OTOP Healthy Catchments Project: Impact of targets and approaches to nutrient reduction

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1 Introduction

This report summarises the implications of adopting different levels of reduction in N losses for the Ashwick Flat, Levels and Orari hotspots. The analysis estimates impacts on the level of reductions required for different targets, the operating profit impacts, the degree of land use change required, the impact on capital value of businesses, and a qualitative assessment of the impact on ability to service debt.

2 Method

The modelling uses operating profit as an indicator of the economic outcomes but extends this by attempting to signal how levels of reduction will impact on farm values, and on the viability of properties with different debt levels.

The base operating profit figures for each land use were derived from the work with farmer stakeholders in the OTOP zone and include depreciation. Profitability by land use and soil is shown in Table 1 below.

Table 1: Operating profit ($/ha) by land use and soil type

	Soil category				
Land use	**XL**	**L**	**M**	**H**	**VH**
		IRRIGATED			
Dairy	$3,126	$3,126	$3,126	$2,402	$2,402
Dairy support	$687	$687	$687	$687	$687
Arable	$915	$915	$915	$915	$915
Sheep and beef intensive	$588	$588	$588	$588	$588
		DRYLAND			
Dairy	NA	NA	$2,402	$2,402	$2,402
Dairy support	$344	$344	$344	$344	$344
Arable	$342	$342	$342	$342	$342
Forestry	$177	$184	$177	$201	$186
Sheep and beef intensive	$583	$583	$583	$583	$583

2.1 The costs of reducing N losses

The costs of mitigation are estimated in terms of operating profit, which is revenue minus expenses including depreciation, but taking no account of costs of capital, taxation or returns to management. The costs of mitigation in N losses were estimated from information generated with the farmer stakeholder group utilising mitigations developed for the Waimakariri zone and additional mitigations proposed from within the OTOP zone, and from information provided by Dairy NZ. Generally, the mitigations investigated by the farmer stakeholder group fall into the category of changes that can be made to existing farm systems, without making major adjustments involving significant changes to the farm system. These mitigations are described in (Fietje, 2018), and achieved up to ~10% reduction in N losses. The costs to profitability are based on the estimates for similar mitigations in the Waimakariri zone and are in the order of -10 – 5%. The DairyNZ work on mitigations extended on the farmer stakeholder work and investigated a 10%, 20% and 30% reduction in N losses beyond GMP and associated costs.

The data used to estimate the costs of mitigation, and the curve generated and included in the modelling are shown in Figure 1. The figures used here exclude some of the DairyNZ mitigations which included the use of irrigation efficiency improvements to mitigate N loss below GMP. Under PC5 this would not be possible as the irrigation efficiency requirements are included in the definition of GMP that defines baseline. The DairyNZ work includes mitigations based on adjustments to N losses that may not be available to farmers depending on the way in which the ECan PC5 proxy for nitrogen requirements works in their situation, and some caution with the estimates is therefore warranted.

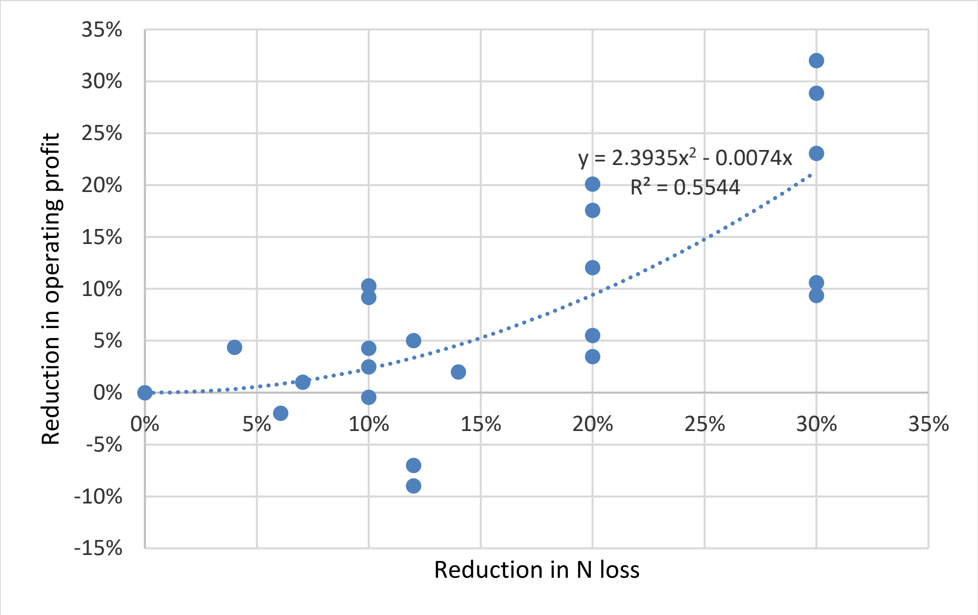

Figure 1: Reduction in profit for reduction in N losses, dairy operation

The implications for profitability of dairy were calculated using the fitted curve, but it should be noted that there is a range of possible costs for different operations that should be taken into account. The modelled, high and low range of costs are shown in Table 2 below.

Table 2: Range of operating profit implications for reduction in N losses from dairy operations

Reduction in N	Change in operating profit		
	Low	**Modelled**	**High**
5%	9%	-1%	-4%
10%	9%	-2%	-10%
20%	-3%	-9%	-20%
30%	-9%	-21%	-32%

The farmer stakeholder group also investigated potential mitigations for sheep and beef and arable. No specific mitigations were found for mitigating beyond GMP for these land uses, which is generally typical of exercises of this nature and reflects the fact that:

- Sheep and beef land uses tend to be lower intensity and have lower levels of inputs, which provides fewer opportunities for mitigation. GMP as defined in the PC5 already includes the major sets of mitigations available.

- Arable run at GMP reflects a very efficient system where nutrients are captured by product, and any reduction in losses will tend to have a direct reduction in yield because they require a reduction in inputs. Because of the high levels of fixed costs, and the small margins in cropping, it is not likely to be worthwhile to take this approach.

For this reason the sheep and beef and arable mitigation curves were generated by reducing revenue and variable costs directly in relation to the reduction in N losses required, while the fixed costs are left the same. This approach reflects a reduction in area utilised or intensity of operation. In terms of removal of area from production, forestry is likely to be the most feasible land use that would be used to substitute. In the short term this would not provide any additional cashflow, and therefore the ability to service debt is reduced. In the longer term forestry does generate cashflow and has a non-zero land value. The analysis therefore uses two approaches. For impacts on operating profit over the short term The fixed costs are left the same, and no substitution with an alternate land use is utilised – the low leaching alternate land use of forestry may not be appropriate, and from a cashflow perspective will not generate returns within a 30 year period and so is not relevant to the immediate returns for farm operations. For the longer term analysis shown in Figure 3 to Figure 5 and the impacts of mitigation requirements on land value, the area of land is altered, but the operating profit on any remaining land is not altered. This long term analysis reflects that fact that with major changes in land use there is likely to be reorganisation of land parcels and amalgamation in order to maintain sufficient scale for the operation to be viable.

Dairy support was treated as a dairy land use when considering which land uses mitigation should be required from (ie dairy/dairy support vs all land uses), which reflects the need to treat them together because of the fluid nature of the potential options for grazing within or external to the dairy farm boundary. However the reduction in operating profit for dairy support was calculated in the same way as sheep and beef and arable. In addition dryland dairy on very light and light soils has been reclassified to dairy support.

The short term operating profit implications for these operations are summarised for irrigated properties in Figure 2.

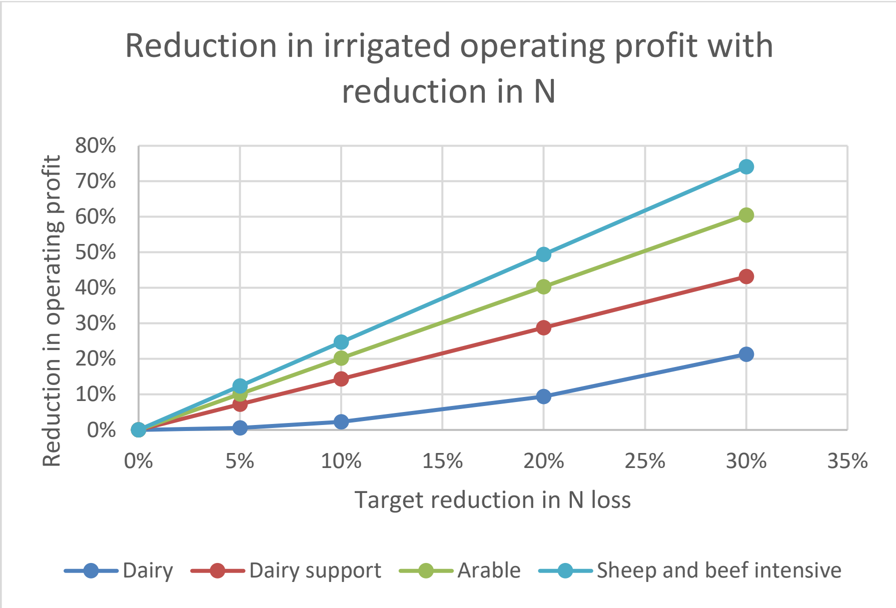

Figure 2: Implications of targets for reduction in N loss for operating profit on irrigated farms, by farm type (over the short term with no returns from alternate forestry land use included)

2.2 Implications for farm value

Generally the value of a productive asset reflects its ability to generate a profit. While this is not always true because some of the returns (e.g. capital value gains) may not be reflected in the annual operating profit. However in a stable situation where demand for land and product are in equilibrium, and returns are not increasing, there is a reasonable expectation of a relationship between operating profit and asset value. The analysis here uses this relationship to provide an indicative estimate of the likely implications for asset values from requirements to reduce N leaching. The reduction in asset value is estimated as directly proportional to the decrease in operating profit, with the proviso that the asset value does not decrease below that of an alternate land use (sheep and beef for dairy and dairy support, and forestry for sheep and beef and arable).

Current land and building asset values are estimated from national and regional statistics based on survey data of asset prices per kgMS (dairy), per su (sheep and beef) and per ha (arable). These were checked against REINZ 3 monthly average to April 2018[1] to ensure no major discrepancies were occurring. This information is summarised in Table 3 below.

[1] The REINZ figures are not reliable enough to use directly because of the relatively low number of sales, and because it is not possible to identify other factors (such as location) that are influencing sale price.

Table 3: Farm value estimates

Land use	Unit	Metric	Farm value ($/ha)	REINZ Canterbury sales median 3 months April 2018 ($/ha)	Note
Dairy	$41	$/kgMS	$55,000	$45,000	Light dairy land, average of last five years national sales price/kgMS.
Sheep and beef irrigated	$1900	$/SU	$30,000	$33,000	
Sheep and beef dryland	$1900	$/SU	$12,000	$10,000	
Arable	$28,000	$/ha	$27,000	$38,000	Based on Mixed finishing land use
Forestry	1000	$/SU	$4,000	$11,000	Uses hill country sheep and beef as the most likely alternate land use. Sales price may include forests

2.3 Farm indebtedness and vulnerability

There are a number of potential source of information on dairy farm indebtedness and vulnerability.

- Statistics NZ (Statistics New Zealand, 2014) estimated that the total equity-to-asset ratio for the dairy industry was 30% in Canterbury.
- DairyNZ estimate of average assets is $12-$13 m for a 240 hectare farm (210 effective) with liabilities/debt around 50%[2]. The DairyNZ data indicates that Canterbury farms carry higher total absolute debt based on size, but on a per kg MS basis they are similar to national debt levels.
- DairyNZ in the 2015/16 Economic survey estimates debt at $19.7/kgMS for Marlborough/Canterbury, and a debt/asset ratio of 49.7%.
- Debt servicing and rent costs nationally have been $1.36/kgMS for 2014/15 and 2015/16. For the model irrigated dairy farm on light land this amounts to $1,864/ha or 75% of operating profit. This correlates closely with data provided by DairyNZ which showed median debt servicing costs of $1,835/ha and average of $1,869/ha.
- The Reserve Bank (Reserve Bank NZ, 2015) undertook stress testing of the potential impact of the low milk price through to 2018/19. Under a base scenario with the milk price recovering to $5.50/kg MS in 2016/17 and subsequently to $6.50 in 2018/19, non-performing loans (where cashflow is negative and equity is less than 10%) increase to 7.8% of debt. In a scenario where the milk price is $4/kg MS in 2015/16 and increases at 50c/kg MS annually through to 2018/19, 25% of farms and 44% of debt is in non-performing loans. This indicates that a small proportion of farms (<10%) are vulnerable to any decrease in operating profit, and a larger proportion (~25%) are vulnerable to a sustained decrease in operating profit.

Beef and Lamb NZ statistics indicates that sheep and beef, and mixed cropping properties have a lower level of debt than dairy properties carry.

[2] Source: Matthew Newman, DairyNZ, pers.comm. Also for later information regarding debt loadings for Canterbury relative to the national figures.

- Mixed cropping (farm class 8) have a debt/asset ratio of 22% in 2016/17, and debt servicing and rent costs of $390/ha or 50% of operating profit for the model arable farm.
- Debt/asset ratio for finishing-breeding sheep and beef properties was only 15%, although this covers a mix of irrigated and dryland properties. It is likely that irrigated properties will have a higher debt ratio because of greater capital demands with irrigation. Debt servicing costs and rent were an average $13.44/SU for over the last five years, which amounts to $215/ha or 32% of operating profit, and $87.20/ha or 26% of operating profit for the dryland operation (both intensive).

3 Results

Three sets of results are shown:

- The implications for operating profit of a reduction in N loss by farm type for each zone.
- The aggregate reduction in land value for each of the priority areas with a given reduction in N loss
- A qualitative interpretation of the likely implications for farm viability for targets set within the next 10 years.

These results utilise the best available information but this information is limited and based on averages and case studies. The impacts of different soil types, climates and individuals is not represented in detail, and it is likely that there will be a range of cases where the ipmacts are greater or less than has been estimated here. As a result caution in utilising the results is warranted.

3.1 Change in N loss required and profit changes by hotspot

This section discusses the implications for the primary sector economic outcomes of different targets for catchment N reduction. The analysis produced four sets of graphs per catchment. The information in these four graphs is discussed below.

- ***Proportion of N load by land use*** – this pie graph in the top left quadrant shows what proportion of the N load is from manageable and non-manageable sources, as well as how much the intensive land uses and dairying contribute to the total N loss. This information is useful to understand why the costs of mitigation vary by catchment, because the distribution of land uses in the catchment is a primary driver of the costs of achieving N reduction targets.
- ***Reduction in N losses required from landholders relative to reduction in catchment N loss*** - Because not all land use in the catchment is in primary production, and because losses from some of the productive land (i.e. forestry) cannot be reduced, the percentage reductions required of landholders exceeds the overall catchment percentage reductions. This line graph in the top right quadrant shows by how much the reductions required of landholders exceed the catchment reductions.
- ***Operating profit with reduction in N loss*** – this line graph in the bottom left quadrant shows the operating profit derived from the catchment for different levels of reduction in N loss, based on the farm level analysis discussed above.

- ***Change in land use with mitigation of N loss*** – where mitigation is not available within an existing land use, the model changes land use to one with a lower loss rate (forestry). This graph shows how much change is expected for different land uses as the requirement for catchment mitigation increases.

The results show that for all Ashwick flat and Levels hotspots areas N load from dairy and dairy support is less than half of the total load, and therefore if reductions are focused on dairy only the target will be significantly higher than the reduction required. For example in Ashwick flat a 10% reduction in catchment load would require a 24% reduction from dairy and dairy support. However in the Orari catchment 89% of the load is dairy and dairy support, and therefore the reductions required of these land uses if dairy only were targeted would be close to the target load reduction – for example a 10% reduction in catchment load in the Orari would require a 11% reduction from dairy and dairy support. Therefore in Ashwick flat and Levels a given load reduction will require greater reductions for dairy and dairy support if they are targeted directly than for the Orari catchment.

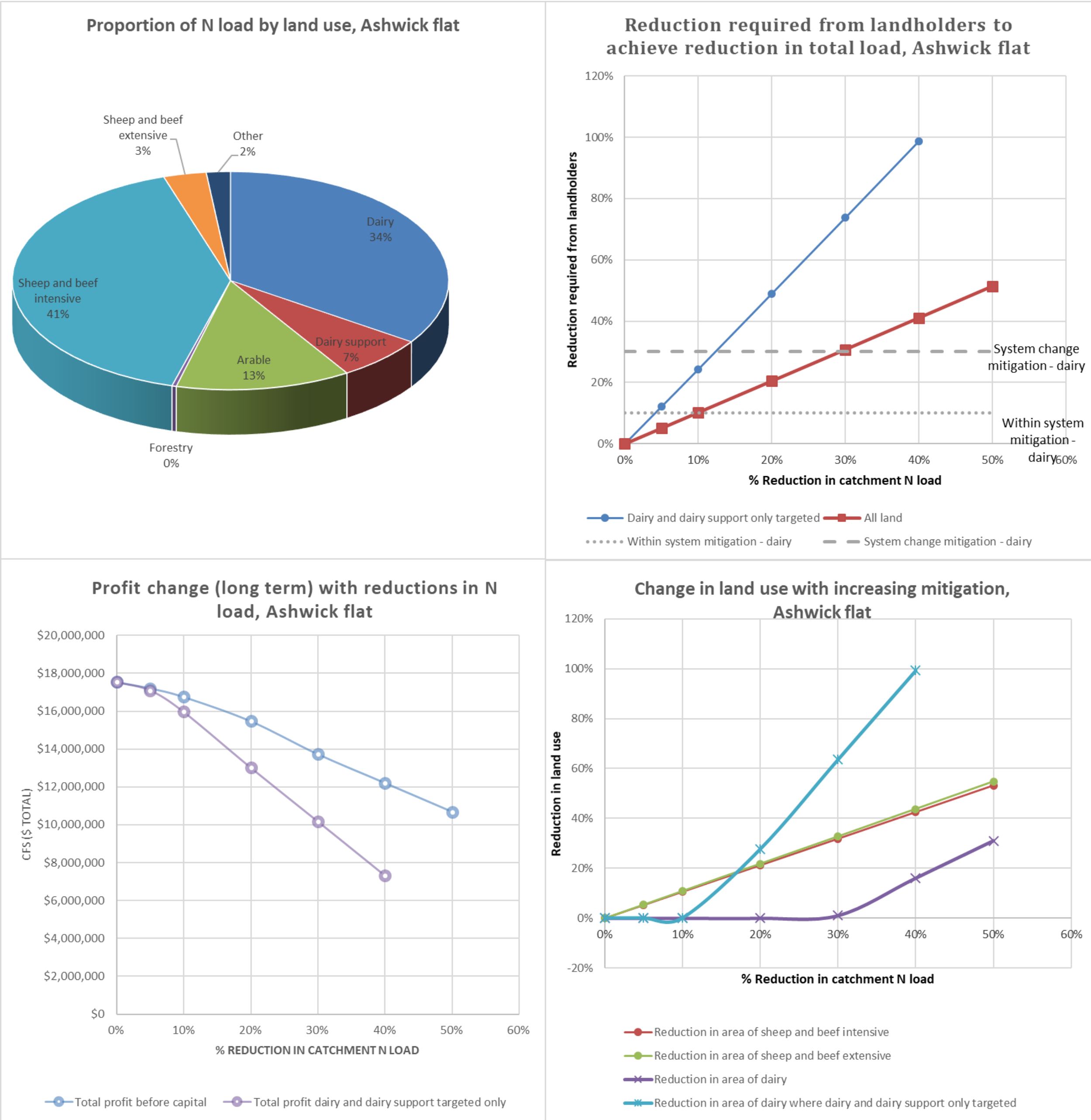

Figure 3: Land use source, reduction target, profit outcomes, and land use change - Ashwick flat

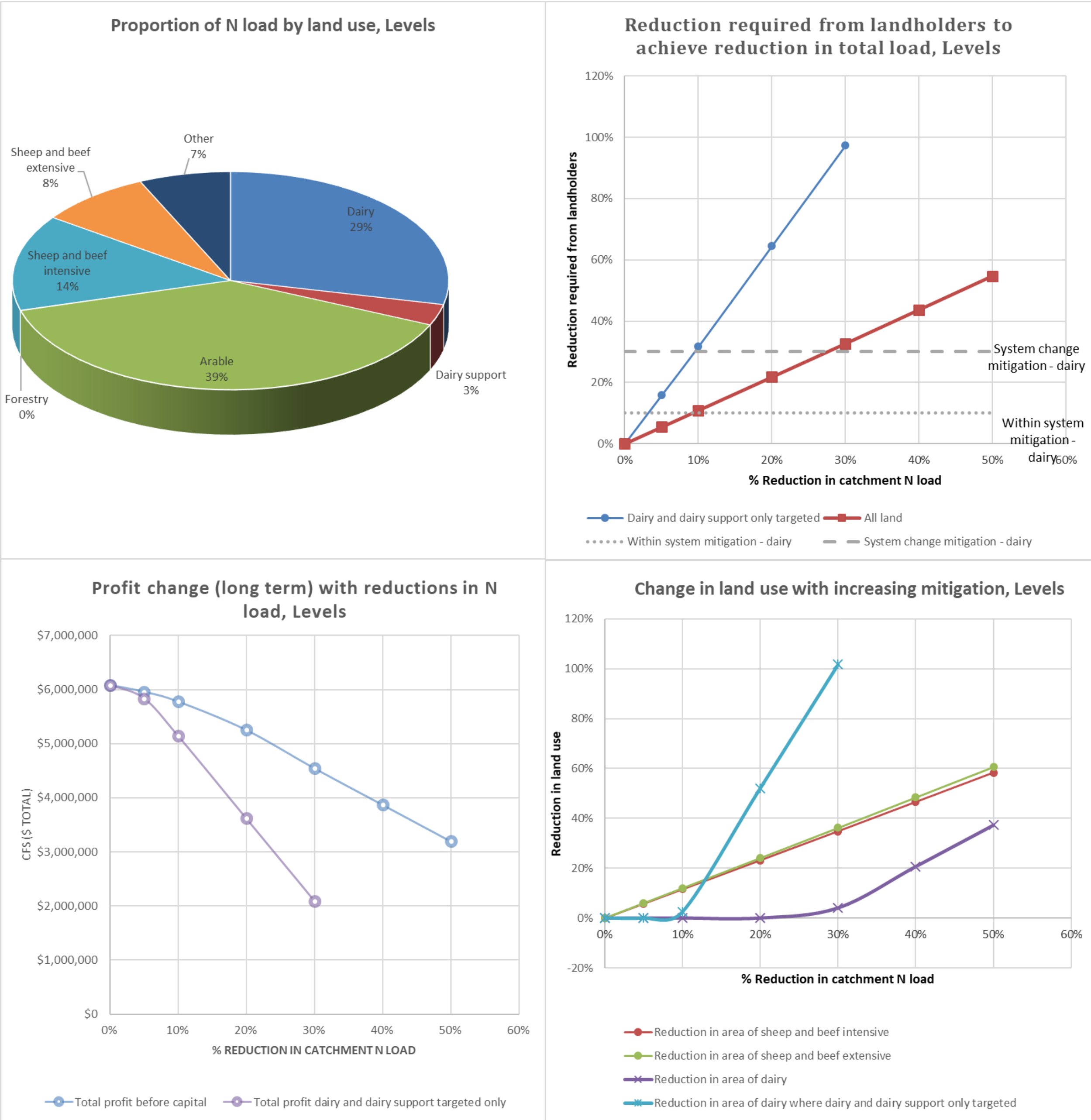

Figure 4: Land use source, reduction target, profit outcomes, and land use change -Levels

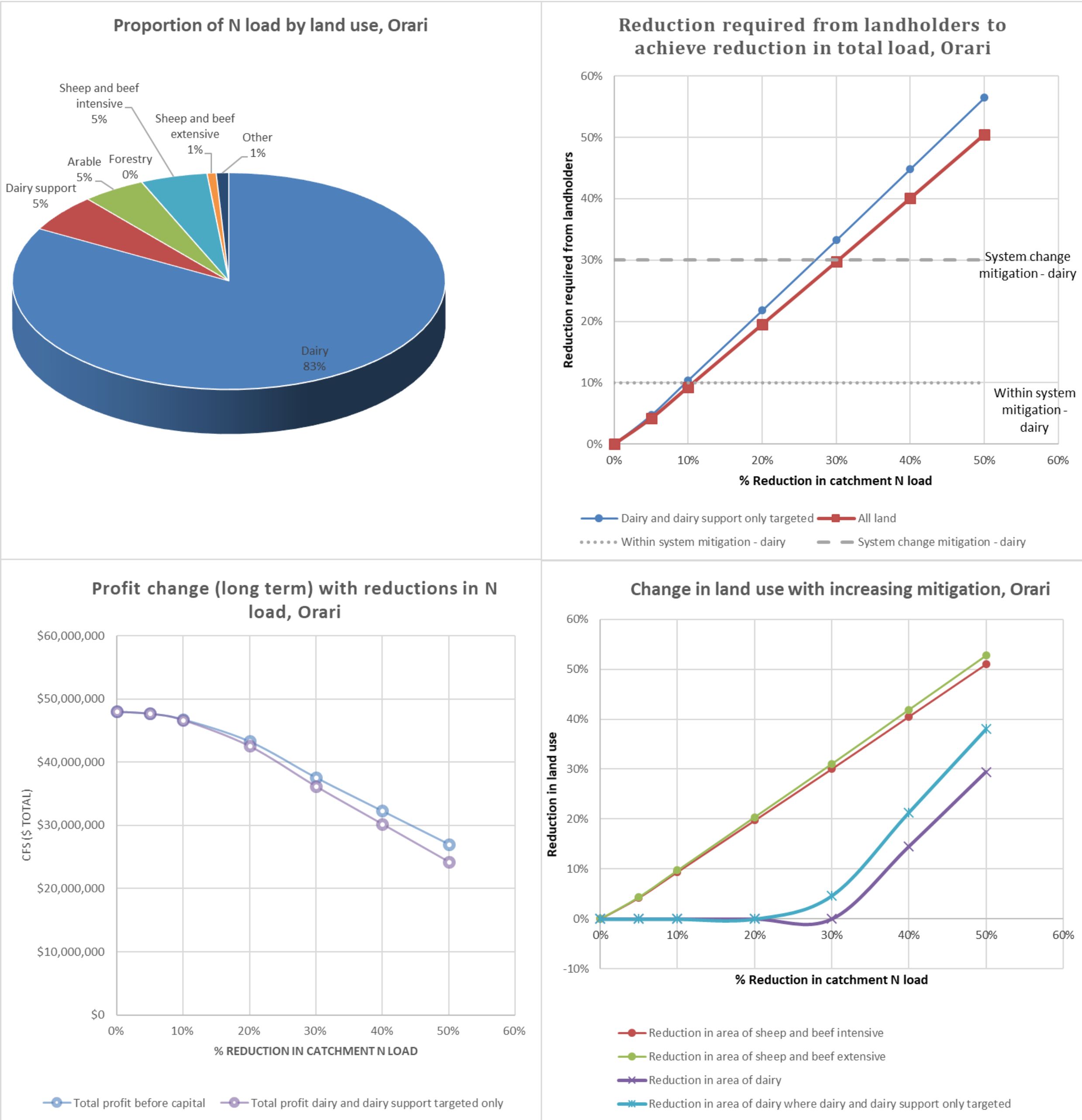

Figure 5: Land use source, reduction target, profit outcomes, and land use change - Orari

It appears therefore that in the short term achieving large reductions in N loads beyond GMP is possible, but is also problematic without causing significant costs in terms of reduced profit and land use change. Even where the costs are not large in regional terms because of the size of the catchment and the relatively low returns from sheep and beef, changes such as this if undertaken over a short time frame are disruptive and likely to be highly problematic for the individual landholders involved.

3.2 Implications for farm value

As noted above it has been assumed that there is a direct relationship between farm value and operating profit. The total reduction in farm value that is associated with the reduction in operating profit is shown in Figure 6 to Figure 8Figure 7 below. At lower levels of N loss requirement the reduction in land value for Ashwick flat will be $14 million (5% reduction), rising to $110 million at a 30% reduction in N loss if the reduction were to be required of all land uses. If only dairy and dairy support were targeted, the reduction in land value would amount to $2 million (5% reduction) to $36 million at a 30% reduction. In aggregate for the three areas a 10% reduction across all land would result in a $80 million reduction in land value, or $30 million if only dairy and dairy support were targeted.

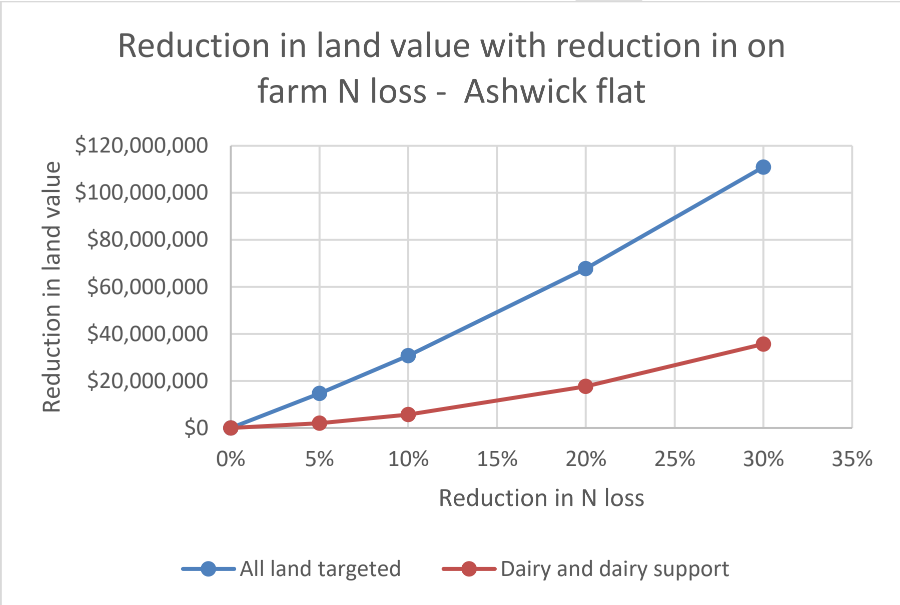

Figure 6: Reduction in land value associated with a reduction in N loss, aggregate for Ashwick Flat hotspots area

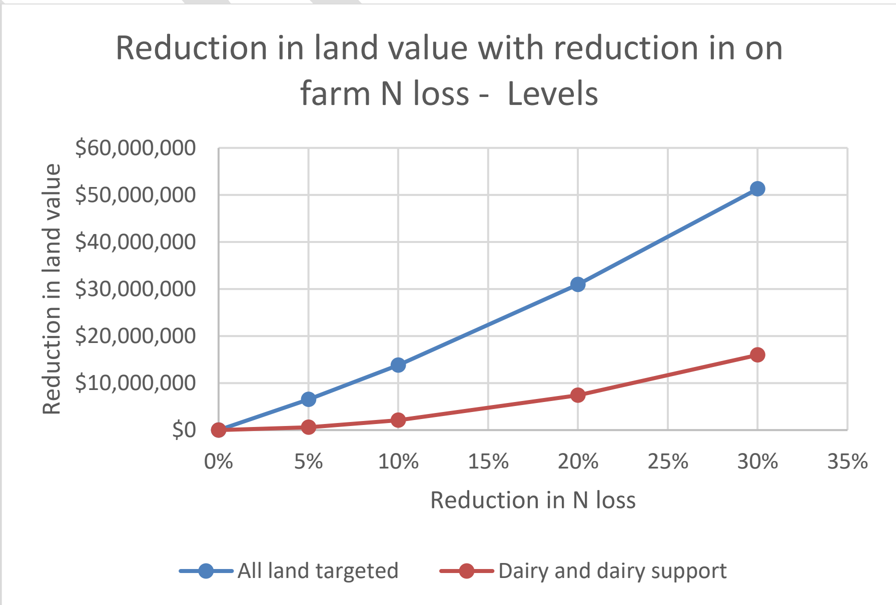

Figure 7: Reduction in land value associated with a reduction in N loss, aggregate for Levels hotspots area

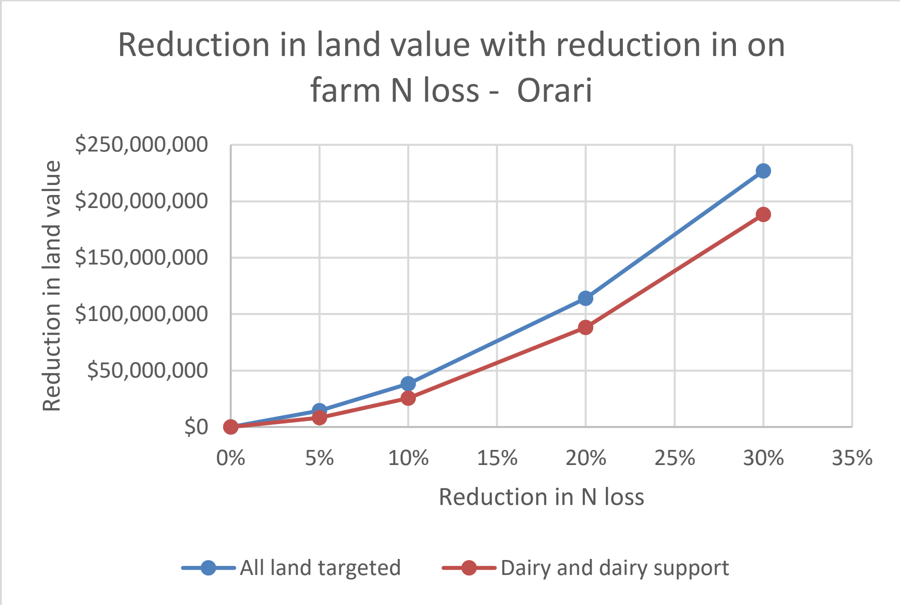

Figure 8: Reduction in land value associated with a reduction in N loss, aggregate for Orari hotspots area

Table 4: Reduction in land value with reduction N losses required

	Ashwick Flat, Levels and Orari combined	
Reduction in N required	**Change in capital value all land uses targeted ($ million)**	**Change in capital value dairy and dairy support targeted ($ million)**
5%	-$40	-$10
10%	-$80	-$30
20%	-$210	-$110
30%	-$390	-$240

3.3 Implications for farm viability

Threats to farm viability have implications for economic disruption, but also have negative social consequences for individuals and their families which should be taken into account. The implications for farm viability are difficult to determine, because debt levels are not fixed, and changes to ownership and ownership structures can alter over time. However if a short term (<10 years) perspective is taken, the ability to repay debt is reasonably limited, so the implications can be seen to be more directly related to the current circumstances of the properties.

The estimated impacts for the model farm are shown in Table 5, which suggests that the ability to accommodate reduced operating profit are limited for dairy operations with 76% of their operating profit taken up with the interest costs associated with debt.

Table 5: Debt levels and debt servicing by land use

Land use	Debt/Asset ratio	Estimated debt servicing costs model farm ($/ha/annum)	Proportion of operating profit model farm
Dairy	48%	$1,864	76%
Arable	22%	$390	50%
Sheep and beef irrigated	32%	$215	32%
Sheep and beef dryland	26%	$87	27%

The issue of farm viability is greatly complicated by the range of indebtedness of different farming operations, with some properties having little debt, while others can be heavily indebted. This relates to appetite for risk, and where in the cycle of farm ownership the property is, with typically younger owners and more recent purchases/conversions having higher debt while older and more established properties having lower debt levels. The relative profitability of farming operations also affects their ability to service debt, with higher profit operations both within and between land uses being more resilient than low profit operations. There is little data available at a regional level that allows detailed understanding of the spread of debt and debt servicing capacity, so the analysis here is provided as qualitative and should be seen as indicative only. They are based on expert assessment rather than data and should be viewed with caution. The indicative impacts on farm viability for different levels of N reduction are shown in Table 6 below.

Table 6: Qualitative assessment of likely impacts to farm viability over 10 years (indicative only)

Reduction in N loss	Impact of required reduction in N loss for viability of different land uses		
	Dairy	Sheep and Beef	Arable
5%	Low impact	Most farms able to cope but impacts for cashflow	Most farms able to cope but impacts for cashflow
10%	Low impact for most farms depending on baseline	Significant impacts	Significant impacts
20%	10% - 25% of farms non-viable[3]	Average farms threatened	Average farms threatened
30%	Average farms non-viable[4]	Average farms non-viable	Average farms non-viable

[3] Based on Reserve Bank stress testing 2014

[4] While interest costs could be just be serviced for most farms there would be no profit available for drawings, debt repayment or farm development. This is not sustainable over the long term.

4 Discussion

4.1 Balancing action and timing

Business owners adopt risk when they invest in their business, and the potential for a change to the regulatory environment is a risk that is well known and understood. However despite this risk being understood there is an efficiency gain from a stable regulatory environment, since the more frequently and faster changes in regulation occur that impact on business owners, the less willing they are to invest capital and take on risk. Capital investment and risk-taking by business owners leads to increased economic activity, and an unstable regulatory environment can operate to the detriment of economic potential.

Over the long term the impacts of changes to the regulatory environment can be accommodated by individuals more readily. While there will be a loss in economic output because collectively will produce less from the resources available, farm ownership will change and capital structures will adjust to accommodate the new economic potential represented by the environmental constraints.

It is appropriate to implement regulatory change to manage N contaminants where the benefits of reducing impacts outweigh the costs, even if there are negative economic implications for individuals. The key consideration for decision makers is the time frame over which these changes should take place. Longer time frames have environmental costs, but provide individuals with greater ability to adjust, and lessens the economic disruption and associated social consequences. They also provide assurance for business owners that if they invest and take on risk, any future changes to the regulatory environment will be signalled in advance and they will have time to adjust. Decision makers must therefore weigh up the various social, economic, social and cultural costs, the certainty with which they are understood, the time frames for adjustment, and the impacts on future willingness to invest.

4.2 Baseline N loss

The analyses adopted here assume that all farms are at a standard GMP that is represented by the PC5 definition of practices required (irrigation efficiency, N application etc). However a consequence of PC5 has been that the Baseline (2009 – 2013) N loss is represented by the actual N loss including GMP for a farming operation. Under PC5 farms which had undertaken mitigations or practices that reduced their N loss below standard GMP at the time of Baseline have a lower N loss allowance than farms which had not undertaken those mitigations.

The implications of this for the analysis are that farms which had undertaken mitigations at Baseline period no longer have those mitigations available to them to undertake further reductions. The costs for mitigation on these farms will be higher, and in some cases substantially higher, than for farms that did not undertake mitigation during the Baseline period. These situations have not been incorporated into the analysis, which assume that all landholders were at GMP rather than beyond GMP at the starting point of the analysis.

5 Bibliography

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