Should we be milking fewer cows?

Kevin Macdonald, DairyNZ Senior Scientist Farm Systems; Dave Clark, DairyNZ Principal Scientist Farm Systems

Summary

- Use of comparative stocking rate (CSR; kg cow live weight/t DM offered) is still the best method to calculate how many cows to milk
- From a trial at DairyNZ it was identified that economically the optimum comparative stocking rate is 77 kg live weight/t DM
- Any methods to reduce the effect of dairying on the environment must allow the total farm system to at least maintain current profitability and remain simple to operate
- Lowering stocking rate (SR) may be a profitable option on some farms
- The use of lower stocking rate must be combined with high genetic merit cows – these are cows with all the following attributes – high intake capacity from grazed pasture, high MS yield, high fertility, BCS recovery, high health and high survivability and matched with feeds that support high intake
- A test if SR is correct for the farm or the management system, is whether the required targets for feed and cows at a body condition score (BCS) of 5 at calving are always achieved - if not a review is necessary
- A reduction in replacement rate is feasible on a lot of farms and will reduce costs and thus increase profitability.

Introduction

Are we growing less feed on farm to warrant milking fewer cows? Should we be running a lower stocking rate to account for our higher genetic merit cows? How can we reduce environmental impact while maintaining profit? What are the facts? This paper will give a summary of where we are today in terms of the known facts in regards to stocking rates and suggest options for the future.

Where have we come from?

McMeekan (1950) and Bryant (1990) reporting on the results from farmlet studies suggested that increasing pasture utilisation by increasing stocking rate (SR) would ultimately increase total milksolids (MS) production, and it was assumed this would lead to increased farm profitability. In summary, SR should balance the dual objectives of generous feeding to achieve high levels of efficiency of milk production per cow while maintaining high levels of pasture utilisation to meet the overall objective of optimising farm profitability.

In a trial at DairyNZ, a range of SR (2.4 to 4.3 cows/ha, all self contained on pasture) were compared (Macdonald et al., 2008b). As SR increased, production per cow decreased and per hectare increased (Figure 1). More importantly, the operating profit ($/ha) was maximised at a SR of 3.3 cows/ha (Macdonald et al., 2011) (Figure 2; comparative stocking rate (CSR) = 77 kg live weight per t of DM, where CSR the kg live weight on the farm per tonne of feed available per cow). However, the results suggest that high profit can be attained from SRs between 2.7 – 3.7 cows/ha (CSR 70 - 89) as long as decision rules are employed to optimise management at these SR although operating profit will be reduced by 2 to 6%, either side of the optimum.

An important finding from this trial was that as SR increased from 2.7 to 3.7 cows/ha pasture utilisation increased from 13.8 to 15.6 t DM/ha (Figure 3). This gave pasture utilisation values of 76% at 2.7 cows/ha to 84% at 3.7 cows/ha. This identifies the benefit of high pasture utilisation, and an optimum range of pasture utilisation, where high profits can be attained.

Figure 1: Milksolids per cow and per hectare for a range of stocking rates in a whole farm efficiency trial (adapted from Macdonald *et al.*, 2008b)

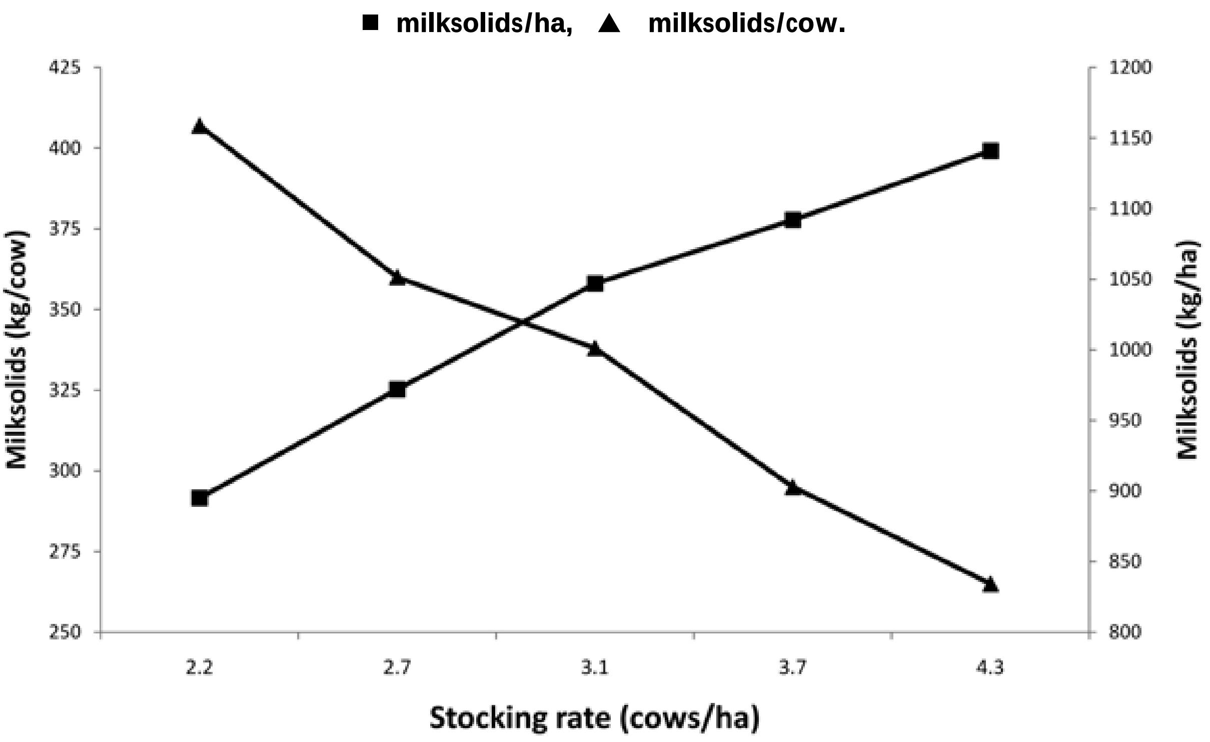


Figure 2: Operating profit per hectare for a range of stocking rates in a whole farm efficiency trial (adapted from Macdonald *et al*., 2011. In Press)

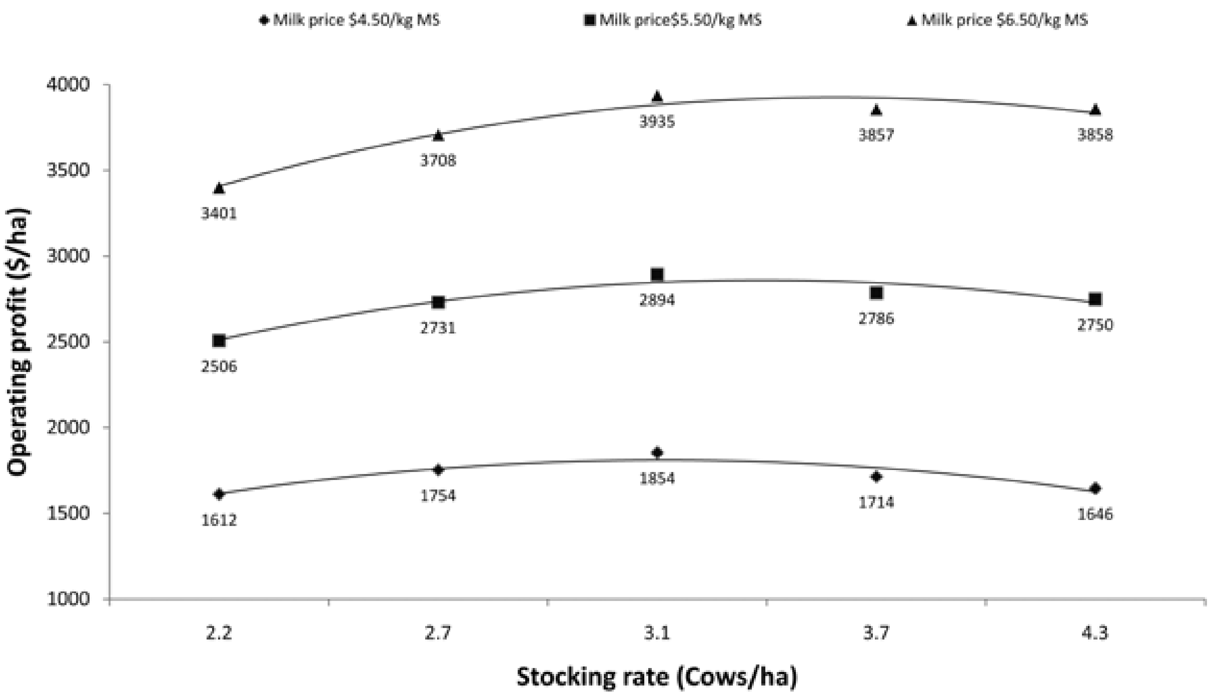
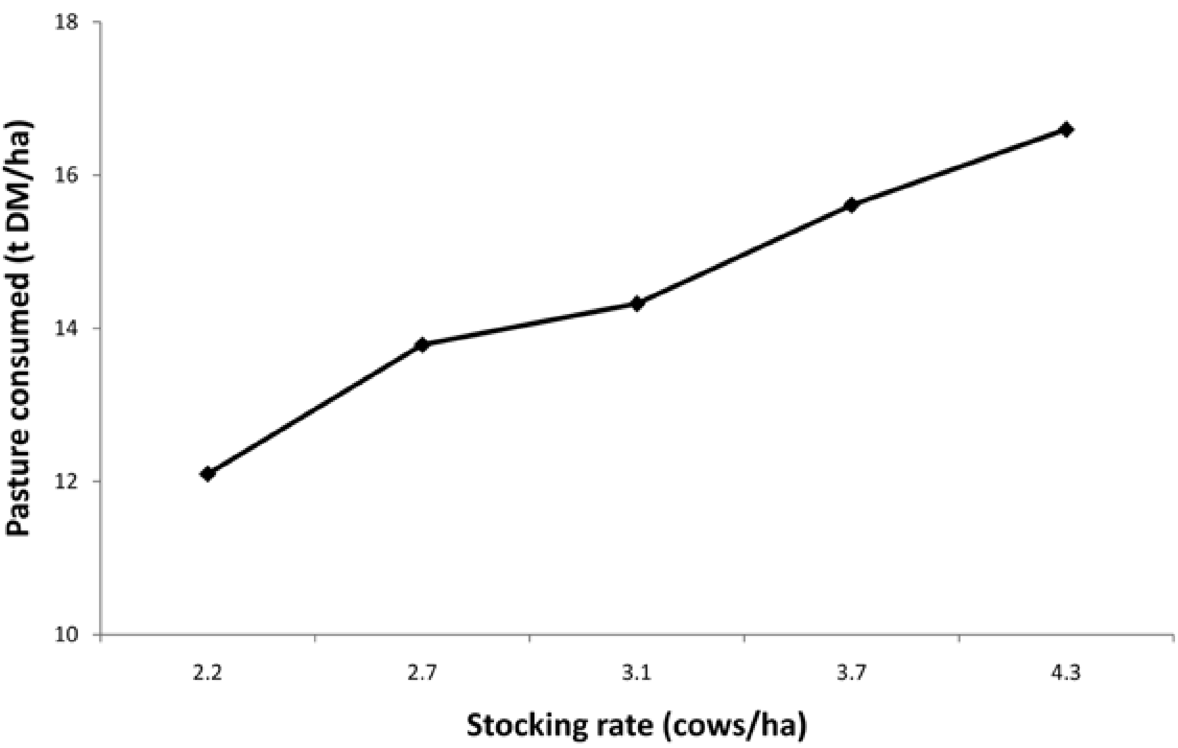


Figure 3: Pasture consumed (t DM/ha) for a range of stocking rates in whole farm efficiency trial (adapted from Macdonald *et al.*, 2008b)



Are farms growing less grass?

For the last 30 years there have been questions about whether more or less grass is being grown on farms. Holmes (1989) and Rawnsley et al. (2007) both reported that pasture eaten has increased from 4 t to 11.7 t DM/ha/yr from 1935 to 2007. Recent estimates from high performing New Zealand dairy farms show pasture eaten to be 15-17.5 t DM/ha/yr (Holmes 2007; Glassey 2007; Macdonald et al., 2008b).

For at least 20 years this increase in pasture eaten has been attributed to pasture renewal (Edgecombe 1988) but some of this can be attributed to the increased use of nitrogen fertiliser. Data from DairyNZ farms suggest that annual pasture grown has not improved over the past 30 years averaging 17.9 t DM ha ± 2.1 SD with the only increase since recording started being due to regular use of N fertiliser since 1993 (12 kg DM/kg N applied). A small number of farms record annual pasture DM production and where these figures are available for the Waikato region they suggest a decrease since 2004. DairyNZ farm data show increased variability between years for pasture production since 2004, but the average has not changed. This variability has been accentuated by droughts in the northern part of New Zealand in recent years.

What has happened to stocking rate and genetic merit of the cows in New Zealand?

The average SR on New Zealand dairy farms has increased from 2.1 to 2.8 cows/ha from 1980 to 2010 (LIC 1980, 2010). There has also been a breed change from Jersey to Friesian-Jersey cross cows with a resulting increase in average cow live weight from 390 to 460 kg. This effectively has resulted in a 57% increase in live weight/ha. Cow genetic merit has also improved, with a 20% increase in per cow production and larger more productive cows requiring higher feeding levels if profitability is to be maintained (Macdonald et al., 2008a, Glassey and Macdonald, 2007). The data show that at a SR of 2.1 cows/ha with a 390 kg cow, there is a need for 10.6 t DM/ha, whereas 460 kg cows at 2.8 SR require 16.7 t DM/ha – therefore stocking rate should be reduced if feed on farm has remained constant; or, feed has to be increased providing it can be done in a way that the marginal cost of feed is less than the marginal milk price received

To compensate for the effect of increasing cow genetic merit and the resultant increase in feed demand, Montgomerie (2010) suggested that farmers reduce their herd size by one cow/150 cows/year. The challenge now is to meet the intake potential of the cows without compromising profitability through excessive costs via feed grown or purchased but not consumed.

On the farm, the optimum SR is that which, when combined with appropriate management, results in achieving the target amount of feed on the farm at calving, and ensures all cows attain a BCS 5.0 at calving and BCS 4.0 or above at mating.

What about the future?

In the last 15 years there have been questions around the environmental impact of dairying. This is largely around issues such as nitrate leaching and nitrous oxide emissions from urine patches, and methane from feed digestion. To be able to maintain a clean green environment farmers may have to make some compromises to their system or improve existing management systems. Proposed use of nitrification inhibitors, stand-off pads or herd homes will all help to reduce the loss of nutrients but only if used effectively. One absolutely essential requirement is to think about the effect of either technology or management on the WHOLE dairy system – thinking about just the cow can be very misleading.

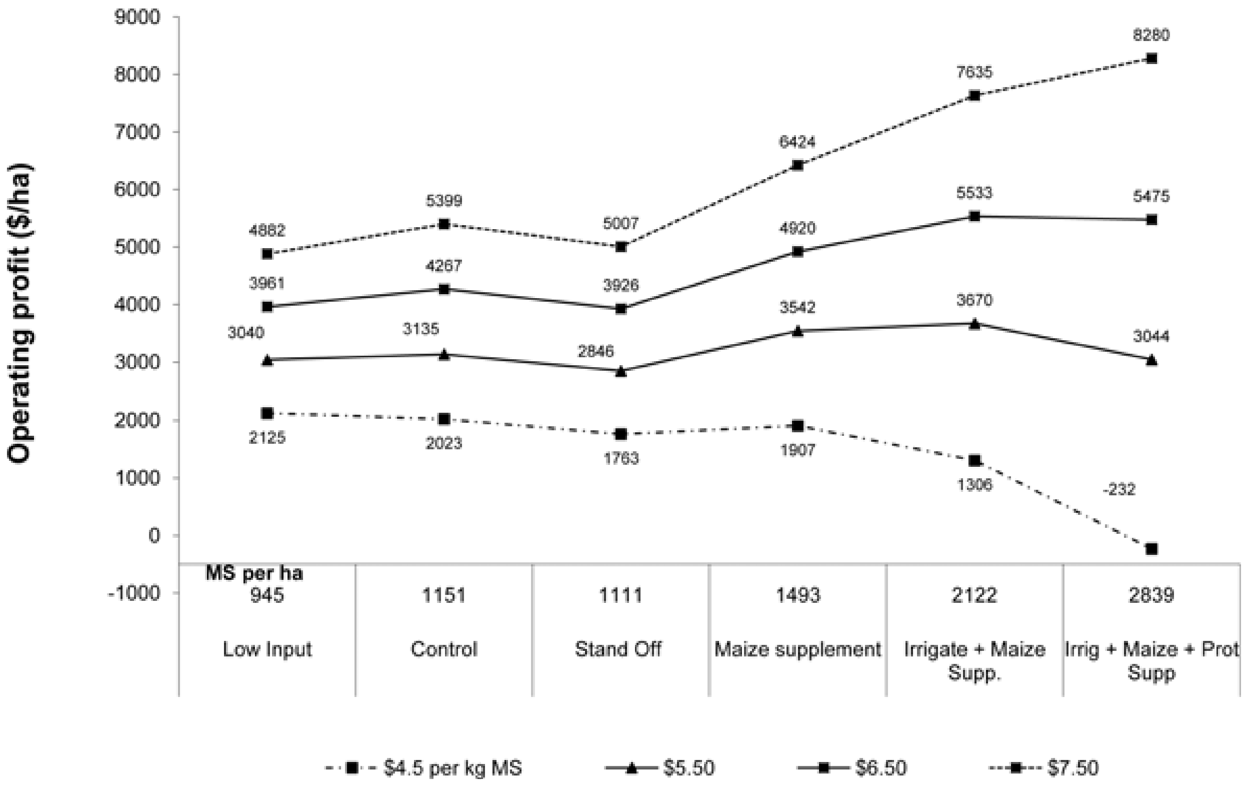
What can farmers do?

Can we get away with using less N?

A trial that ran at DairyNZ, Scott farm (RED trial) for 10 years had one farmlet with no N applied and others with a range on inputs ranging from standing the cows off in wet weather to very high levels of supplementary feed. The results from five years have been modelled to determine the economics of the range of systems within the trial (Figure 4). Results from this farmlet study have indicated that:

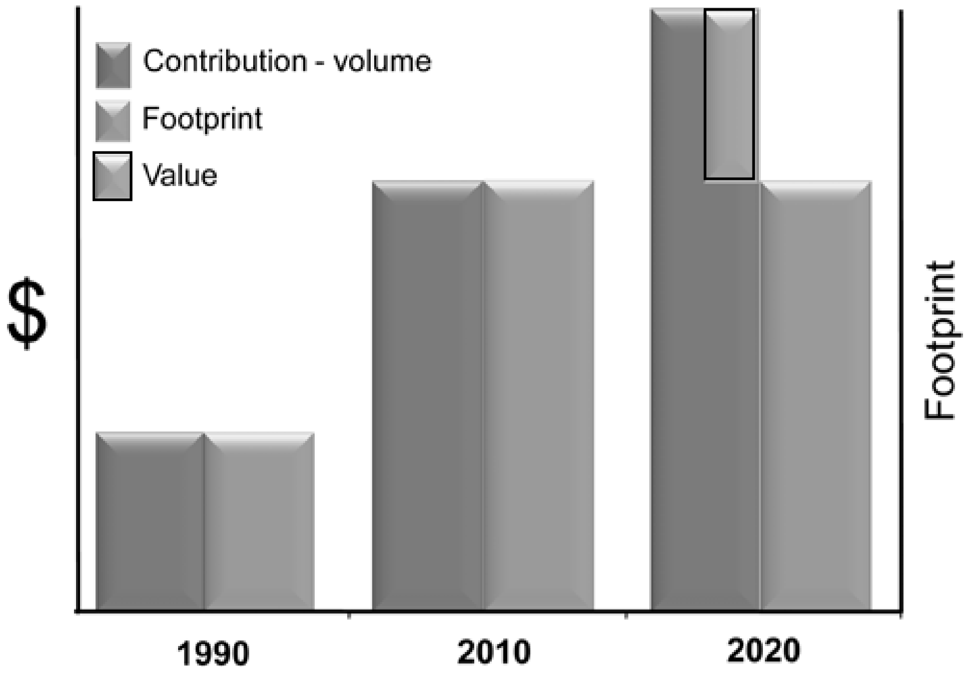
- The low input systems are much more resilient to milk price volatility than any system that uses N fertiliser and supplements, especially a very high supplement system
- In seven out of ten years of the trial, milk price has been <$5.50/kg MS and in those circumstances there is little to be gained from inputs of either N fertiliser or supplements
- At average or below average milk price, inputs simply don't pay off – but they increase both financial and environmental risk
- At a very high milk price there are major economic opportunity costs if N fertiliser and supplements are not used – but at >$8.00/kg MS a 100 ha the extreme farmlet in terms of supplementary feeding in the trial (SR - 7 cows/ha and producing 3000 kg MS/ha) would have an operating profit > $1,000,000 – probably enough to cover some costs associated with environmental protection.

Figure 4: Operating profit from farmlets in the RED trial over 5 years (2002-2006) at a bought in feed price of $0.25/kg DM and N applied at $1.60/kg N, and a range of milk prices.



Dairy farmers have been carbon trading for a long time – milk (protein, fat and lactose) and meat are very valuable forms of carbon that are moved off the farm. Any efficient dairying simply aims to channel as much carbon & nitrogen into milk as possible and lose as little as methane and nitrous oxide as possible.

Figure 5: NZ dairy farm economic and environmental goals



New Zealand dairy industry entities have set a target to increase productivity and at the same time not increase the environmental footprint (Figure 5). When setting targets societal agreement needs to be made on any trade-offs to achieve productivity, profit and environmental sustainability indicator. Society needs to be fully aware of the implications for the regional and national economy.

The key challenge is getting 'average' farmers to the position of today's best farmers – there are different rates and levels of adoption of skills etc. Existing tools such as the farm enviro walk (where the farmer does an environmental audit of the farm) will assist markedly in ensuring the farm is managed in such a way that losses of nutrients into waterways etc are limited.

Technology will eventually help with the use of products like nitrification inhibitors – but it is not a trivial task to reduce carbon and nitrogen losses. Systems have to be in place to manage this and might include:

- Reducing excreta left on pasture through controlled duration grazing. This is removing the cows from pasture after a set period and then standing them off to capture the urine and faeces on a pad allowing increased nutrient recycling from captured excreta. The use of nitrification inhibitors along with direct drilling of crops will both have an impact on carbon and nitrogen losses. The use of crops may allow the cows to be fed appropriately and if used in conjunction with feed pads will reduce wastage.
- Reducing SR per se might lead to good environmental outcomes but may also lead to lower profits. A way to break through this problem is to change the feedbase from low quality ryegrass with low summer yield to a high 'Intake Potential' diet fed to cows with the potential to produce 1 kg MS per kg live weight – But this must also be achieved at a cost that doesn't cripple the enterprise.

Replacement rate

Stocking rate is a key variable and a low SR should allow lower replacement rates aiding both economic and financial performance. It has always been assumed that replacement rates > 20% were optimal for overall herd genetic improvement, but recently Lopez-Villalobos & Holmes (2010), using a simulation model, have shown that replacement rates at 15% in combination with culling of low PW cows and selecting for high BW heifers may be best in a system context. This is only possible in herds where there is a high pregnancy rate and excellent cow health. High pregnancy rates will depend on good heat detection plus two critical factors at the start of calving: having the appropriate amount of feed on the farm and all cows at BCS of 5 and heifers at 5.5 (Macdonald & Hedley, 2010). The use of a set of decision rules (Macdonald & Penno, 1998) and lower stocking rates can both assist to achieve these targets.

Profitable and more efficient use of feed

Feed can be used more efficiently in a number of ways. SR can be increased so that pasture utilisation is maximised and thus maximise pasture production per hectare. Feed intake per cow can be increased by the use of ad libitum feeding of pasture or adding in supplements, and this will increase per cow production but can lower pasture utilisation. The third option is to increase the genetic merit of the cows so that they have a drive to eat more or are more efficient at converting the feed they eat into production. However, there is a caveat with this, that the cows must not carry detrimental traits such as excessive BCS loss or lower fertility. A major trial is under way at present (Feed Conversion Efficiency - FCE; Waghorn & Macdonald, 2010) to identify gene markers that will allow the AI companies to market sires whose progeny are more efficient. Results from the trial should be available in 2013, but in the mean time, selection of cows for high BW will go a long way towards improving profit.

Greenhouse gases

Beukes et al. (2010) modelled 2 farms to investigate what happens to operating profit and greenhouse gas (GHG) emissions when management is improved. One farm achieved the current average for New Zealand. The other was an efficient farm that had better reproductive performance and therefore fewer replacements, lower N fertiliser use, use of a stand-off area, application of nitrification inhibitors and some grain cropping/feeding.

- Nitrification inhibitors are considered to increase annual DM yield per ha by 2% with major reductions in nitrous oxide emissions and N leaching
- Cropping was used to make best use of effluent from the dairy and the stand-off area and to get grain for high per cow yield. It also allows pasture renewal to change from total ryegrass to 'diverse pasture' with better balance of grass/legumes/herbs.

The modelling identified an increase in MS production of 16%, a decrease in total feed eaten of 8% and a 26% increase in feed conversion to MS (g MS/kg DM). The result was a 33% increase in profit. A word of caution about these results is that the data used in the model to generate the simulation are all from individual trials, but have never been run together at a farmlet or demonstration farm level. Thus, in the simulation there is an assumption that the results are additive and compound but this has not been proven. Nevertheless, there is an indication that it may be possible to reduce effects on the environment and increase profit at the same time by the use of some of these technologies and management systems.

Main points from this study

1. Total feed eaten decreased by 8% but more feed was channelled into milk and less into dry cows or replacements, as less was used for maintenance
2. Feed conversion efficiency was improved by 26% - higher BW cows but also more feed into milk and fewer replacements
3. Profit was increased by 33% due to lower herd variable costs, less N fertiliser, lower replacement grazing costs but higher costs for nitrification inhibitors, stand-off and cropping. However, it is important to note that the cost of increasing genetic merit is not considered and neither is the cost of likely greater managerial skill to handle more complex pastures and new decision rules.

What happens to greenhouse gases?

Using management changes of: lower stocking rate, higher BW cows, less N fertiliser, stand-off, N inhibitors and grain cropping/feeding there was an increase in milk production and profit and a decrease in environmental footprint. The milk increase occurred despite a decrease in intake, because more DM was being channelled through milking cows and less through replacements and higher feed quality through grain input. The decrease in methane simply reflects the decrease in DM intake (DMI) associated with the management changes such as lower N fertiliser use.

The lower urinary-N levels were much more than would be predicted from the DMI decrease and occurred because of lower N fertiliser and use of N inhibitors, and decrease of N content in the diet with use of a low N grain. The combination of lower urinary N and methane means that total GHG is lowered by approximately 20%. The combination of increased milk and decreased GHG leads to about a 30% decrease in GHG/unit milk.

Conclusion

A test if SR is correct for the farm or the management system, is whether the required targets for feed and cows at a body condition score (BCS) of 5 at calving are always achieved - if not a review is necessary. The use of CSR is still the best method to calculate how many cows to milk and the optimum is 77 kg live weight/t DM. Any methods to reduce the effect of dairying on the environment must allow the total farm system to at least maintain current profitability and remain simple to operate. Lowering SR may be a profitable option on some farms, particularly those that are growing less grass or have little option to bring in supplement. But the use of a lower stocking rate must be combined with high genetic merit cows – these are cows with all the following attributes – high intake capacity from grazed pasture, high MS yield, high fertility, BCS recovery, high health and high survivability and matched with feeds that support high intake. A reduction in replacement rate is feasible on a lot of farms and will reduce costs and thus increase profitability.

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