in the matter of: the Resource Management Act 1991

and: submissions and further submissions in relation to proposed Variation 1 to the proposed Canterbury Land and Water Regional Plan

and: **Fonterra Co-operative Group Limited**
Submitter

and: **DairyNZ**
Submitter

Statement of evidence of Duncan Smeaton (farm systems / reductions)

Dated: 29 August 2014

REFERENCE: JM Appleyard (jo.appleyard@chapmantripp.com)
BG Williams (ben.williams@chapmantripp.com)

Chapman Tripp
T: +64 3 353 4130
F: +64 3 365 4587

245 Blenheim Road
PO Box 2510, Christchurch 8140
New Zealand

www.chapmantripp.com
Auckland, Wellington, Christchurch

CHAPMAN TRIPP

STATEMENT OF EVIDENCE OF DUNCAN SMEATON

INTRODUCTION

1 My name is Duncan Colquhoun Smeaton.

2 I am an independent agricultural consultant and dairy farmer. A significant part of my consultancy business involves working as a science/extension contractor to DairyNZ and AgResearch.

3 I have a Bachelor of Agricultural Science and a Master of Agricultural Science (Hons I) degree from Massey University.

4 After graduating from Massey University, I was employed by AgResearch as a scientific liaison officer. After 4 years, I took a position as scientist in sheep and beef nutrition and grazing management at the Whatawhata Research Station for 8 years.

5 In 1985, I went dairy farming in the Bay of Plenty. My wife and I now own a 500 cow dairy farm in Waihi and have a 40% shareholding in a 1000 cow dairy farm in Waimate, South Canterbury.

6 In 1992, I returned to science research and consultancy work on a part time basis. My science work centred initially on beef cattle farming systems using novel reproduction techniques. Then for 8 years I was doing research on farm systems in both sheep/beef and dairy farming. This involved a mixture of field and modelling work, much involving case study farms in the Rotorua and Taupo districts and then on a selection of dairy farms throughout New Zealand.

7 In August, 2007 I completed a project on the dairy farms and a small sample of the sheep and beef farms in the Lake Rotorua catchment. This involved modelling of the farms at a production and financial level using the model UDDER and then determining their Nitrogen (*N*) loss[1] rates using OVERSEER®. A range of N loss mitigation strategies were also tested, for impacts on farm productivity and profitability.

[1] Note that throughout this submission, the term “N (nitrogen) removed to water” (the output value described in Overseer) is abbreviated to “N loss”. In essence, it represents mineral N lost via leaching through the soil profile (99%, mostly in the nitrate form) and N lost via surface runoff (generally <1% in most circumstances).

8 I am a competent user of the farm production models Farmax® (sheep & beef, and more recently dairy), UDDER, and the nutrient budgeting model OVERSEER®[2].

9 For the last five years of my career, I managed DairyNZ's North Waikato extension team of consulting officers. This involved the running of regular farm discussion groups and field days. I am now focused on working as a part time agricultural consultant and managing my farming interests.

10 I have authored more than 30 refereed papers, written one book on beef production and co-authored another. I have written other technical reports, delivered presentations to numerous farmer and other groups, organised field days and run numerous farm discussion groups.

11 In preparing my evidence I have reviewed the following:

11.1 the case study farm systems analyses conducted by Alfredo Adler (contractor to DairyNZ) in the last six months. He used the Farmax and OVERSEER® modelling tools for this work. His analysis has formed the basis of much of my evidence as it involved case study farms in the Selwyn-Waihora zone; and

11.2 the report on "*Selwyn Te Waihora N loss reduction and allocation systems*" by Sam Howard et al, (2013).

12 I am familiar with the aspects of proposed Variation 1 (*Variation 1*) to the proposed Canterbury Land Water Regional Plan relevant to my evidence to which these proceedings relate.

SCOPE OF EVIDENCE

13 In my evidence I discuss the following:

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[2] UDDER and FarmaxDairy® are both computerised versions of dairy farms. They incorporate feed flows in and out of the dairy farm, animal intake and milk production, liveweight change, sales and purchases, calving and drying off, cropping, supplements bought and sold, nitrogen fertiliser used and also include a financial component including farm working expenses and product sales such as milk. Both models contain underlying pasture growth and decay and animal feed intake functions and have also both been tested against real farm data obtained from research farms. Overseer is a nutrient flow model. The user can apply the information obtained from Farmax or Udder to estimate nitrogen and phosphorus nutrient flows into and out of the farm grazing system. Overseer is described in much more detail by other submitters. It operates on an annual basis using long term average data; e.g. rainfall.

13.1 The impacts of a 15% and 30% reduction in N loss from case study farms in the Selwyn Waihora zone (to illustrate the effects on productivity, profit and N loss (all per hectare) on an individual farm basis);

13.2 why a blanket rule requiring nitrogen loss reductions of 30% from dairy farmers under policy 11.4.14 will put increasing proportions of dairy farmers into the financially "at risk" category; and

13.3 how some farms can tolerate greater reductions in N loss than others.

14 Although this is a Council hearing, I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2011. I have complied with the Code of Conduct in preparing this evidence and I agree to comply with it while giving oral evidence before the hearing committee. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

KEY FINDINGS

15 Based on our analysis there are a number of key findings that I consider are relevant to informing the final provisions of Variation1:

15.1 To meet the community outcomes for the catchment it is desirable to maintain economic viability of existing dairy farms at or close to present levels (alongside the wider desired environmental, social and cultural outcomes). The modelling allowed us to form a view of the costs of achieving this, and the impacts on farm profits;

15.2 The adoption of good management practice (*GMP*), in line with the Matrix of Good Management project (*MGM*) as described by **Mr James Ryan** and **Mr Roger Williams** is the appropriate starting position for all farms;

15.3 It is important that the regional council rules, in whatever form they are finally manifested, do not reward N use *inefficiency.* That is, rules which manage N loss should not reward farms that presently lose high rates of N per hectare (after taking account of soil type, and climate) or penalise farms that are already N use efficient and have relatively low N loss rates. N use efficiency is defined as kg N loss/kg milk solid (*MS*), within agreed N loss limits. Mostly, those farms that are already N-use efficient, have low levels of N loss (for their soil type, and climate) and are profitable, cannot easily reduce N losses further without significant negative effects on profitability. The corollary to this is that different farms can reduce N loss by different amounts before profit is affected. It all depends on their starting position and the mitigation options available. Every farm is different;

15.4 Similarly, the above are all subject to the caveat that N loss is also driven by many factors and some like rainfall and soil type are outside the farmer's control and can potentially have a significant impact on N losses;

15.5 Reducing the N loss of existing dairy farms, such that their profitability is materially compromised, for the purposes of creating head room for new dairy farm conversions is counterproductive and should be avoided. Conversions within the Variation 1 framework need to occur in a manner that is consistent with the wider catchment outcomes being sought;

15.6 On average (and compared to the Base Farm models), for 6 of the 8 case study farms analysed, a 19% reduction in N loss was associated with a 5% reduction in profit and a 33% reduction in N loss was associated with a 17% reduction in profit. It was noted that there was wide variation around these average figures and it is also emphasised that with only 8 case study farms and such variability some caution needs to be taken in terms of the results set out – again, every farm is different; and

15.7 Deeper cuts in profitability to achieve greater reductions in N loss will further increase the percentage of farms at financial risk, depending on milk prices and borrowing interest rates, compared to the status quo or base situation.

USE OF CASE STUDY FARMS TO ANALYSE THE IMPACTS OF THE PROPOSED RULES

16 Dairy farming in the Selwyn Te Waihora zone occupies about 50,000 hectares[3]. In addition there is a further amount of dairy support which is integrated into other farm operations (e.g, cropping, sheep and/or beef farms). This combined area of milking platforms and dedicated dairy support accounts for about 25% of the total area of the Sewlyn Te Waihora zone of 272,000 hectares.

17 Eight case study farms were chosen as being generally representative of dairy farms in the Selwyn Te Waihora zone on the

[3] Environment Canterbury. 2012. Selwyn Waihora Limit Setting Process: An Overview of Current Status in 2012.

basis of different soil types and farm system intensities. Farms were selected for the study by DairyNZ based on willingness of the farmers to be involved and the suitability of the farm in terms of availability of data, the complexity of farm operation and ownership, and the representation of different farm systems (http://www.dairynz.co.nz/farm/farm-systems/the-5-production-systems/).

18 A case study approach was used because it allowed for a diverse range of real farm systems to be tested and therefore gives a better insight into the range of potential impacts of proposed Variation 1. Farms were chosen that covered some of the key drivers of nitrogen loss in the catchment; soils and system type (low input vs. high input).

19 DairyNZ used its DairyBase[4] data and local knowledge of dairy farm systems in the Selwyn District to determine the representativeness of each of the case study farms on the basis of farm system, production, profitability and soils.

20 **Appendix 1** summarises the eight case study farms and their representativeness of dairy farms in the Selwyn District.

21 Data from the case study farms were entered into Farmax Dairy and OVERSEER® by Alfredo Adler, a contractor to DairyNZ to provide a picture of current (2012/13) farm productivity, profitability and N loss. The farm models were refined to reflect future scenarios and what the farms might need to do to meet the proposed new rules. This process is iterative; that is, the modeller applies mitigation strategies that are likely to achieve target N loss levels at the least impact on profit, while trying to avoid major system changes. The future scenarios tested were:

21.1 Achieving good management practice (based on an interpretation of what might be implemented in Schedule 24 of Variation 1[5]).

21.2 Achieving N loss targets of 15% reduction beyond GMP, 30% reduction beyond GMP and greater than 30% reduction beyond GMP (to test for changes in the slope of the response curve). Because of the way that Farmax works, the actual modelled reductions in N loss achieved were not exactly 15 and 30% in every case. Even so, the results can be plotted

[4] DairyBase is a farm business information (physical and financial) benchmarking package.

[5] Good management practices that could be modelling in OVERSEER® were: no fertiliser applied in June and July, and no more that 60kgN/ha applied in any one month. A cost of $2,500 was applied to all farms for the implementation of an environment plan as part of the GMP scenario.

and the observer can easily integrate the output and see how farm profit and other variables respond to scenario changes.

22 The scenario changes that were applied to each farm to reduce N loss, while having the likely least damaging effects on production and profit (based on the experience and knowledge of the modeller) were:

22.1 Reduction in N fertiliser use at times of the year (autumn/winter) when N loss risk is greatest;

22.2 Reduction in cow numbers to compensate for (a) above;

22.3 Redistribution of supplement use to compensate for reduced N fertiliser use above;

22.4 Some substitution of grain supplement for N fertiliser (this is less profitable than using N fertiliser).

23 Scenario *changes* not applied, because they are considered to be practically infeasible or not available included:

23.1 Wintering off: all the case study farmers were already doing this. The modelling was done for the milking platform and separate analysis was done on a modelled support block.

23.2 Reductions in stocking rate combined with increases in per cow production: We consider this system change to be beyond the capability of most farm managers as cows in the Selwyn Te Waihora zone already perform at high levels of production per cow relative to the national average. Further reductions in stocking rate are likely to result in increasing problems with high pasture utilisation and subsequent negative impacts on pasture quality. Reducing stocking rate to increase production per cow may initially appear to be an easy mitigation available to farmers. In our experience, however, it is not, and the cost of getting it wrong can be high because of reduced pasture utilisation.

24 The results of the modelling work are shown below in **Figures 1 to 4.** All 8 case study farms are shown on each graph.

Figure 1: Relationship between milk solids production (MS/ha/yr) and % reduction in N loss (compared to the Base Farm model). Each line number refers to a separate case study farm.

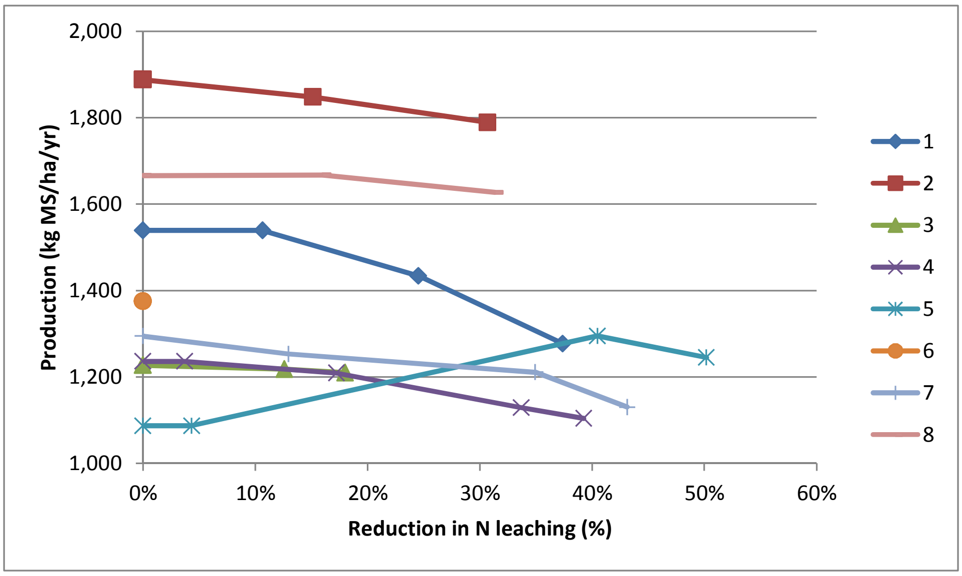


Figure 2: Relationship between production and level of N leaching (kg N leached/ha/year).

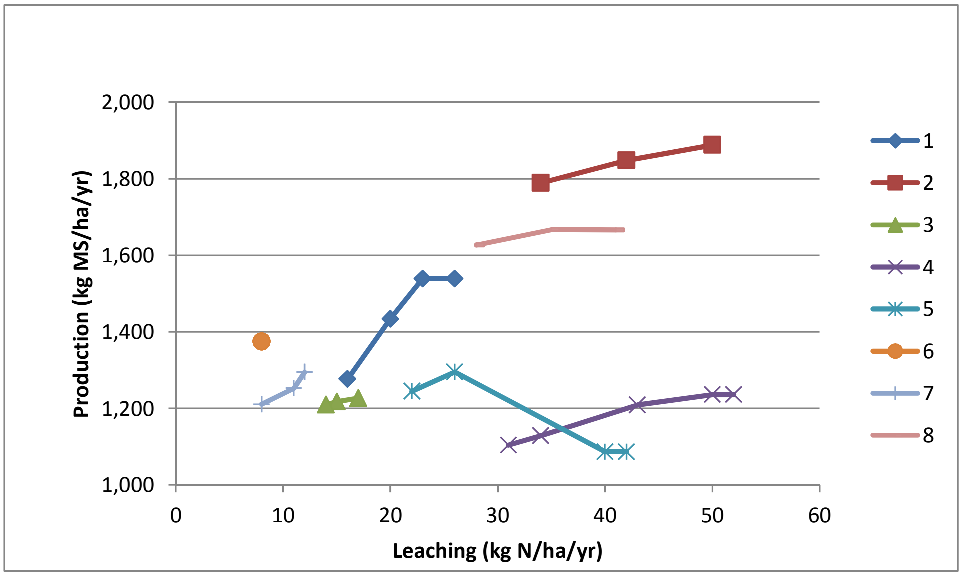


Figure 3: Relationship between operating profit ($/ha/year) and % reduction in N leaching (compared to the Base Farm model).

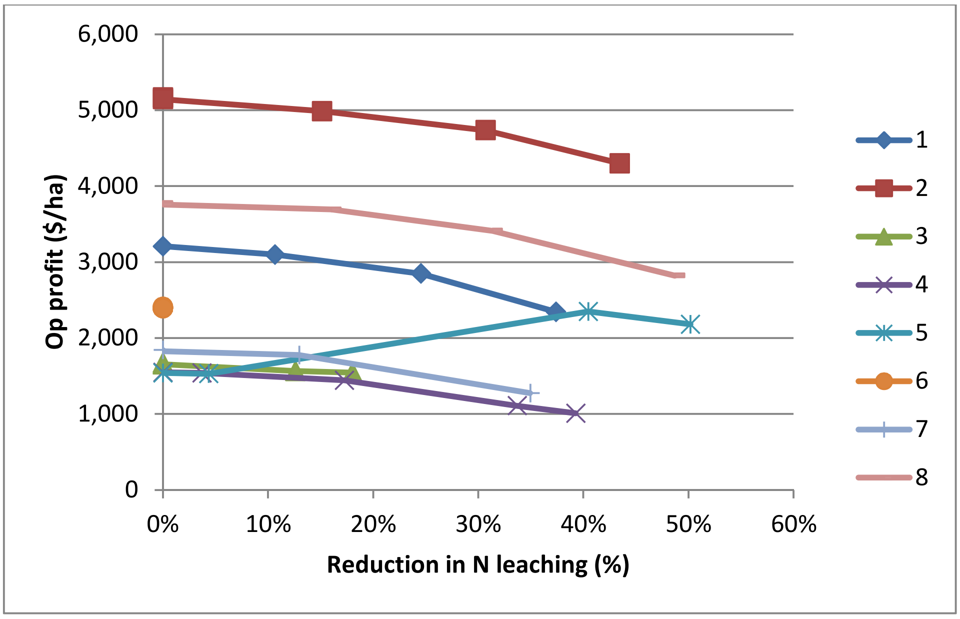
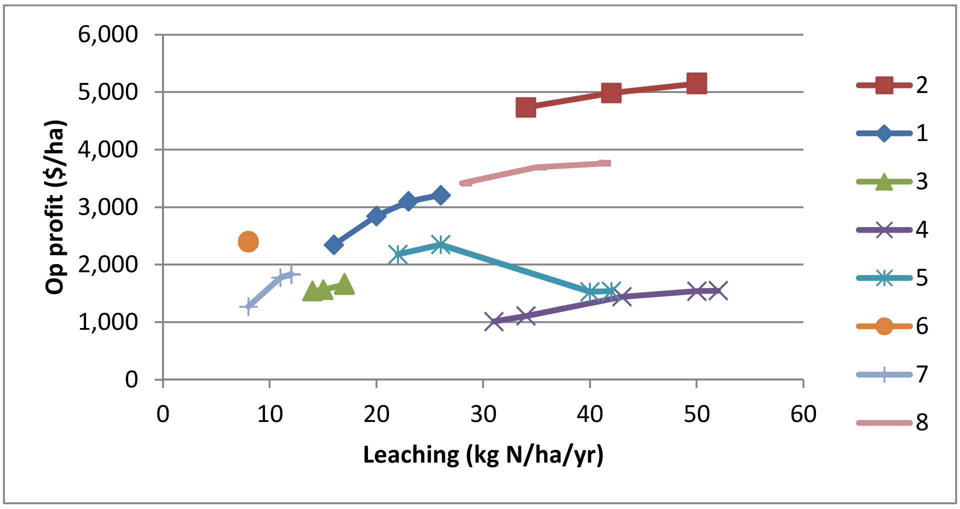


Figure 4: Relationship between operating profit ($/ha/year) and level of N leached.



25 Key findings include:

25.1 All case study farms were able to change their system so that some reduction in N leaching occurred with only small impacts on production and operating profit;

25.2 The amount of N leaching reductions that could be achieved without significantly affecting business viability varied between farms. For example, farm 2 achieved large reductions in N loss with relatively little impact on profit, whereas other farms suffered significant effects on profit for little reduction in N loss. *This was a key result. This also highlights the caution required in using average results as they can mask the impact on individual farms;*

25.3 The response lines are generally curvilinear, which means that the price to be paid (in terms of reduced MS production and profit) increases for each extra unit reduction in N loss;

25.4 An exception was Farm 5 which had the scenario change option of changing its irrigation system from border dyke irrigation to centre pivot. This achieved a virtuous outcome in that profit went up and N loss went down. There is a capital cost to achieving this, of course, which is generally regarded as well worth the cost, but it is a good example of a win/win technological advance. However, all the other case study farms were already using spray irrigation of some kind so that this scenario change option was not available to them. Note that farm 5 showed a reduction in profit when more severe scenario changes were applied; this would be challenging after having spent the money and made the gains outlined due to changing irrigation technology

25.5 Farm 6 showed only one data point because no scenarios were tested for this farm as it was losing less than 15kg N/ha/year and would therefore not require resource consent and further N loss reductions.

25.6 The variations in the positions of the N loss curves for each case study farm in Figures 1 to 4 reflect the soil type, rainfall and system intensity operating on each case study farm.

26 Table 1 shows the *weighted average impacts* of the changes reported for the 6 case study farms that will be affected by Policy 11.4.14 (ie base loss is > 15 kgN/ha/yr and therefore, expected to make 30% reductions in N loss beyond GMP).

27 The graphs show that there is *wide variation around the individual farm responses*, but the table shows that on average, farms could over time reduce N leaching by nearly 20% with relatively low impact on production and profit per hectare. *But*, it is emphasised that this table includes farm 5 which was able to take advantage of a fortuitous change in irrigation system which both *reduced* N leaching and *increased* farm profit. This occurred through the

conversion of inefficient border dyke irrigation to a far more efficient spray irrigation system.

Table 1: Weighted averages of the responses shown in Figures 1 to 4 above for the 6 farms affected by Policy 11.4.14. These are farms whose current N loss is greater than 15kg N/ha/year.

	Base farm	**GMP**	**15% off GMP**	**30% off GMP**
N leached (kgN/ha/yr)	27	26	22	18
MS production (kg MS/ha/yr)	1,197	1197	1,167	1,098
Operating profit ($/ha/yr)	2,354	2,311	2,225	1,965
Change in N leaching (%)		*-5%*	*-19%*	*-33%*
Change in MS production (%)		*0%*	*-3%*	*-8%*
Change in Operating Profit (%)		*-2%*	*-5%*	*-17%*

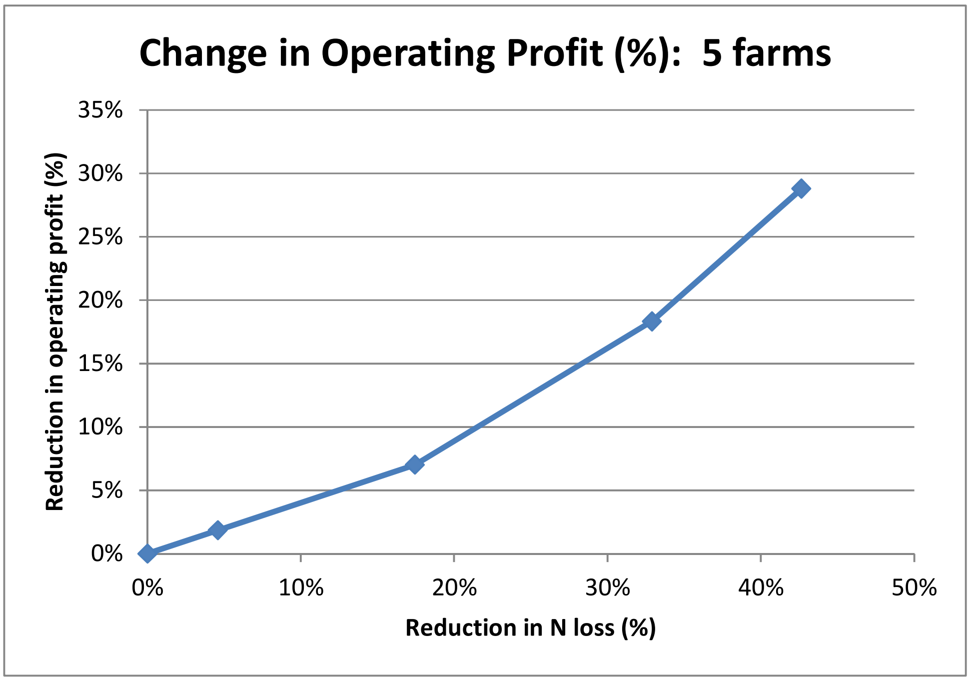
28 Table 2 shows the above average impacts, *but with the farm 5 removed.* This result more accurately reflects the changes likely to be experienced, *on average*, by most dairy farms in the catchment. Now, in Table 2, a 17% reduction in N loss was associated with a 7% reduction in profit and a 33% reduction in N loss was associated with an 18% reduction in profit.

Table 2: Weighted averages of the responses shown in Figures 1 to 4 above: that is, Table 1 but with the border dyke irrigated farm 5 excluded.

	Base farm	**GMP**	**15% off GMP**	**30% off GMP**
N leached (kgN/ha/yr)	31	30	26	21
MS production (kg MS/ha/yr)	1,438	1438	1,390	1,304
Operating profit ($/ha/yr)	2,865	2,812	2,664	2,340
Change in N leaching (%)		*-5%*	*-17%*	*-33%*
Change in MS production (%)		*0%*	*-3%*	*-9%*
Change in Operating Profit (%)		*-2%*	*-7%*	*-18%*

29 Interpolation of the data in Table 2 indicates that for these farms, a 13% reduction in N leaching would be associated with a 5% reduction in profit (Figure 5). The figure includes N reduction scenarios beyond 30% to illustrate the increasing cost in lost profit per unit % decrease in N leaching. That is, it becomes increasingly expensive to reduce N leaching as was illustrated in the figures above.

Figure 5: Change in operating profit for the weighted average of the 5 farms in Table 2.



DISCUSSION

30 The modelling results demonstrate that:

30.1 Every farm varies in terms of how much N leaching can be reduced, depending on its starting position (i.e. how effectively it is already managing N leaching);

30.2 At one extreme, some farms can reduce N leaching significantly with little reduction in profit (farm 2) and at the other extreme, some farms can suffer a major reduction in profit for relatively small reductions in N leaching (farm 1). Other farms vary between these extremes due to various factors including some factors that are beyond the control of the farmer.

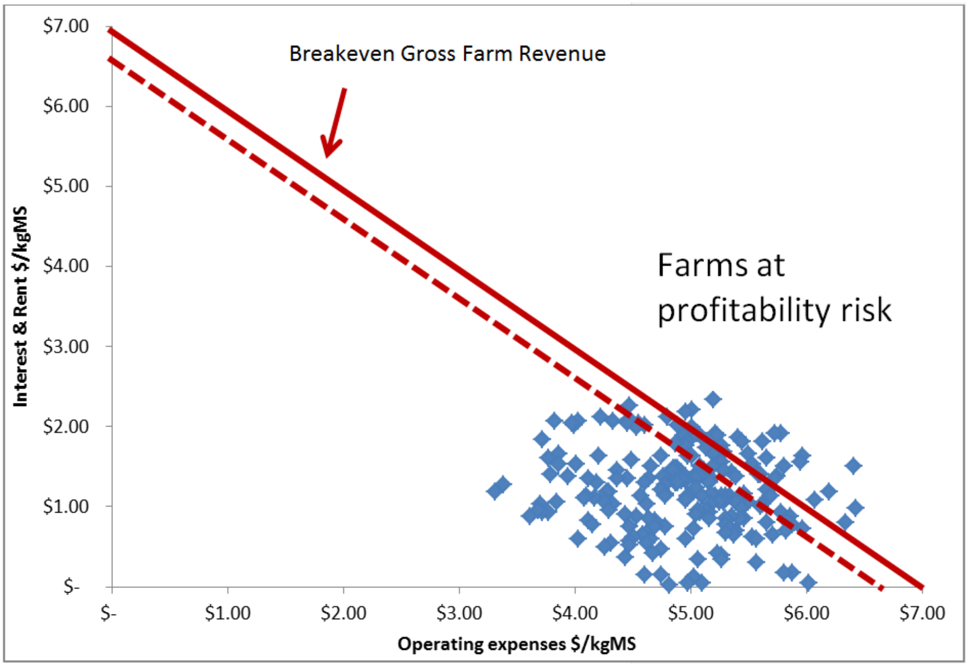
30.3 The implication of the above is that every farm is different and an individual farm systems analysis (as per this study) should be required to determine what is practically feasible in terms of maximum reduction in N loss for least effect on profit.

30.4 On average amongst the case study farms (but with wide variation), a 17% reduction in N loss was associated with a 7% reduction in profit and a 33% reduction in N loss was associated with an 18% reduction in profit. Interpolation of the results (Figure 5) indicated that a 30% reduction in N leaching would be associated with an approximately 17% reduction in profit.

30.5 A reduction in average profitability will impact farm financial sustainability. DairyBase farm data (Matthew Newman *pers. comm.*, DairyNZ) indicate that at an average Gross Farm revenue of $7/kg MS, 12% or 25 dairy farms in the Selwyn Waihora district would fail to meet their operating expenses, interest and rent without off-farm income (see the red line in Figure 6). If profit is reduced by 17% (to achieve a 30% reduction in N loss) this would mean an additional 12-14 farms would fall into this category (dashed line Figure 6) and the original 25 farms would find it even more difficult to meet payments, increasing debt levels until they become insolvent.

30.6 Figure 6 shows that increased costs/reduced profit can have a significant adverse effect on the business viability of farming.

Figure 6: Impacts of increasing costs of production per kg MS (equivalent to a reduction in profit of 17%)



Comments on the economic impact analysis supporting Proposed Variation1

31 I consider the economic impact analysis[6] carried out by Environment Canterbury is inadequate in that it does not examine the potential farm business implications of the above discussion. As the report relies upon standardised farms from Ministry of Primary Industries Farm Monitoring Reports, it does not take account of the reality that all farms are different, with different starting positions and different N-loss operating-profit response curves

32 The economic impact analysis[7] carried out by Environment Canterbury also uses Earnings before Interest and Tax (EBIT) as its profit proxy. EBIT, by definition, does not account for interest and tax and possibly drawings and depreciation, meaning that it is difficult to consider farmers' ability to withstand additional financial cost or reduction in revenue. We would need to confirm that depreciation was included to ensure capital costs of mitigation strategies were accounted for.

33 In addition, economic impact analysis[8] carried out by Environment Canterbury provides inadequate information on the N loss mitigation strategies used. From the report it is not possible to understand what these strategies were and how they affected production and profit. It is my view, that the above omissions wrongly create an impression that zone-wide rules, applying an average cost of mitigation to all farms and implying average effects on profit (EBIT) are a straightforward solution.

CONCLUSIONS

34 Some farmers are running profitable, N leaching efficient systems that have low N leaching values. These farmers have very little opportunity to reduce N leaching further without serious reductions in profit

35 Other farmers have more room to move in terms of N leaching before profit is significantly damaged.

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[6] Harris, S. 2014. Technical Report to support water quality and water quantity limit setting process in Selwyn Waihora Catchment. Predicting consequences of future scenarios: Economic Impact. Report No. R14/12, prepared for Environment Canterbury

[7] Harris, S. 2014. Technical Report to support water quality and water quantity limit setting process in Selwyn Waihora Catchment. Predicting consequences of future scenarios: Economic Impact. Report No. R14/12, prepared for Environment Canterbury

[8] Harris, S. 2014. Technical Report to support water quality and water quantity limit setting process in Selwyn Waihora Catchment. Predicting consequences of future scenarios: Economic Impact. Report No. R14/12, prepared for Environment Canterbury

36 My evidence shows that all farms are different and should be dealt with on a case by case basis (using farm systems analyses as per our case study work) to determine how much capacity they have to reduce N leaching without a significant reduction in operating profit.

37 Our relatively small farmer sample indicates that, on average, (and by interpolating between data points), a 13% reduction in N leaching (compared to base line values) can realistically be achieved with a cost of a 5% reduction in profit, but with wide variation between farms. A 30% reduction in N leaching, for dairy farms already on spray irrigation, would result in a 17% reduction in operating profit. My evidence demonstrates that this would result in an increase in the number of "farms with significant profitability risk" and would also adversely impact those farms already in this category. As payout declines, this risk increases further.

38 It is also worth noting that this analysis, which demonstrates that nutrient loss reductions in the order of 10% – 20% for existing dairy farms are realistic without having significant economic effects, is consistent with other studies carried out throughout New Zealand including in the Hurunui catchment in Canterbury, the Inchbonnie catchment on the West Coast, Lake Rotorua catchment, Manawatu catchment and the Tukituki catchment (McCall, 2012; McCall 2014; Smeaton et al 2006., Wilcock et al, 2013; Laurenson et al., 2012; Kingi et al., 2012; Bell, et al., 2013).

39 Further gains might be possible in the future, due to, for example, higher per cow production at lower stocking rates. In the meantime, this option in my opinion remains out of reach of more than 95% of existing dairy farmers.

Dated: 29 August 2014

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Duncan Smeaton

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Appendix 1: Summary of eight case study dairy farms

	Light to extremely light - Free-drainng soils				Light to Medium soil	Heavy - Poor draining soils		
Farm ID	Farm 1	Farm 4	Farm 5	Farm 8	Farm 2	Farm 3	Farm 6	Farm 7
% of estimated dairy area (milking platform) represented in the Selwyn district	32%	10%	4%	20%	3%	12%	12%	7%
N leached (kgN/ha/yr)	**26**	**52**	**42**	**41**	**50**	**17**	**8**	**12**
Stocking rate (cows/ha)	3.7	3.7	3.1	3.6	4.0	3.3	3.3	3.2
MS production (kg MS/ha/yr)	1,539	1,201	1,107	1,666	1,889	1,227	1,375	1,295
MS production (kg MS/cow/yr)	413	327	356	469	477	376	420	404
Operating profit ($/ha/yr)	3,208	1,097	2,143	3,777	5,165	1,674	2,410	1,840