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THE POSSIBLE IMPACT OF HAVING REGIONAL NITROGEN CAPS ON THE MILK PRODUCTION AND FINANCIAL VIABILITY OF DAIRY FARMS IN THE UPPER MANAWATU RIVER CATCHMENT OF THE TARARUA DISTRICT

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Abstract

This project examined the potential for dairy production whilst farmers operate within the nitrogen-cap for individual farm losses to water that applies within the Manawatū Wanganui Region. Since 2014, various catchments within the Region have been required to obtain their intensive landuse consents in different years. The Upper Manawatu River catchment with over 126 farms is one of the last of these and it provided the focus for this study.

In the study, a nitrogen cap from Table 14.2 of the One Plan was applied to five representative farms selected from dairy farms in the catchment, and the results were used to estimate the possible consequences across all the rest of the farms in the catchment. Two versions of Table 14.2 were considered; the original version in the One Plan based on Overseer® version 5.2.6 (2007) and a second updated version using Overseer® 6.2.3 (2018). Overseer® 6.2.3 was used for the farm system modelling and nutrient budgeting. To fit within their respective nitrogen caps, the representative farms required farm system as well as operational changes to be made including changes in stocking rates. A spreadsheet analysis of the five farms provided the financial results.

It was estimated that if all the dairy farms in the catchment were required to operate within the current nitrogen cap described in Table 14.2 of the One Plan, nitrogen losses from farms would drop by 300 tonnes (60%) and milk production by over 5,000 tonnes (40%) over 20 years. However, over 65% of them would no longer be viable as dairy operations. If Table 14.2 was updated to the latest version of Overseer® then nitrogen losses would drop by over 200 tonnes (40%) and milk production by over 700 tonnes over 20 years (5%). With a revised Table 14.2, the majority of farms could meet the cap and continue to remain viable.

Purpose

Since 2014 dairy farmers within selected high-risk catchments in the Manawatū Whanganui Region have been required to obtain landuse consents to continue their businesses (also intensive sheep and beef farming, arable and horticulture). The granting of controlled consents was conditional on farmers operating within a nitrogen cap calculated from Table 14.2 in the

One Plan, based on the results obtained from Overseer 5.2.6 (2007). Dairy farmers in the upper Manawatū River catchment are one of the last groups of farmers needing to apply for their consent. In 2018 a report was commissioned by the Regional Council to examine the impact of nitrogen capping in the One Plan on dairy farming in that catchment (Parminter 2018[b]). The report highlighted that it would require very significant changes to dairy farming systems before farmers could operate within the nitrogen caps described in the One plan. This paper provides more detail about the farming system changes required.

Methods

In this study the authors wanted to examine the changes in dairy farming systems that might be necessary in order for them to comply with the regional nitrogen caps. Five farm systems were selected by cluster analysis using Tararua farming data (Parminter 2018[a]). Overseer®, a farm systems modelling and nutrient budgeting tool, was then used to calculate the gap that might exist between the nitrogen losses associated with each of the current dairy farm systems in place on the five farms and the caps in Table 14.2. The dairy farm systems were then each modified to ensure that they could each operate within the Table 14.2 caps. The modifications were sequential, beginning with operational changes (such as fertiliser policies) that could be easily adapted or reversed within or between seasons. If these modifications were not enough to close the gap, system changes (such as stocking rate reductions) were introduced that would require more than one season to establish. If still more changes were required ,then structural changes (such as feed pads) were considered, requiring additional capital investment to be included. In this analysis only operating and system changes were needed.

Overseer calculates nutrient losses into the environment by balancing the annual nutrient inputs and outputs based on farms being in long term equilibrium (Wheeler et al, 2006). In this study the base-line farm systems were derived from actual farm data and so could be considered as being quite stable over the long term (Wheeler et al. 2014). However the future states of these farms were modifications of the base line farms and so might not represent equilibrium conditions. Under such constraints, operational changes where their effects are largely independent of the farming system were relatively straight forward to model in Overseer. System changes where the effects are highly interdependent with other parts of the system were more complex to model (Muller 2017). This particularly applied to possible milk production responses to changes in stocking rate. The easiest solution in studies such as this one, might be to hold milk production per cow constant as stocking rates change (ibid). However, a number of commentators consider that to be unrealistic and have projected large opportunities for increased milk production as stocking rates are reduced. For example Dewes (2015) states that it is possible for most [NZ] dairy farmers to have 20-30% fewer cows and 20% more production per cow (producing the same total milk per hectare but less inputs) and that "ironically this can occur and profit can lift by 50-100%". The authors of this paper wanted to re-examine these relationships and develop a different but realistic way of including production responses in Overseer models when stocking rate changes were needed as possible nutrient management mitigations.

Expected Production Responses to Changes in Dairy Cow Stocking Rates

Early research by DairyNZ examined the relationship between stocking rates (cows/ha) and milk production for self-contained grass-based production systems (Macdonald et al., 2001). Macdonald's study looked at the results of applying consistent management strategies set at industry best practice, for stocking rates ranging between 2.2 cows/ha and 4.3 cows/ha. In that study decreasing cow numbers by 1.0 cows/ha increased milk production by 75 kgMS/ha or 0.12 kgMS/kgDM consumption.

The Resource Efficient Dairying (RED) trials of DairyNZ considered stocking rates of between 2.3 cows/ha and 7.0 cows/ha. In that research, production was maintained at around 400 kgMS/cow by adding irrigation and importing supplements into the farming systems that had the highest stocking rates. In the RED trials, reducing stocking rate had little effect on pasture intakes and consequently there was no significant relationship between reducing stocking rates and production per cow (Jensen 2005).

Joy (2015) uses information from Massey University to show that between stocking rates of 1.2-2.6 cows/ha that the most profitable stocking rate was between 1.8 and 2.0 cows/ha, although milk production was maximised at 2.6 cows/ha.

Bringing together New Zealand and Irish dairy farming research on stocking rates Hanrahan (2018) found that across all dairy systems that production and net profit per hectare only increased when additional pasture was consumed. If farmers could only maintain higher stocking rates by increasing the proportion of nonforage feed in the diet then they increased production costs and consequentially reduced farm net profit.

General NZ industry guidance on production responses to reducing stocking rates is related to changes in dairy cow intakes (DairyNZ 2017, p46; Silva Villacorta, 2005). According to the industry guidance, as cow intakes are increased production responses of about 0.14 kgMS/kgDM can be expected.

Dairy Farm Results from the Upper Manawatu River Catchment

In 2015/16, dairy farms in the Upper Manawatu River catchment provided DairyNZ and Horizons with their base-line data. They had a median milking platform area of about 110 ha and a herd size of about 350 cows, producing 340 kgMS/cow or 900 kgMS/ha, or about 13 thousand tonnes of milk solids in total for the catchment. Average farms had nitrogen losses from their farms of 40 kgN/ha/yr or 550 tonnes of nitrogen in total across the catchment.

Nitrogen losses calculated in Overseer® for these farms ranged from 15-75 kgN/ha/yr. The losses in nitrogen appear unrelated to farm production (Figure 1). In the same catchment stocking rates ranged from 1.5-4.0 cows/ha (Figure 2). At higher stocking rates it might be expected that there would be lower feed intakes. However, Figure 2 does not reflect that and shows a very poor relationship between stocking rates and calculated feed consumption. Instead of higher stocking rates being associated with reduced feed availability, farmers at higher stocking rates imported supplements or grew crops to balance any expected feed deficits from pasture.

As shown in Figure 2, farmers in the catchment made available between 3,500 and 6,500 kgDM/cow per year. This enabled those herds to produce between 200 and 500 kgMS/cow per year (Figure 3). However, applying industry figures would suggest that at the very high level of feeding some of the herds should have been producing around 600 kgMS/cow/yr (DairyNZ 2017). Instead, the catchment results suggest that at high levels of feed availability overall, the farm systems within the catchment may be less production-efficient than farms offering only low to moderate amounts of feed to their cows.

Based upon the catchment data, a response rate of 0.07 kgMS/kgDM consumption was used in the impact study (or 14.3 kgDM/kgMS). A maximum herd production of 425 kgMS/cow was assumed with an underlying annual improvement in production of 1.25% from genetic gain and herd selection (Livestock improvement 2017).

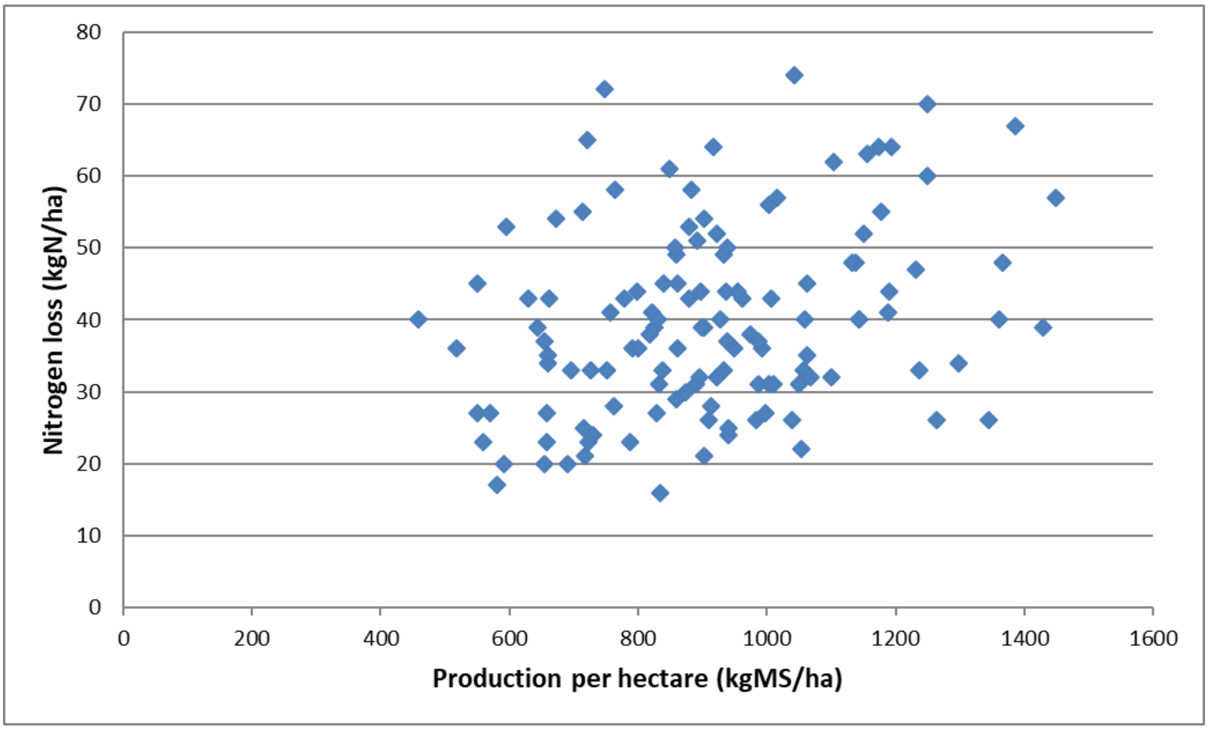

Figure 1. Upper Manawatū River catchment milk production per hectare and nitrogen losses

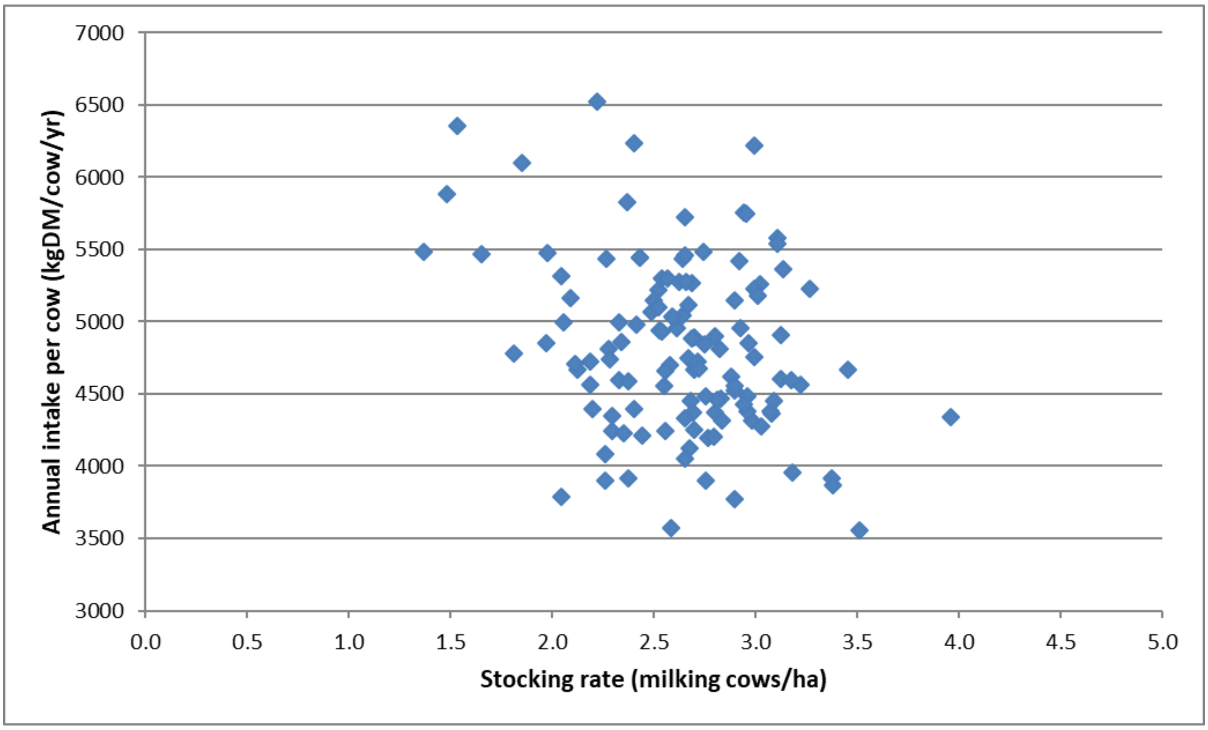

Figure 2. Upper Manawatū River catchment stocking rates and estimated cow intakes (including imported feeds)

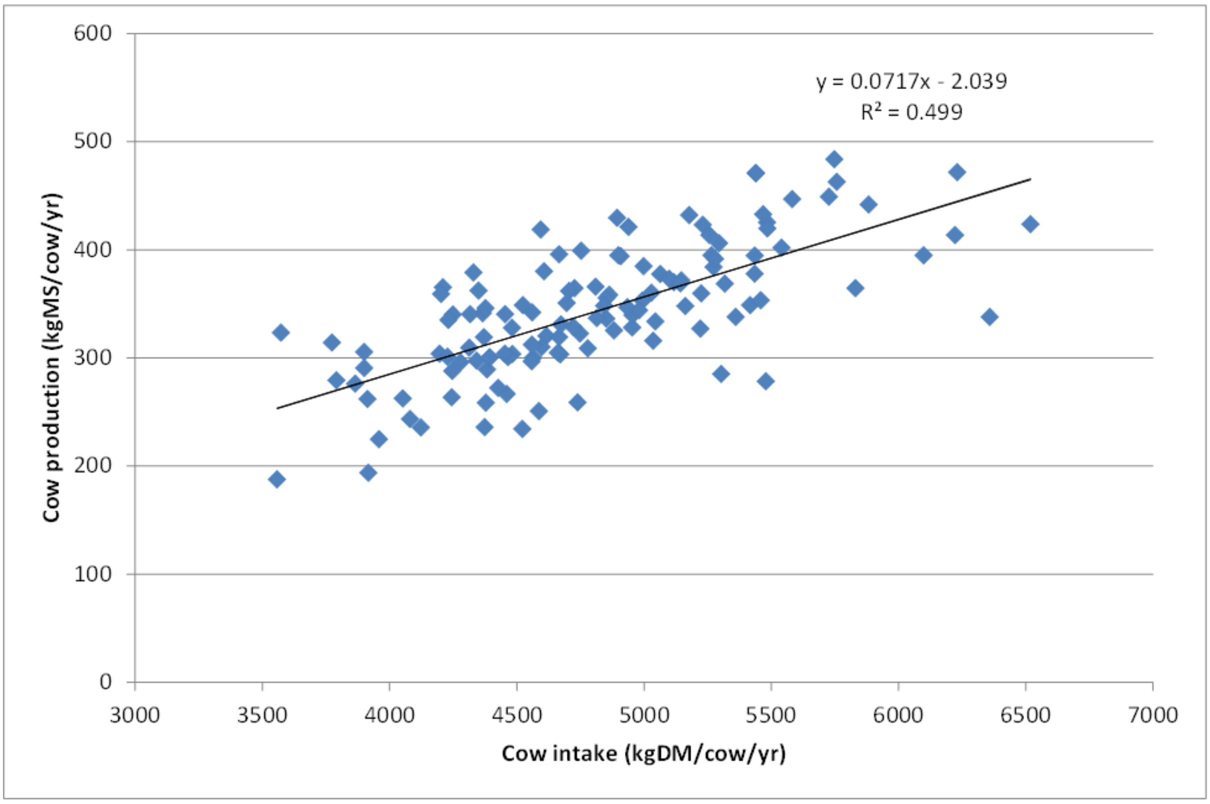

Figure 3. Upper Manawatū River catchment animal intakes and estimated milk solids production

An Evaluation of the Impacts of a Nitrogen Cap on Dairy Farms in the Upper Manawatū River Catchment

For the impact evaluation the catchment was represented by five clusters of farms as shown in Table 1.. On the median farms in the catchment Table 14.2 required dairy farmers to reduce their average nitrogen losses to water to 17 kgN/ha/yr over twenty years. The possible revised version of that table would reduce the reduction required to 25 kgN/ha/yr (Parminter 2018[b]).

Once a cluster analysis had been used to help select representative farms for the catchment (Parminter 2018[a]), then an analyses of the farming systems was undertaken using Overseer® to model the farm systems and Excel® to calculate expected changes in farm operating profitability. Farm expenses included fixed costs for each farm and variable costs were linked to land area, livestock numbers, or milk production. Income included milk sales, livestock sales and any surplus pasture. The profit figures shown in Table 1 do not take into account depreciation, tax, and the costs of farm debt.

Table 1. A comparison of the results from five representative farms in the upper Manawatu River catchment, comparing their performance in the initial year (2012/13) with year 20 of their consent, for both the One Plan Table 14.2 and the same table with updated figures.

Farm	Number of farms	Initial Farm Attributes					One Plan Table 14.2, results after 20 years				Revised Table 14.2, results after 20 years			
		Milking Platform Area (ha)	Nitrogen Loss to Water (kgN/ha/yr)	Peak Milking Cows (cows/ha)	Annual Milk Production (kgMS/ha)	Operating Profit ($/ha)	Nitrogen Loss to Water (kgN/ha/yr)	Peak Milking Cows (cows/ha)	Annual Milk Production (kgMS/ha)	Operating Profit ($/ha)	Nitrogen Loss to Water (kgN/ha/yr)	Peak Milking Cows (cows/ha)	Annual Milk Production (kgMS/ha)	Operating Profit ($/ha)
1	27	116	41	2.9	942	1921	16	1.3	478	868	24	2.0	810	1838
2	10	112	42	3.0	1107	2387	18	1.3	569	1383	28	2.3	987	2379
3	18	99	28	2.6	880	1293	17	1.8	752	1456	28	2.4	1008	1737
4	16	131	46	2.9	1137	2407	18	2.3	973	1513	22	2.7	1081	1748
5	55	108	39	2.5	840	1533	16	1.5	394	124	24	2.5	793	1119

In the study the initial year results were compared with the results of applying the nitrogen caps in the One Plan and a revised version of Table 14.2. These are summarised in Table 1. None of the farms had their performance optimised in this process as instead the results were based on what was actually being achieved across the catchment in practice (Ridler 2017, Muller 2017). Individual farm results were then extrapolated to the catchment scale.

Applying mitigations to implement Table 14.2 in the One Plan required significant reductions in cow numbers across the representative farms. In response to the decreased stocking rate and increased feed availability their production was estimated to increase from 320 – 390 kgMS/cow to 370 – 425 kgMS/cow. To maintain pasture composition over time, pasture conservation was used to maintain minimum annual production of 9,000 kgDM/ha. The surplus feed could not be used to extend lactations as that would have increased nitrogen losses and so it was sold instead. Although production per cow increased, production per hectare and gross income were both reduced. Some costs were saved but operating profit for three of the five representative farms were halved (Farms 1, 2 and 5 in Table 1). Farm 3 was able to save enough costs to increase profitability and the profit for farm 4 reduced less than the others.

If the figures in Table 14.2 were updated to account for more recent versions of Overseer, nitrogen losses from farms could still be reduced by more than a third. There was still some loss of production on the representative farms but profitability was reduced by a quarter or less. In contrast to the other farms, representative farm 3 reduced stocking rate slightly and cut its costs enough to increase its profitability by almost 5% as a result of meeting the updated nitrogen caps.

Conclusions and Discussion

Applying the representative farm study to the upper Manawatu River catchment indicates that using the nitrogen caps from the existing Table 14.2 in the One Plan would result in nitrogen losses from dairy farms in the catchment dropping by over 300 tonnes/yr (60%) and milk production by over 5,000 tonnes/yr (40%). It is expected that imposing this on farmers would possibly result in 65% of dairy farms within the catchment not having sufficient operating profit to cover their existing debt levels.

If a nitrogen cap from an updated Table 14.2 in the One Plan was applied to the five representative farms it was estimated that nitrogen losses would drop by over 200 tonnes (40%) and milk production by over 700 tonnes over 20 years (5%). However, some farms would still struggle to remain financially viable at current costs and prices. It is possible that some of the affected farmers would consider amalgamating and others to change their existing landuse away from dairying.

Applying Overseer® in catchment scale studies in the way that it was here, introduces some complexities that are not easily resolved without extensive local knowledge and farming systems capability.

This study highlights that farming within nitrogen caps for many farmers in the catchment will mean considering reductions in stocking rates. Grazing management with reduced stock numbers is likely to means that dairy farmers have to develop new skills and expand their existing skills in order to continue to maintain their profitability (Muller 2017). Lower stocking rates require dairy farmers to monitor pasture cover and pasture quality closely. To maintain pasture quality on low stocked farms, it may be necessary for some of them to top (cut to waste) almost all the pastures on their farms in late spring (Macdonald 2001). They may also need to conserve more pasture than they can use and then sell their surplus.

Some international research indicates that larger farms employing more labour may be less capable of developing the sorts of pasture management skills required for them to be efficient at the lower stocking rates (Hanrahan 2018).

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