THE FARMING FOR THE FUTURE RESEARCH PROJECT – UNDERSTANDING THE OUTCOMES OF LOWER NUTRIENT INPUT ON SHEEP/BEEF FARMS USING DICALCIC PHOSPHATE

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Abstract

From 2009 to 2013, the Farming for The Future research project monitored 11 NZ North Island Class 3 (North Island hard hill country) to 4 (North Island hill country) sheep/beef farms that applied pH-neutral dicalcic phosphate (DCP) fertilisers instead of acidic monophosphatic fertilisers. Farms were located across three regions – Northland, Central North Island and Hawke's Bay/Wairarapa. Three user groups were compared according to length of use i.e. new, medium-term or long-term users of DCP. Farm management and outcomes were determined and where possible compared with industry benchmarks. The farms applied noticeably less P and S. Average soil quality values including P generally were in the medium to high ranges (reported by the laboratory). The exceptions were low S and pH which may be inherent to sheep/beef farms in the regions concerned. Available soil P levels tended to decline although less so for farms that had been using dicalcic for the longest. Overall, there was little change in pH across the farms. Generally, pasture quality measures were in the medium to high ranges. The exceptions were low digestibility of organic matter in dry matter and low nitrogen which may have been a consequence of sampling before maximum clover production. Some micronutrients were high. Most of the average pasture quality values did not change markedly with the exception of a decline in some micro-nutrients and P which varied notably between years compared to other macronutrients. Physical indicators like effective area, stocking rate and lambing percentage on average did not change much and overall did not differ between user groups. Production and financial measures varied between farms with some being above industry average and some below. Overall, there were no differences between the user groups, with the average values tending to fall between the average industry values for Class 3 and Class 4 farms. According to Overseer, the amounts of P reported to be lost to water ranged from 0.1 to approximately 6 kg/ha/yr. It is acknowledged that this project has used a case study approach, with a limited number of farms. Nevertheless, some interesting trends have been identified and additional research looking at the outcomes on farms applying less nutrient could be valuable given that phosphate rock is finite and the lower environmental impacts.

Introduction

Farmers are faced with the challenge of utilising finite resources and mitigating environmental impacts while at the same time maintaining their livelihoods. NZ sheep/beef farmers in particular rely on phosphate fertilisers, which have the potential to run off farms into waterways and cause problems. Given these constraints, more efficient use of phosphate fertilisers is prudent. To that end, the Farming for the Future (FFTF) project described here set out to gain a better understanding of the outcomes of lower nutrient input use on sheep/beef farms in NZ applying pH-neutral dicalcic phosphate fertilisers (DCP). DCP is a fusion of superphosphate and lime and inherently contains significantly less phosphate than straight superphosphate.

Materials and Methods

Eleven sheep/beef farms throughout the North Island of New Zealand were studied over a 5 year period from 2009 to 2013. Farms were located in three regions namely Northland (n = 1), the Central North Island (n = 4) and Hawke's Bay/Wairarapa (n = 6). Farms were further categorised into three DCP user groups according to the length of use i.e. new users (≤5 years use, n = 4), medium-term users (6 – 15 years use; n = 4) or long-term users (>15 years use; n = 3). As farms were spread across different regions, they differed in physical factors like climate and soil type. This is important to note when interpreting the results.

Soil and pasture, productivity and financial outcomes were determined and compared between groups and years. Management style, production and financial inputs were determined through annual face-to-face interviews with each farmer. Soil and pasture quality was determined using standard soil and pasture sampling methods. Herbage and soil core (0 - 75mm) samples were collected each time and analysed by Hill Laboratories. On each farm, 3 or 4 monitoring sites (transects) were sampled each year at a similar time (late October – middle of spring). Each site was in a paddock that was representative of large management areas (blocks) on each farm. Where appropriate, the outcomes were compared with available industry benchmarks, particularly Beef & Lamb New Zealand data.

Where applicable, results were analysed using a mixed model analysis to identify differences in the rate of change between the three user groups.

Results and discussion

Nutrient inputs

As expected, the farms in this project applied considerably less nutrient than farms with more traditional fertiliser inputs (Table 1). In particular, they received half the amount of P.

Table 1. Average amounts of nutrient applied to FFTF farms for the 5-year 2009-13 period, and average BLNZ values for the same period and regions.

	kg/ha			
	P	S	N	Ca
FFTF	9	17	1	81
BLNZ	20	28	8	Not available

Physical indicators

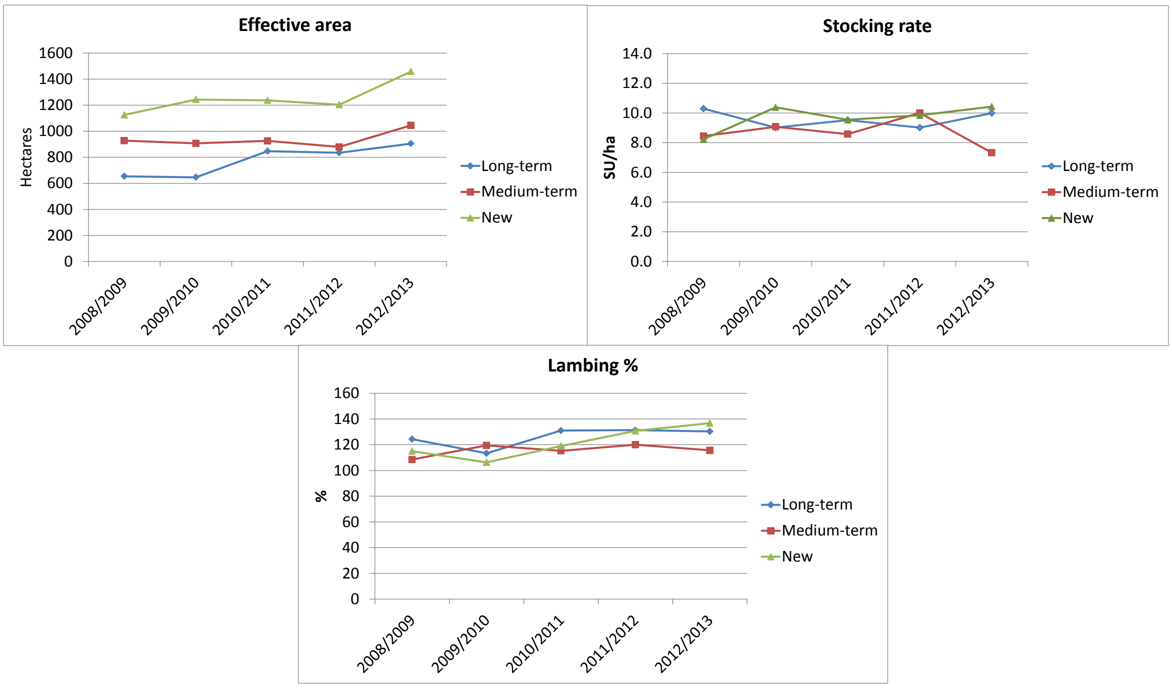
Compared to BLNZ values, farms in this project on average had greater effective area while average stocking rate and lambing percentage was higher than BLNZ Class 3 and similar to BLNZ Class 4 values (Table 2).

The size of the farms, stocking rate and lambing percentages did not change markedly throughout this study, and if anything increased (Figure 1). Stocking rate and lambing % did not differ between the user groups. On average, the new farms had greater effective area while the long-term farms had less with medium-term farms in between.

Table 2. Physical indicators of FFTF farms, relative to Beef & Lamb NZ values.

	Effective area (ha)	Stocking rate (SU/ha)	Lambing %
FFTT Average	964	9.4	121
BLNZ Class 3 (NZ)	810	8.0	115
BLNZ Class 4 (NZ)	414	9.3	122

Figure 1. Trends in physical indicators for FFTF farms.



Soil quality

Overall, soil quality values for the farms were in the medium to high ranges reported by the laboratory (Figure 2). The exceptions were low S and pH which may be inherent to sheep/beef farms in the regions concerned. Generally, average soil quality values did not change significantly over time. However there were some exceptions, notably available P (i.e. Olsen P and Resin-P) and Organic S levels, which declined particularly in the first few years (Figure 3). The available P levels on farms applying DCP fertilisers for the longest declined less so. These initial declines are consistent with a reduction in P and S applications. Some soil properties differed between user groups however differences in soil types are likely to have contributed to these.

Earthworms were counted each year and although more were consistently found on the farms that had been applying dicalcic for the longest, soil differences may have contributed to this. Overall there was no change in the number of earthworms with no statistical difference between the user groups in the rate at which the numbers changed.

Figure 2. Average soil quality results for FFTF farms for the 5-year 2009-13 period, relative to Hill Laboratories medium ranges for drystock farms.

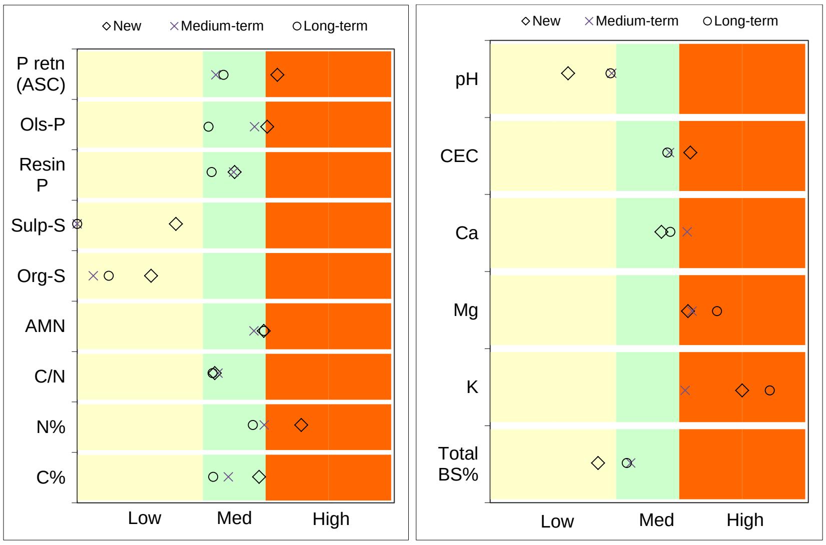
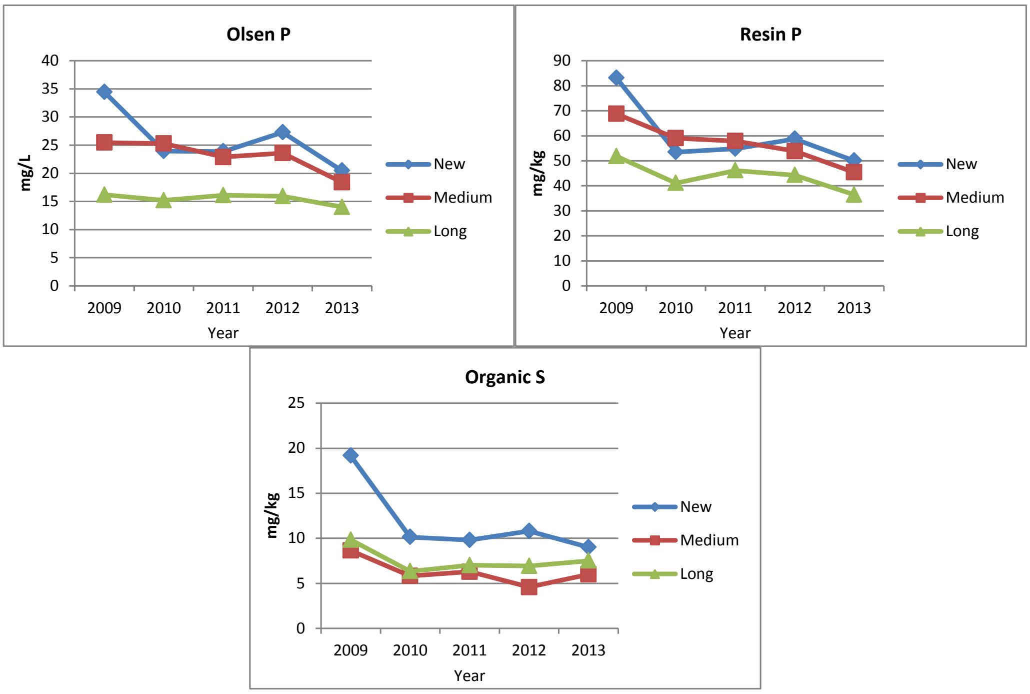


Figure 3. Trends in available P (i.e. Olsen and Resin-P) and Organic S levels across FFTF farms.



Pasture quality

Like soil quality, pasture quality values were in the medium to high ranges reported by the laboratory (Figure 4). The exception was low digestibility of organic matter in dry matter (DOMD) and nitrogen, possibly as a consequence of sampling prior to maximum clover production each year. Most of the pasture macronutrient and palatability values did not change noticeably on the farms with no clear differences between user groups. Figure 5 shows some examples. Average pasture P levels varied from year to year more than other macronutrients. Some micronutrients like Cobalt, Selenium and Zinc declined on average while others were relatively stable like Copper and Boron (data not presented).

Figure 4. Average pasture quality results for FFTF farms for the 2009-13 period, relative to Hill Laboratories medium ranges for drystock farms.

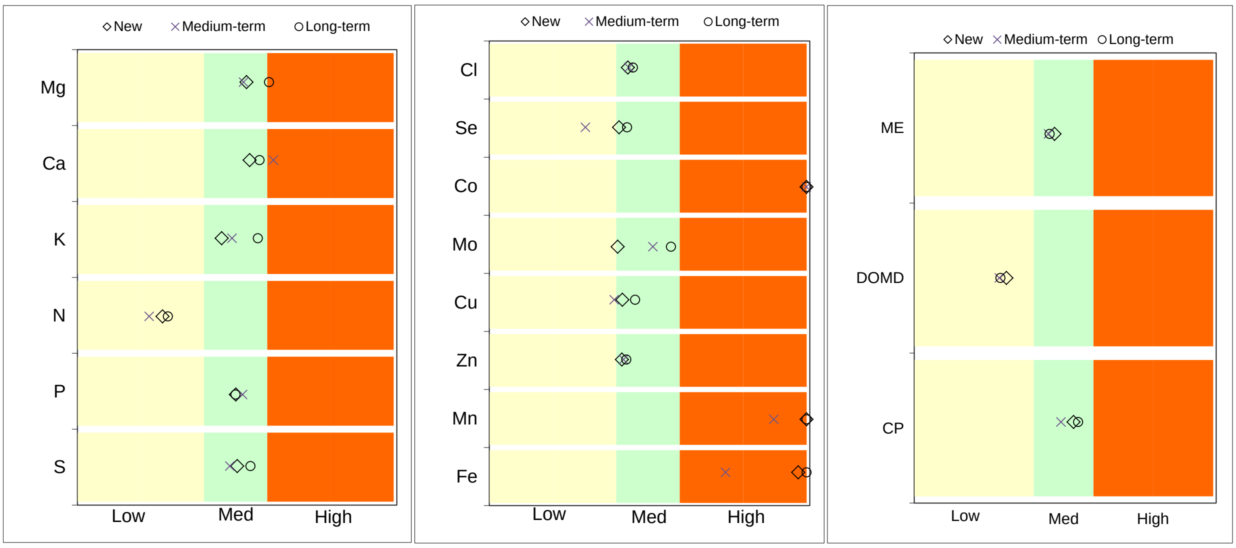
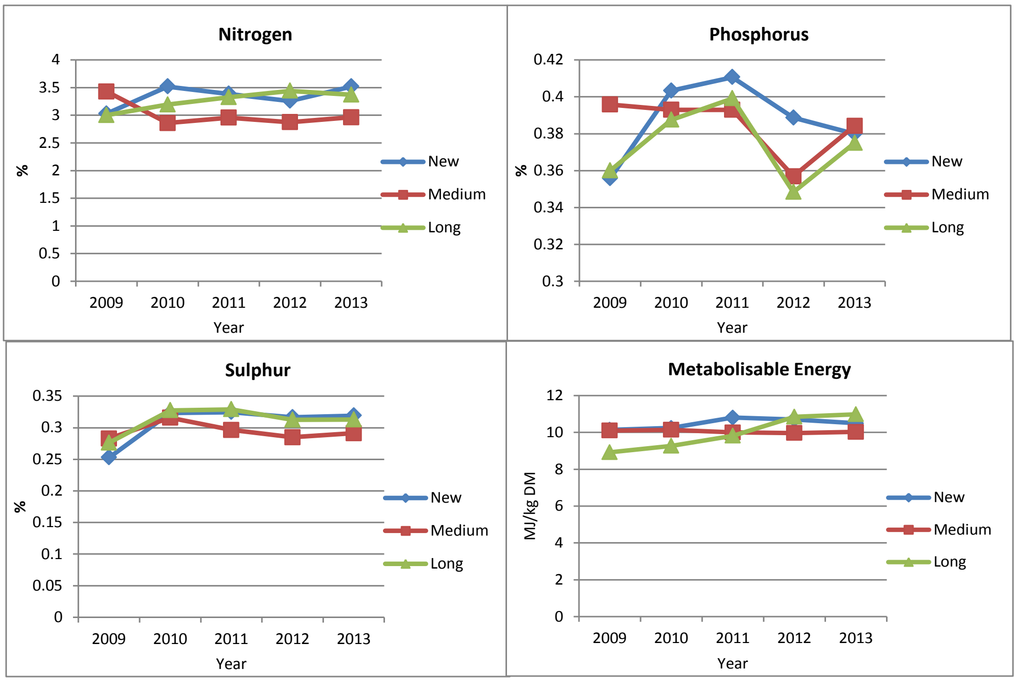


Figure 5. Trends in selected pasture quality measures across FFTF farms.



Production

Net meat output was used in this study as a measure of production across the farms. This is the total kilograms of carcase meat exported per hectare less total kilograms of carcase meat imported per hectare. Imported meat included trading stock as well as importing sires for breeding. This varied notably between years with no clear difference between groups (Figure 6). This variation is largely due to inconsistencies in when stock was let go relative to the end of financial years i.e. in some seasons stock was relinquished before the end of the financial year and in other years, after. Overall, the net meat output values were between industry average values for Class 3 (North Island Hard Hill Country) and Class 4 (North Island Hill Country) (Figure 7).

Figure 6. Trends in net meat output for the FFTF farms.

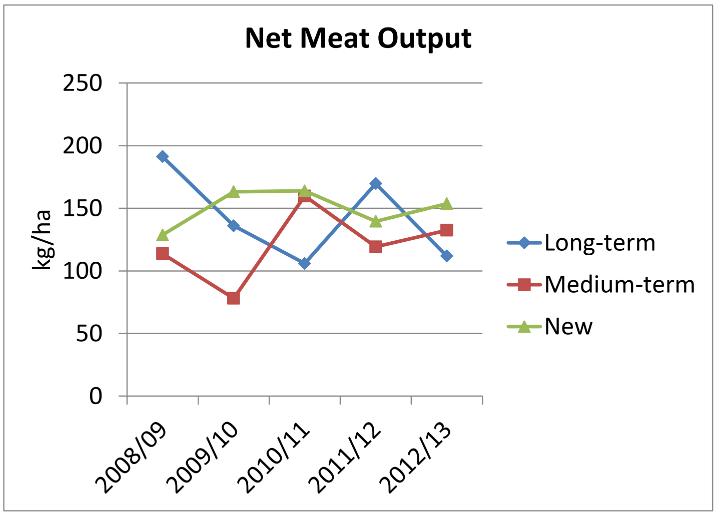
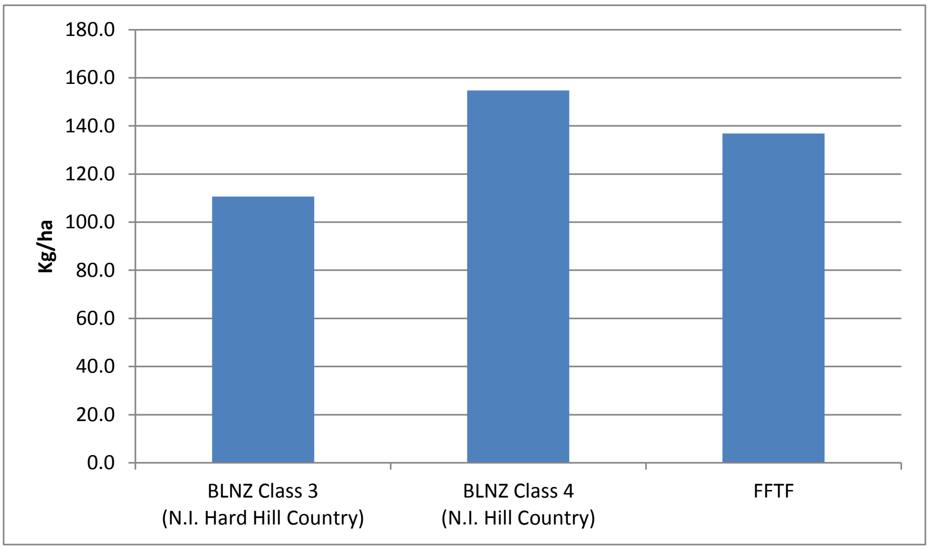


Figure 7. Average net meat output for FFFT farms relative to Beef & Lamb NZ (BLNZ) values for the 4-year 2009/10 – 2012/13 period.



Financial outcomes

Gross farm revenue, cash farm expenditure and cash farm surplus was quantified each year and there were no significant trends i.e. overall they did not increase or decrease (Figure 8). Furthermore there were no clear differences between user groups although there was significant variability between farms within each group. On the whole, the average financial bottom line values, as well as fertiliser cost, were between the industry average values for Class 3 (North Island Hard Hill Country) and Class 4 (North Island Hill Country) (Figure 9).

Figure 8. Trends in average financial bottom line values for FFTF farms. GFR = Gross Farm Revenue, CFE = Cash Farm Expenditure and CFS = Cash Farm Surplus. The vertical bars represent the variability between individual farms within each user group.

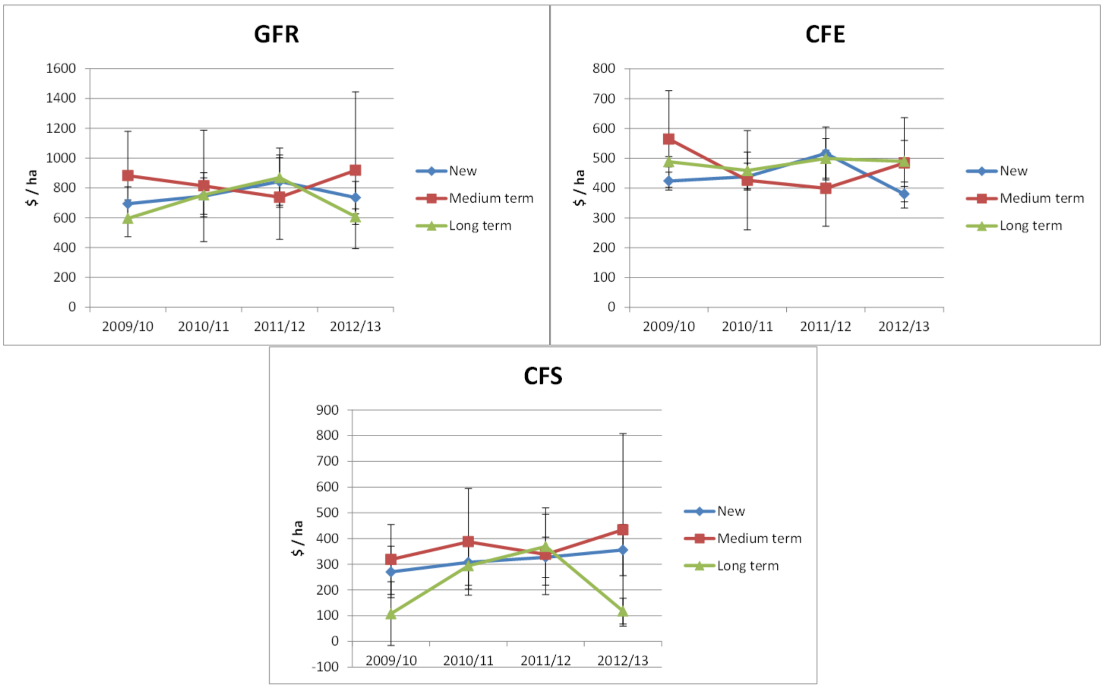
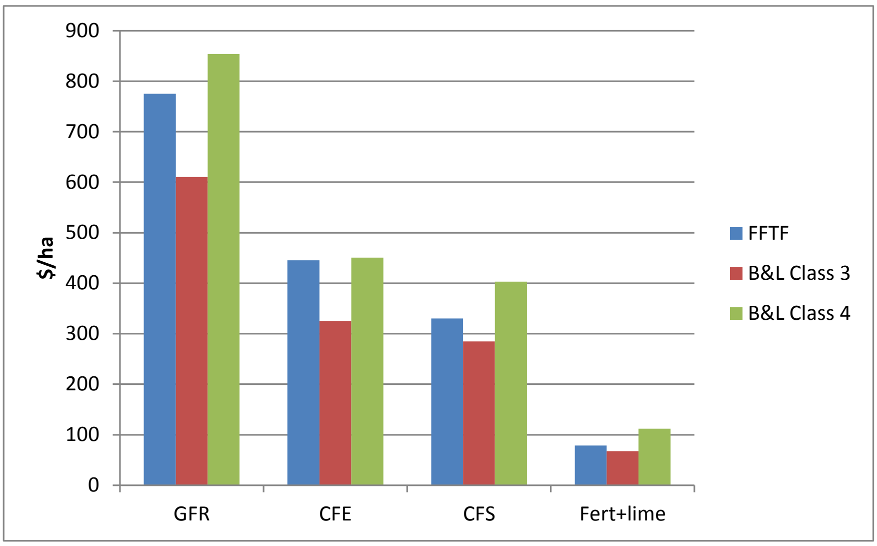


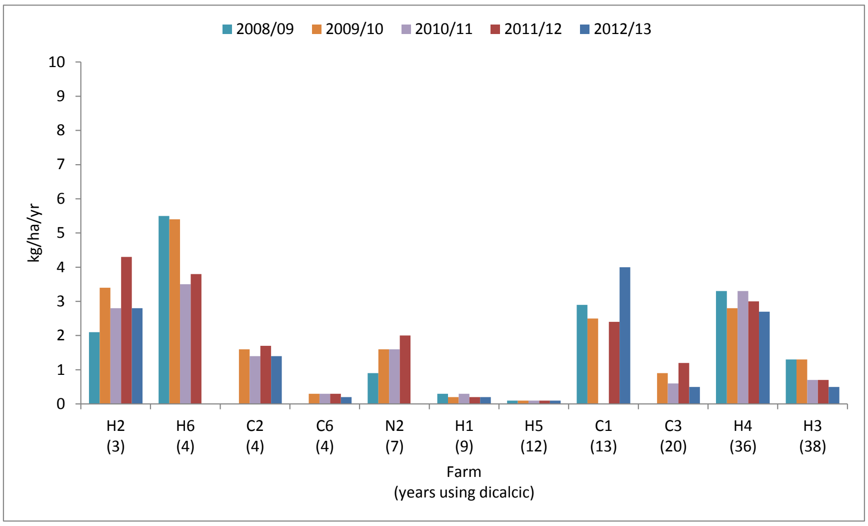
Figure 9. Average financial bottom line values for FFFT farms relative to Beef & Lamb NZ (B&L) values for the 3-year 2010/11 – 2012/13 period.



Environmental outcomes

Information collected each year was fed through the latest version of Overseer (v.6.1.3). The resulting 'P lost to water' values ranged from 0.1 to 6 kg P/ha/yr approximately (Figure 10). There were some notable differences between farms reflecting differences in soil, fertiliser inputs, topography and other management. These losses would be expected to be lower than if they had have been applying acidic monophosphatic fertilisers at similar rates because of the lower P content of DCP fertilisers.

Figure 10. Phosphorous lost to water as modelled by Overseer v6.1.3.



Summary

The Farming for the Future project described here has provided some insights into the outcomes associated with lower nutrient input use on sheep/beef farms. It is acknowledged that the project has used a case study approach, with a limited number of farms. Nevertheless, the findings indicate that key production and financial outcomes could be maintained by a lower nutrient input system. Additional research looking at the outcomes on farms applying less nutrients could be valuable given that phosphate rock is finite and the lower environmental impacts.

Acknowledgements

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