

STOCKING RATE AND CALVING DATE DECISIONS FOR DAIRY FARMS

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Key points

- Stocking rate has an impact on milksolids/ha, pasture utilisation, pasture growth and pasture quality.
- Good profitability can be achieved at a range of stocking rates as long as a set of decision rules are followed.
- Applying these decision rules is easier at high, rather than low, stocking rates.
- Monitor average pasture covers and post-grazing residuals to determine the requirement to change feed offered per cow.
- Consider a change in calving date rather than a reduction in stocking rate to overcome early season feed deficits.

Background

Stocking rate (SR) has a dominant effect on milk production and profitability per hectare (see results of McMeekan, 1961; Bryant, 1980). In 1961, McMeekan stated that, “Properly understood and used, it (SR) can influence productive efficiency for good more than can any other single controllable factor. Misunderstood and misapplied, it can lead to abuses which may have permanent harmful effects on land use.” In other words, changing stocking rate requires a change in key management decisions (see decision rules outlined by Macdonald and Penno, 1998).

Generally, herd energy demand and pasture energy supply are matched using one of two methods.

1. the number of cows per hectare (stocking rate (SR)) or
2. the kg liveweight (lwt) per tonne of feed available (comparative stocking rate (CSR)).

However, each method of setting herd energy demand has its limitation. For SR, differences in cow liveweight mean differences in energy demand per cow. Also, SR doesn't account for feed imported onto the farm or grazing off. Comparative stocking rate was

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developed to overcome these problems; however, increasing kg lwt/ha increases the amount of pasture grown and utilised, and increases pasture quality (Macdonald, 2004).

Table 1. Results from the whole farm efficiency trial (Macdonald, 2004)

Herd	1	2	3	4	5
Stocking rate (cows/ha)	2.2	2.7	3.2	3.7	4.3
Pasture grown (tDM/ha)	18	18	19.5	18.5	20.5
Pasture utilisation (%)	63	70	72	81	79
Milksolids (kg/ha)	967	1043	1105	1145	1168
Annual feed allowance (t DM/cow/year)	8.1	6.8	5.8	4.9	4.2
Nitrogen (kg N/ha/year)	200	200	200	200	200
Silage made (kg DM/cow)	702	509	293	99	23
No. of times farm was topped	2.1	1.0	0.4	0.1	0
Days in milk	296	278	260	238	222
Economic Farm Surplus(\$/ha)					
@ \$4.00/kg MS	1592	1669	1782	1714	1544
@ \$5.00/kg MS	2574	2725	2901	2871	2727

Setting stocking rate

The profitability and success of dairy farming in New Zealand is dependent on:

- pasture production and utilisation
- cow efficiency of milksolids (MS) production (kg MS/kg lwt)
- economic and social goals of employer and employees.

Changing stocking rate to increase pasture production and utilisation

Target

Set herd demand such that a post-grazing residual of 7 clicks on the rising plate meter is achieved throughout the year.

Graze pasture at a stage to prevent canopy closure (i.e. the point at which sunlight is not able to reach the ground).

How

Getting residuals right sets the platform for high quality pasture production, as lax defoliation of perennial ryegrass often results in a reduction in the amount of green leaf and the number of tillers in a ryegrass sward (Lee et al., 2008). The production of high quality pasture

will be maximised when grazing to 7 clicks (approx. 1500 kg DM/ha using the winter rising plate meter equation) is accompanied by grazing pasture at a stage to prevent canopy closure (when the base is still green: approx. 2,700 to 3,000 kgDM/ha) and the decision rules of Macdonald and Penno (1998) are followed. Post-grazing residuals and average pasture cover, at three times of the year, can be used as an indicator of when to alter stocking rate or supplement offered.

The critical times (Bryant, 1990) are:

1. at the start of calving – to ensure cows are not underfed in early lactation
2. times of high pasture growth - the amount of feed on the farm in October is related to the amount of feed on the farm in December. Maintaining optimum cover at times of potential high growth minimises the senescence associated with high cover, or the ‘lag phase’ associated with short rotations (low average pasture cover)
3. when ryegrass is flowering – maintaining a post-grazing residual of 7 clicks on the rising plate meter in late spring minimises seed set, ensuring good quality pasture and utilisation is maintained.

Changing stocking rate to increase efficiency (kg MS/kg LWT)

Target

Systems 1-3 (Hedley et al., 2006) - cows producing 80% of their liveweight as MS per annum.

Systems 4 and 5 - cows producing 90% of their liveweight as milksolids per annum.

How

Increasing kg MS/kg LWT can be achieved by one (or both) of the following:

1. Decrease liveweight (maintenance requirement) per cow
2. Increase kgMS/cow

Decrease liveweight per cow

Clark et al. (2007) reported a negative association between liveweight and feed conversion efficiency, with feed conversion efficiency increasing by approximately 10% as liveweight decreased by 100 kg. In their analysis, smaller cows ate more and produced more per kg of liveweight. However, to maintain liveweight per hectare, more cows would be required.

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Increasing kg MS/cow

Generally, for pasture-based systems, there is a large gap between actual and potential production per cow. The average commercial dairy cow in New Zealand produced 280kg MS per year in the mid 1990s (Dairy Statistics, 2007-08). A similar cow type however, when offered generous allowances of pasture, achieved 410kg MS, and when offered a total mixed ration produced 602kg MS/cow (Kolver et al., 2002), highlighting the production potential of the '90s cow type.

Increasing kg MS/cow by adlib feeding cows pasture increases pasture wastage and reduces pasture quality due to the quantity of feed left in the paddock post-grazing, and subsequent pasture deterioration. Supplementary feeding to increase kg MS/cow when feed supply exceeds demand will also increase levels of pasture wastage and further reduce pasture quality. Cows will eat the supplement and leave pasture ungrazed (substitution) and the little extra milk will be produced at a high cost (see Holmes and Roche, (2007) for full details about supplements in dairy systems).

For cows offered predominantly pasture as their feed, energy will generally be the nutrient first-limiting milk production up to 30-35kg milk/cow/day (2.3 to 2.5kg MS/cow/day) (Kolver, 2000). For the majority of dairy cows in New Zealand, increasing the quality (ME) of pasture consumed by cows will increase milksolids yield per cow (see Section 3: 'Assessing your stocking rate').

Changing stocking rate to achieve economic and social goals

Target

Low cost milksolids production in a farm system that suits the style and skill level of the employer and employee(s).

How

The industry average farm working expenses have fluctuated in line with milk payout over the last 10 years (Figure 1). Focusing on reducing these expenses, rather than the fluctuation in milk price (which is generally out of your control), is the key to profitable dairy farming. In this respect, the principles developed by McMeekan and Bryant for low-cost milk production in the 1960s and '80s, respectively, still apply. These principles have been compiled as a set of decision rules (Macdonald and Penno, 1998) that can be used across all farm systems.

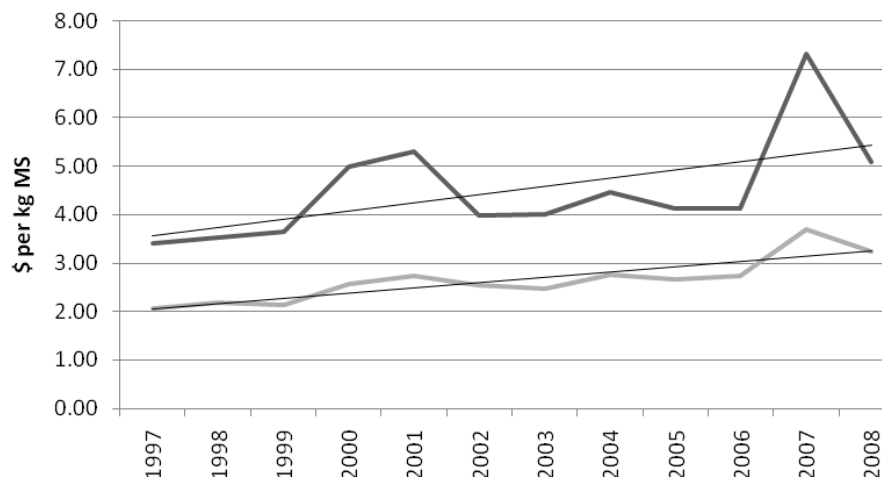


Figure 1. Trend in company payout (black) and farm working expense (grey) for the last 10 years. Source: DairyNZ Economics group, LIC Dairy Statistics

If these rules are followed and pasture utilisation is high, good profitability can be achieved at various stocking rates, as per the Whole Farm Efficiency (WFE) trial (Macdonald, 2004). In the WFE trial, the returns from increasing utilisation of pasture and milksolids production per hectare were, to an extent, offset by the costs of increasing the number of cows per hectare (Table 1). In practice, the cost and skill of labour and shed setup, will have a large influence on changes in cow numbers. The key factors when considering changes in cow numbers are given in Table 2.

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Table 2. The key factors for low and high stocking rate farms to achieve high profitability

	Low stocking rate	High stocking rate
Management	<ul style="list-style-type: none"> • High management skill required 	<ul style="list-style-type: none"> • Shed capability in relation to cow number. Time/cow to milk • Require strategies to cope with climatic risk • Anticipation of feed deficits and pasture damage
Pasture	<ul style="list-style-type: none"> • Use of Spring Rotation Planner to ensure that early season grazing management maintains adequate farm cover • Location with 'flatter' growth curve to enable increased lactation length. Strategic nitrogen applications to increase pasture growth in early spring and autumn • Land needs to have suitable contour for topping and silage conservation • Good reliable contractor is required to harvest quality silage • Potential to speed up rotation length early in spring to minimise conservation costs • Intensive effort to maintain pasture quality 	<ul style="list-style-type: none"> • Use of Spring Rotation Planner to ensure that early season grazing management maintains adequate farm cover (slow spring rotation). In summer use a slow rotation to ensure a good feed supply is always available • Depending on soil type and rainfall pattern there may be a requirement for a standoff facility to protect future pasture growth • Environmental sustainability of system. For instance, limits imposed by councils regarding loss of nutrient to the environment
Cow	<ul style="list-style-type: none"> • Aim is to encourage per cow intake and kg MS/cow • Requires excellent reproductive performance to ensure a tight, early calving spread to capitalise on days in milk. See InCalf book 	<ul style="list-style-type: none"> • Increased costs of high stocking rate • Early culling better than drying off early • Late lactation – BCS and setting farm up for planned start of calving

Assessing your stocking rate

Combining the targets, the performance of a dairy farm system can be reviewed and improved using the strategy in Figure 2. Increasing feed offered per cow equates to increasing supplementary feed and/or reducing stocking rate and/or increasing pasture growth through nitrogen application. Reducing feed offered per cow equates to reducing supplementary feed and/or increasing stocking rate and/or decreasing nitrogen application.

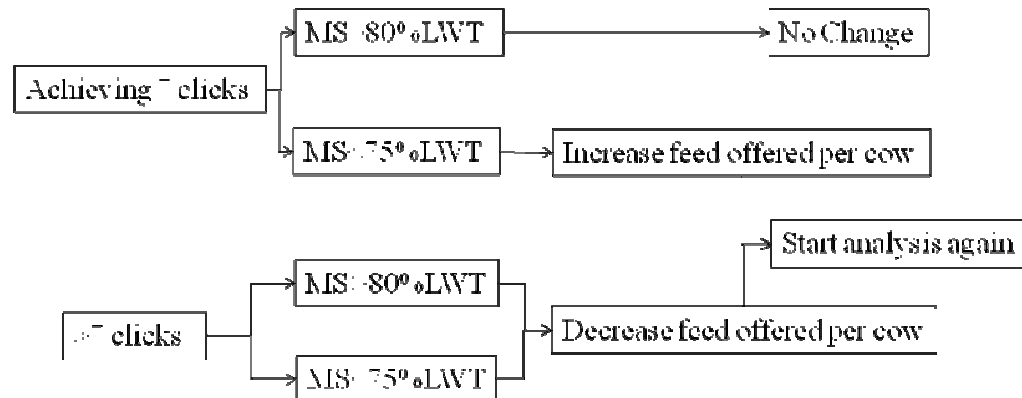


Figure 2. Strategy using targets to increase or decrease feed offered per cow

Lincoln University Dairy Farm (LUDF) has followed a similar process to become one of the most profitable systems in New Zealand. Initially (season 2003/04), cow efficiency on LUDF was excellent with cows producing 422kg MS (1,684kg MS/ha), close to 85% of their liveweight. Post-grazing residuals, however, were greater than 7 clicks for the majority of the season (Figure 3). Feed offered per cow was subsequently decreased by reducing imported feed from 550 kg/cow to zero, and by increasing stocking rate from 3.7 to 4.3 cows/ha from the 2003/04 season to the 2007/8 season, respectively. In the 2007/08 season, the target post-grazing residuals were achieved (7 clicks for the majority of the year) and cow efficiency remained high (414 kg MS/cow) due to the resulting increase in pasture quality (Figure 4). The removal of imported feed from LUDF and maintenance of milksolids production in the 2007/8 season (1,744kgMS/ha) showed that, at a system level, the response to the supplement in the 2003/4 season was zero.

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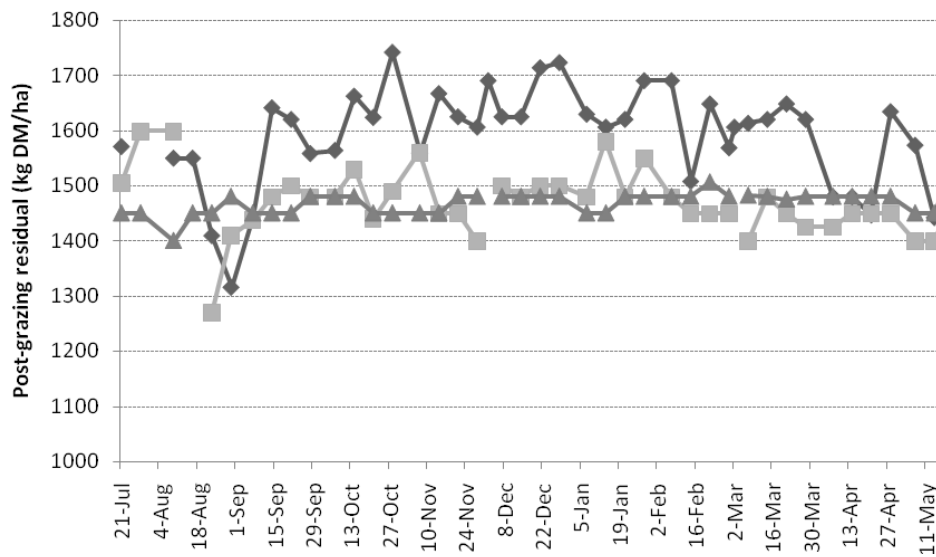


Figure 3. Average weekly post-grazing residual (kgDM/ha) for LUDF for the seasons 2003-04 (diamond), 2004-05 (square) and 2007-08 (triangle)

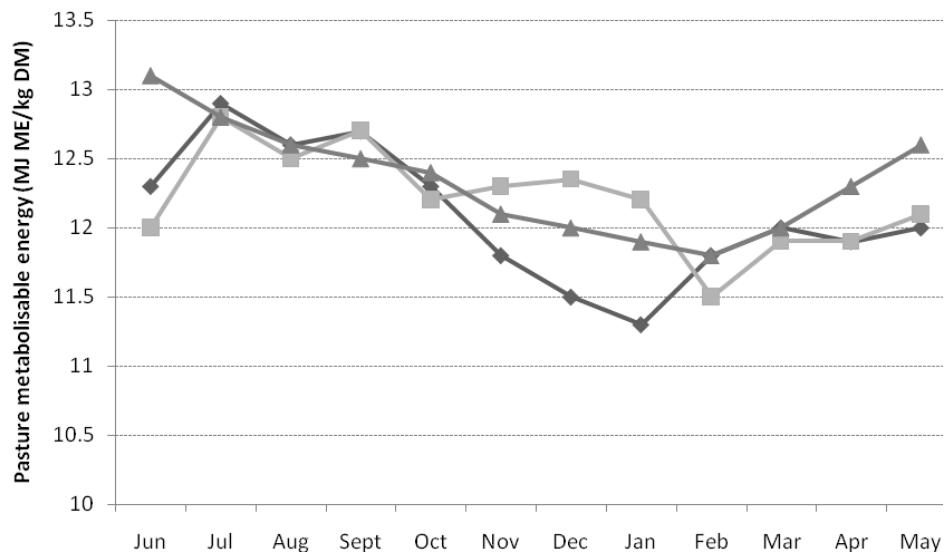


Figure 4. Average monthly pre-graze pasture energy content (MJME/kg DM) for LUDF for the seasons 2003-04 (diamond), 2004-05 (square) and 2007-08 (triangle)

Setting planned start of calving (PSC) and calving pattern

Selecting the correct PSC is critical to maximising pasture utilisation and profitability on any seasonal dairy farm. The PSC should be determined according to pasture growth and herd energy demand, so that pasture energy supply meets herd energy demand for as long as possible, to minimise conservation and the feeding of supplements. In this respect, changing

PSC can be an alternative to changing stocking rate. As a general rule, peak cow energy demand occurs around 80 days after calving.

For a herd, as reproductive performance improves, the calving season becomes more compact, which results in an earlier and more rapid increase in feed demand. There are five ways to deal with this change in calving pattern:

1. Have a greater pasture cover at PSC. Increases pressure on system in late autumn/winter to build pasture cover for early spring. There is also the loss of cover from senescence associated with very high pasture covers to consider.
2. Feed more supplement. Factor in costs of machinery/pad depreciation and additional labour associated with feeding out before deciding on this option.
3. Increase the energy deficit in early lactation. Impairs herd reproductive performance, decrease MS/ha and increase body condition score loss in early lactation.
4. Decrease stocking rate. Often stocking rate is decreased as cows are short of feed in the spring when the farm actually has the right stocking rate but is calving too early.
5. Move PSC closer to balance date. Increases pressure on system in late lactation to maintain days in milk.

As an example, LUDF has decreased the calving spread over time resulting in an earlier and more rapid increase in feed demand. The early season energy deficit for LUDF is shown in Figure 5. With option 5 above, and shifting the mean calving date back by two weeks to late August from mid-August, gives a better fit to the pasture growth curve.

Of similar, or greater, importance to setting the correct calving date, is setting pasture cover and cow body condition score targets at the PSC, as severe underfeeding can impair herd reproductive performance for the next season. The target calving condition score for all herds is 5 for cows and 5.5 for heifers and second calvers (see InCalf book). The target average herbage mass at PSC is 2,400kgDM/ha for LUDF, higher than the 2,200kg DM/ha recommended by Macdonald and Penno (1998) for the North Island.

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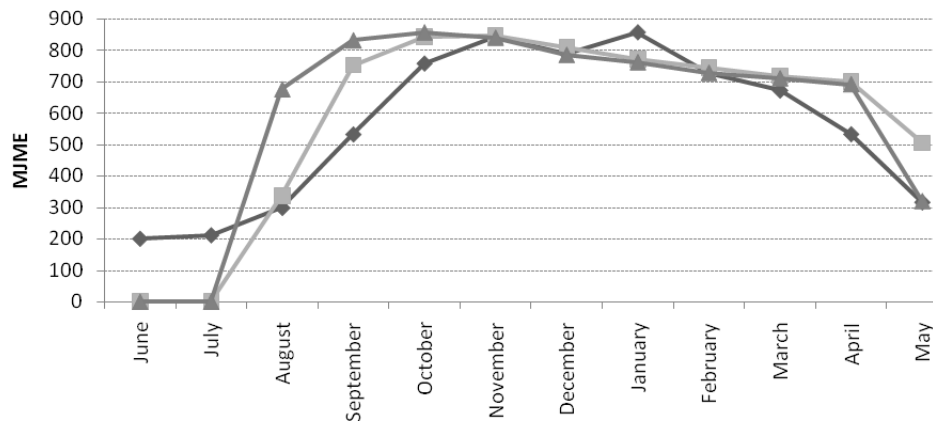


Figure 5. LUDF pasture ME supply (diamond) and ME demand for 4 cows/ha calving mid-August (triangle) or mid-September (square)

Conclusion

Good profitability can be achieved at a range of stocking rates as long as the set of decision rules given by Macdonald and Penno (1998) are followed. In practice, the application of these rules is easier at high, rather than low, stocking rates. High stocking rates make the control of average pasture cover and post-grazing residual easier, resulting in increased pasture utilisation, pasture growth, pasture quality and milksolids production per hectare. Each farm will attribute different costs (economic, social and environmental) to running additional cows, which need to be weighed against these benefits.

Maintaining a fixed PSC as the calving season is shortened from improved reproductive performance will result in an earlier and more rapid increase in feed demand and an associated feed deficit (assuming the level of supplementation remains the same). Prior to changing stocking rate, consider a change of calving date to better match pasture supply with feed demand.

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