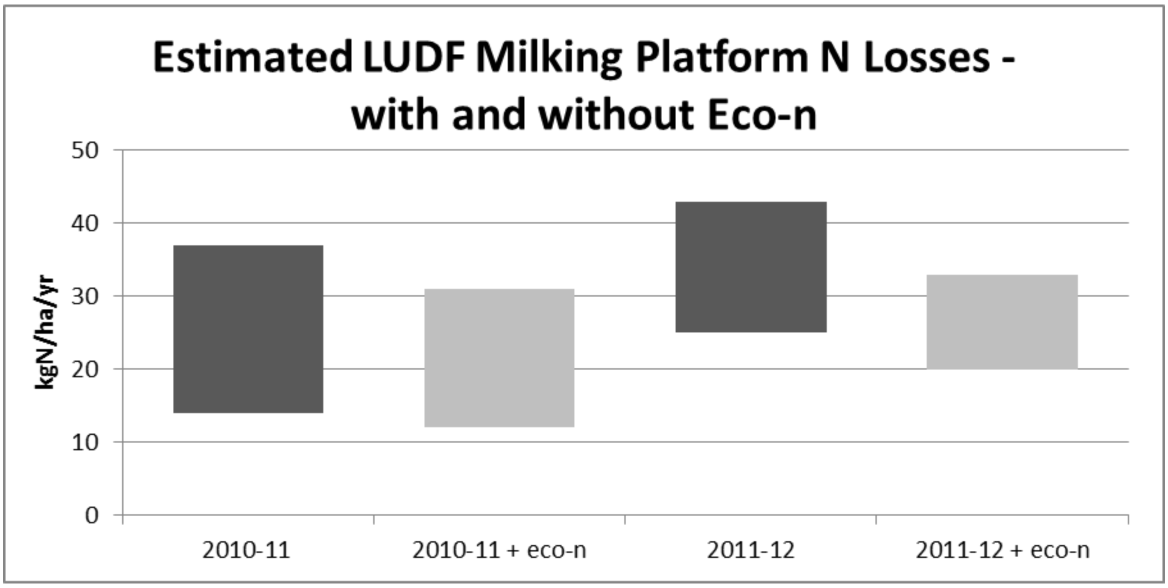
A fourth application of eco-n, as shown on the right hand column, could provide additional benefits if drainage (and limited growth) was forecast well beyond mid September (in the Canterbury environment). LUDF will reserve the opportunity to use a fourth application of eco-n if it is deemed necessary to extend inhibition later into the spring period.

It is likely this would only be used in seasons with high winter rainfall (and therefore drainage), above normal August / September rainfall, and forecast above average rainfall with below average pasture growth rates through October. This decision could normally be expected to wait till into September to occur, but equally may be combined with Gibberellic Acid use if occurring at the same time across the farm.

Predicted N Losses from LUDF

Overseer modelling of LUDF enables calculation of the estimated N losses from LUDF, as shown below. The range of losses shown reflects the various blocks on LUDF and in part, the range of likely losses. Comparing N losses with the recent benchmark of Canterbury N losses (Fert Research, March 2012) puts LUDF in the lowest 40% of Canterbury dairy farms for N loss per hectare.

The current Overseer version calculates reduction in N losses from the use of eco-n at 16% across the paddock, based on 2 applications of eco-n as per standard practice. FertResearch Fact Sheet Number 11 reports that the inhibitor can achieve a 25-40% reduction in paddock scale nitrate N losses in the South Island. Additional research comparing the effect of two versus three applications of eco-n indicates a third application should result in 1.3 times more N retention, therefore the 2011-12 +eco-n results in the graph below are based on the standard Overseer estimate of 16% multiplied by 1.3 to get to 21% reduction in Nitrate leaching at LUDF. The 21% figure (for three applications at LUDF) is still a conservative estimate of inhibitor effectiveness compared to the FertResearch values of 25-40% for two applications in the South Island. (Note calculation of losses is based on Overseer 5.4.10).



Additional work:

Further work is continuing and will be reported in the future, including the winter and stocking rate aspects described above, and 'whole business' influence on LUDF's total N losses. The increased productivity achieved by increased spring and summer N this year, and additional mitigation indicates N losses are in the same range as in past years. The drive to further increase productivity without increasing the footprint will continue including more attention on increasing pasture responses to applied N.

While higher N rates are applicable in the high yield environment at LUDF, the timing, rates and the additional mitigation with eco-n are all important parts of the efficient use of N fertiliser in this system.

Summary notes on Linear Programming:
Barrie Ridler, Grazing Systems Ltd.

GSL Systems Modelling

Modelling real farm systems; the use of LP

GSL model discussion points

OVERVIEW:

A confusion between production structures rather than SYSTEMS.

Confusion between BIOLOGICAL & ECONOMIC efficiency.

Creating this confusion is the fact that:

- Averages are used rather than actual (real) data.
- The use of these averages then further disconnects the data from reality.
- This disconnect is allowing incorrect policy to become embedded at all levels in New Zealand.

The biggest opportunities for improved profit in NZ agriculture are in areas that current analytical methods cannot detect.

Introduction:

Farm systems are complex and function as an interaction of many components.

Although often perceived as being stable they are more often on the edge of change due to undefined constraints in critical resources.

The key to systems success is being able to identify any constraint (time, quantity, quality) and provide a viable substitute or alter the system mix to minimise its effect.

New Zealand agriculture has simplified the concept of systems by reporting ratios such as production per hectare and stock/ha. That average data, then use these ratios as a means to compare between farms or farm systems.

Obviously, averaging data destroys detail, and detail is required to identify and overcome constraints yet this “benchmarking” is a major contributor to extension efforts. Averaging results in a less efficient allocation of resources at the margin, which can in turn lead to systems collapse if not recognised in time.

Massey University’s Agricultural Economics and Farm Management Department developed a number of linear programming models through the period 1970-1985 in order to better handle the marginal changes that occur within biological systems. Production Economics was part of this modelling effort and resulted in models of pasture growth with additional nitrogen, modelling forage crops in dairy systems in Northland, dairy farm systems and bull beef systems.

These models suffered from varying levels of inflexibility due to the need to establish some fixed rules for solving. This somewhat obscured the marginal productivity edge of the models although they were generally an improvement on simple gross margin and partial budget analysis as they allowed substitution (to a limited extent) of resources based on the diminishing returns of selected resources.

LP allows allocation of resources through an iterative process, ideally using a constant re-evaluation of the production and economics of the system.

The importance of diminishing returns and marginal productivity.

GSL Model Examples:

Response to nitrogen is a critical factor in both the economic and environmental outcome of many dairy farm systems. (It is of limited value for other farm types except in specialist circumstances.)Yet data on nitrogen response in New Zealand is sparse.

The Table and graphs in the Appendix relate to one trial with bull beef. The actual returns from adding nitrogen are summarised in both production and economic return.

When Table 1 is studied many will conclude that nitrogen should be added up to about 85 kgN per hectare as it is still “making money” ($150.70 cost vs. $162.70 return).

The ***reality*** of the marginal analysis shows that any nitrogen added beyond 45 kgN/ha is actually uneconomic ($MC vs. $MR).

Return should not be calculated using average response rates and total return less total cost, but on marginal productivity.

Fig 1 shows how the response to nitrogen diminishes and Fig 2 shows where the cost of nitrogen (MC) and the $ return for each additional kgN cross over (when MC=MR) compared to the total revenue vs. total cost lines.

This process is a crucial requirement for any farm systems model in order to identify when to cease adding input. Without LP it is difficult (impossible?) to identify this point for each individual system and the use of average response rates invariably encourages overuse of resources, reduces profit and increases environmental damage.

The marginal productivity analysis is able to be handled within LP. Each LP model iteration moves the solution closer to an optimal mix of resources until a best mix “optimum” is reached.

Provided the time period is short enough (2 weekly seems accurate enough under most circumstances) efficient allocation of a variety of inputs can be accurately calculated to ensure the most economic outcome.

The point to emphasise is that LP has the ability to identify constraints and to substitute inputs (sometimes output) based on the differing levels of performance of the resources.

Data in the graphs therefore applies to only one unique set of circumstances.

Changing any one resource (price, quantity, quality, and timing) will have a cascading effect on the system and may provide a slightly better or worse overall system result.

It is of interest that when the most limiting resource is constrained further in an LP, the entire process may be compromised and in certain cases may lead to economic collapse of the system (Fig 5 where nitrogen use is constrained and the LP system adjusts all other factors as N leaching reaches lower levels.)

LP models when properly constructed are able to identify the “tipping point” after which economic performance will sometimes drastically decline (as shown in Fig.3)

A properly constructed model can use LP to solve all these interactions, often with new insights about the emergent systems that develop, or clues as to the likely constraints that will prevent further progress. The LP can then be used to investigate the best way to overcome these constraints.

Summary:

Biological efficiency can be striven for but does not miraculously result in the best profits. In New Zealand, the very best high-input systems struggle to perform as profitably as efficient pasture systems because high inputs at the margin are making a negative contribution to profit; the same process as the nitrogen example for pasture.

LP modelling holds hope for change, innovation and emergent ideas.

As always, management must be a participant in the process and is the key to the final success of any system. Without management buy in, even the best resources can be wasted.

So models need to be realistic enough to not only provide options, but convince the management that they offer a better (more profitable /simpler/ less risky or all three) option.

This requires management to be provided with the means to understand and assess the fundamental message that fusion of production efficiency and production economics through LP modelling can provide viable and reliable farm systems.

Conclusions:

- LP provides the key to allow thinking to break out of the current time warp orientation of farm production.
- The LP process must be designed to allow emergent systems to evolve rather than be constrained to current perceptions of what farm systems are.
- There needs to be a change in the manner in which farm management advice is conveyed with more emphasis on efficient resource allocation rather than simple messages and "comparative ratios" which provide poor indicators for resource efficiency or R&D investment.
- The current entrained thinking results in deterioration of both the economic and environmental outcomes of real farms.

Appendix.

Table 1: Marginal Cost and Marginal Return Table:

The Relationship between Input (Nitrogen) and Production (pasture and beef)

Units N applied(1 unit = 1kg)	Total additional DM grown	Total cost N	Total Revenue (cw x price/kg)	Average Revenue	Added DM per added kg N	Extra cw per unit N	Return per added unit N CWxprice /kgN	Cost per added unit N CWxprice /kgN
	(kg)	(TC) $	(TR) $	(TR/TC) $ cw / $N		kg	**$MR**	**$MC**
0	0							
10	150	16.74	40.0	2.39	15	1.0	4.00	1.67
20	310	33.48	82.7	2.47	16	1.1	4.27	1.67
30	430	50.22	114.7	2.28	12	0.8	3.20	1.67
40	510	66.96	136.0	2.03	8	0.5	**2.13**	**1.67**
50	550	83.70	146.7	1.75	4	0.3	**1.07**	**1.67**
60	590	100.43	157.3	1.57	4	0.3	1.07	1.67
70	610	117.17	162.7	1.39	2	0.1	0.53	1.67
80	620	133.91	165.3	1.23	1	0.1	0.27	1.67
90	610	**150.65**	**162.7**	1.08	-1	-0.1	-0.27	1.67
100	590	**167.39**	**157.3**	0.94	-2	-0.1	-0.53	1.67

Fig.1: Diminishing Returns Curve. Pasture Dry Matter response to added Nitrogen (from Table 1 data).

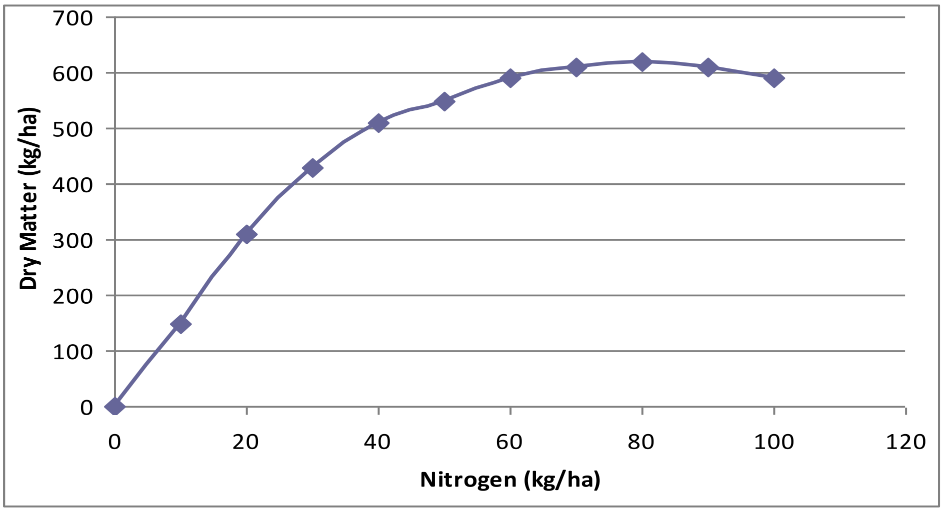


Fig.2: Total Revenue vs. Cost of added Nitrogen (from Table 1 data).

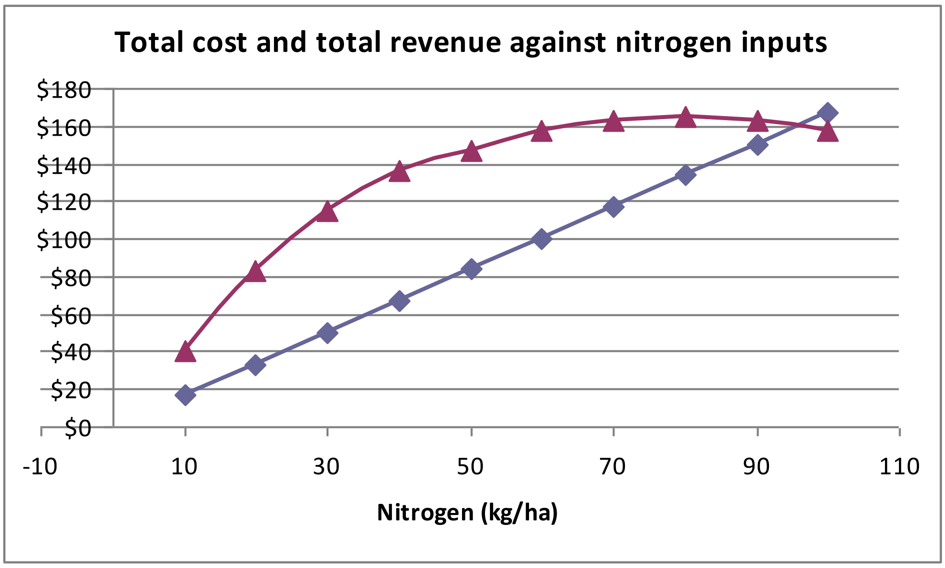
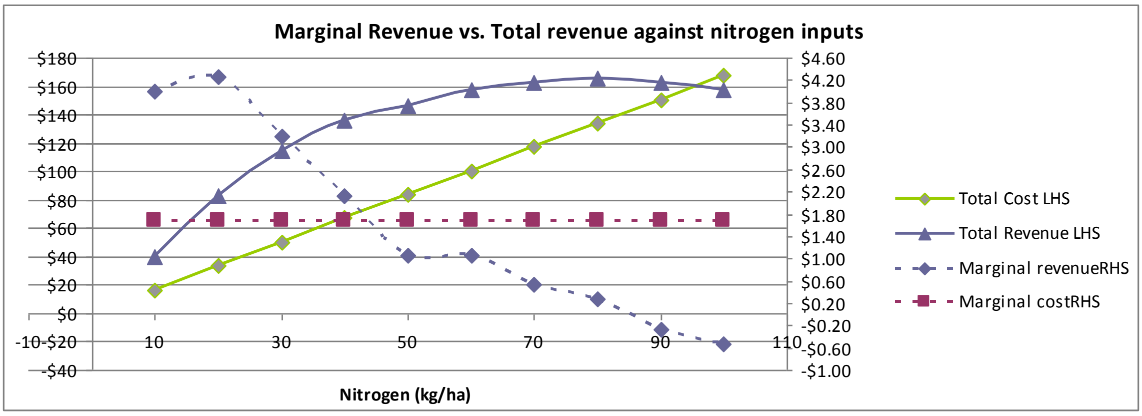


Fig.3: Marginal Cost and Marginal Return to additional nitrogen (from Table 1 data).



Lincoln University Dairy Farm - Farm Walk notes

Tuesday, 8th May 2012

CRITICAL ISSUES FOR THE SHORT TERM

1. **Maintain the intake of the herds above 190 MJME to support milk production and generate gain in live weight and body condition score.**
2. **Maintain consistent post grazing residuals to ensure pasture quality at the next grazing - targeting 7-8 rising plate meter height.**
3. **Monitor average pasture cover and respond to surplus or deficit.**
4. **Use back-fences on all herds whenever paddock grazing takes more than 24 hours.**
5. **Continue Mg supplementation via water system.**

Herd management

6. There have been 581 cows milking into the silo. The small herd is now 174 cows, its composition and purpose was changed significantly on 28 April. It is now made up from non-pregnant cows being milked on until their sale dates in mid to late May, and 5+ condition score pregnant cows. This small herd has been used to clean up behind the main herd five days a week with two days on fresh pasture breaks. This herd will be used to ensure the last grazing occurring before winter is below 8 rising plate meter “clicks”, and will be managed to maintain live weight, it is expected they will lose some milk production and to date this is what is happening.

Growing conditions

7. Pasture growth this last week has been 22kg DM/ha/day, down from the 49kg DM/ha recorded last week, there is a pasture deficit of 36t DM in the wedge to sustain a 36 day round.

8. Soil temperatures at 9.00am have averaged 9.3°C which is 1.6°C lower than the week before. The weather has remained dry with some sunny and warm days, however, the nights have been cold.

9. 0.2mm of rain this week with no irrigation (none since the 3rd week of February). The Aquaflex soil moisture meters indicate that soil moisture levels are now at 20 - 40% of field capacity. Consideration regarding irrigation is tempered by the time of year with low evapo-transpiration (ET) and the risk of adding moisture to soils that will, by late May, normally be close to field capacity. Current ground conditions are ideal with very high utilisation of pasture and silage, but in one small light soil area grass grub damage has been made worse by the current dry soil management. Our judgement is that pasture growth has not been affected in other areas of the farm.

Feeding management

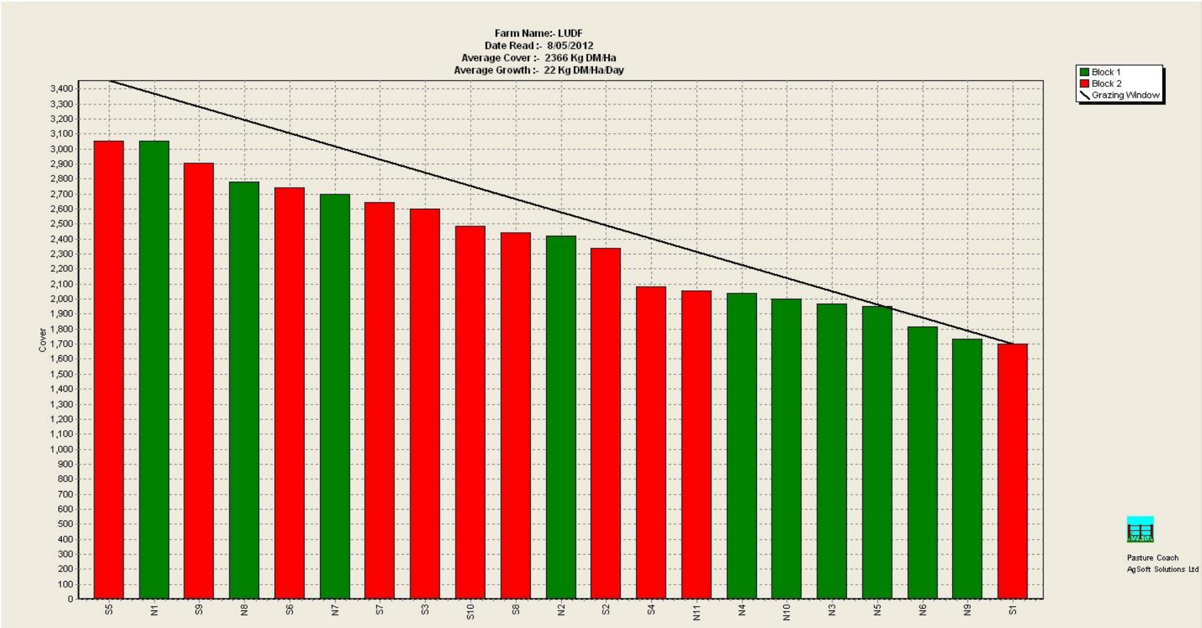
10. 21.5t DM silage has been fed this week to the herds, an average of 5.2 kg DM per day over all cows. No pre mowing of pasture done, and the round length was 36 days [36 last week]. Target was to be at 36 days.

11. The walk over weighing indicates that the whole herd has gained weight again this week. The herd has gained 37kg live weight in the 18 weeks since the beginning of January.

12. The milkers need about 190 MJME to produce 1.43 kg MS, maintain themselves, and allow for 2kg weight gain per week. This week the cows have gained weight, and lost 0.04kg/day of milk solids during the week.

Pasture Production and Management

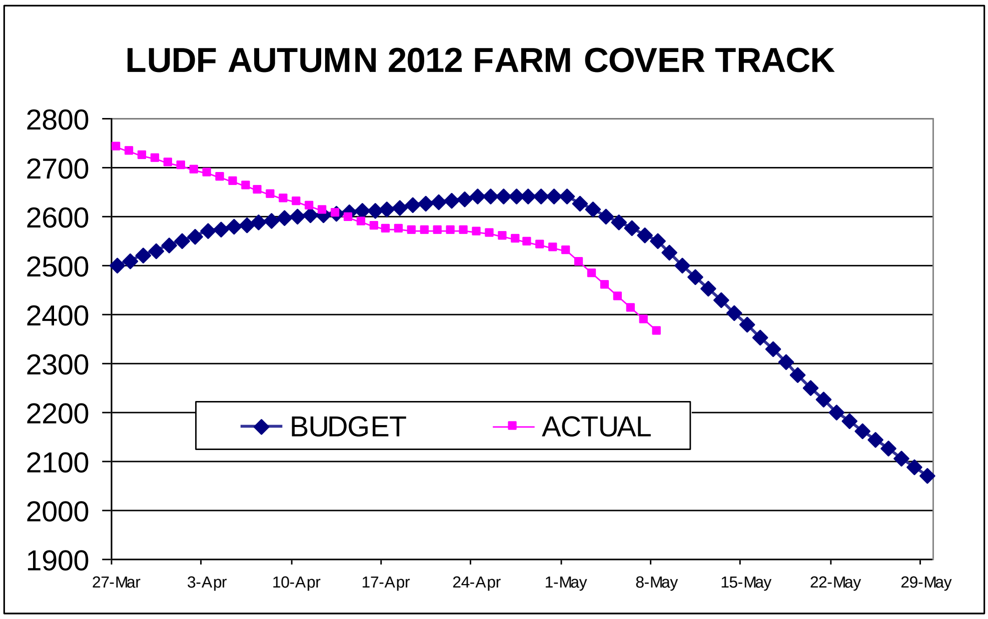
This week's wedge is printed below and shows the total demand from the herds. The deficit will be made up with pasture balage as part of the normal autumn plan.



13. Feed Wedge for this week shows an expected deficit. We intend to keep pre-grazing levels below 3600kg DM/ha to maintain the excellent quality that we are observing in our pastures. This will facilitate good pasture utilisation with cows readily achieving low even residuals. In terms of round length, we want to stay at 36 days for the remainder of the season and will continue to feed sufficient silage to achieve this. We will also cull cows as needed to stay on track [see points 22 - 23].

14. Average cover of 2366kg DM/ha, a decline from last week. This decline is greater than ideal but is exaggerated by rising plate meters reading low due to high DM in pasture at the moment. There is enough feed remaining to anticipate that dry off cover level will not be reached until late in May. Soil conditions (wet if it occurs) will be the reason if an earlier dry off date becomes necessary.

15. The average pasture cover targets for the remainder of the autumn are shown in the graphic below. Cover is lower than the target as less silage has been used than in the budget so far. The difference is not of concern representing about 36t DM. The current strategy is to allow the average pasture cover to decline in a controlled way to have 2050kg DM average at the end of May.



16. 197.2ha has been mowed either in front [162.1ha] or behind [35ha] the herds so far this season.

17. No Urea was applied this week.

18. We will not be applying any more GA this season.

19. The whole farm has had one round of eco-n. Another round has begun with 39 ha having an application this week.

20. 5.6% of the herd remained below body condition score of 4.0 when assessed yesterday [up from 4.4% 2 weeks previously]. 32 August calvers were dried off yesterday, and there are very few additional cows to dry off because of light condition before the whole herd is dried off.

21. There will be additional cows dried off during May on body condition score relative to calving date. We have identified 2 groups of 50 cows each [empty cows and lower BCS cows] to dry off should conditions make this advisable. At herd test 10 days ago there were 10 empty cows producing less than 1.0 kg MS/day. The well culls are all still in the herd because we can feed them profitably and ground conditions are very favourable. Any lame cows will be dried off from now on.

LUDF Weekly Report	17-Apr-12	24-Apr-12	1-May-12	8-May-12
Farm grazing ha (available to milkers)	160	160	160	160
Dry Cows on farm / East blk / other	0/0/0	0/0/32	1/0/32	2/0/32
Culls (Includes culls put down & empties)	0	2	0	0
Culls total to date	28	30	30	30
Deaths (Includes cows put down)	0	0	0	0
Deaths total to date	10	10	10	10
Calved Cows available (Peak Number 632…)	619	617	584	583
Treatment / Sick mob total	4	1	2	2
Mastitis clinical treatment	1	0	2	0
Mastitis clinical YTD (tgt below 64 yr end)	75	75	77	77
Bulk milk SCC (tgt Avg below 150)	162	165	158	161
Lame new cases	15	6	11	6
Lame ytd	161	167	178	184
Lame days YTD (Tgt below 1000 yr end)	1830	1872	1949	1991
Other/Colostrum	0/0	0/0	0/0	0/0
Milking twice a day into vat	585	603	571	575
Milking once a day into vat	30	13	11	6
Small herd	176	214	177	174
Main Herd	409	402	394	401
MS/cow/day (Actual kg / Cows into vat only)	1.58	1.52	1.47	1.43
MS/cow to date (total kgs / Peak Cows 632	422	434	445	453
MS/ha/day (total kgs / ha used	6.08	5.84	5.33	5.19
Herd Average Cond'n Score	4.40	0.00	4.30	4.40
Monitor group LW kg WOW 157 early MA calvers	501	503	506	508
Soil Temp Ave Aquaflex	12.5	11.0	10.9	9.3
Growth Rate (kgDM/ha/day)	55	66	49	22
Plate meter height - ave half-cms	14.8	14.8	14.5	13.3
Ave Pasture Cover (x140 + 500)	2573	2569	2529	2366
Surplus/[deficit] on feed wedge- tonnes	[8.4]	4.9	[18]	[35.6]
Pre Grazing cover (ave for week)	3473	3291	3308	3317
Post Grazing cover (ave for week)	1750	1750	1750	1650
Highest pre-grazing cover	3685	3510	3900	3566
Area grazed / day (ave for week)	5.65	5.50	4.42	4.40
Grazing Interval	28	29	36	36
Milkers Offered/grazed kg DM pasture	11.8	11.0	12.1	11.1
Estimated intake pasture MJME	145	135	151	138
Milkers offered kg DM Grass silage	4	7	5	5
Silage MJME/cow offered	42	76	52	58
Estimated intake Silage MJME	36	65	44	52
Estimated total intake MJME	181	200	195	190
Target total MJME Offered/eaten (incls 6% waste)	187	200	195	190
Pasture ME (pre grazing sample)	12.3	12.3	12.7	12.6
Pasture % Protein	21.4	20.9	21.5	22.0
Pasture % DM - Concern below 16%	13.3	17.3	17.8	18.7
Pasture % NDF Concern < 33	37.7	36.3	35.4	34.2
Mowed pre or post grazing YTD	197.2	197.2	197.2	197.2
Total area mowed YTD	242.8	242.8	242.8	242.8
Supplements fed to date kg per cow (632 peak)	327.0	376.3	408.0	442.0
Supplements Made Kg DM / ha cumulative	609	609	609	609
Units N applied/ha and % of farm	40units/21%	25units/24%	25units/26%	0
Kgs N to Date (whole farm)	336	342	348	348
Rainfall (mm)	20.6	0	208	0.2
Aquaflex topsoil relative to fill point tgt 60-80%	30-60	30-60	20-50	20-40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