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Analysis Of The Economics Of Aerially Applying Lime On A Typical High Country Merino Property

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Executive summary

Declining soil pH leads to a rise in aluminium (Al) levels. At some threshold point the decline in pH is accompanied by a rapid rise in Al levels. Aluminium reduces clover growth, nodulation and nitrogen fixation, which in turn reduce overall pasture production and quality.

This study compared the financial implications of halting this process by applying lime, with the alternative option of accepting the declining pH and reducing stocking rates accordingly.

It found that:

- Liming is not economically viable on such soils unless they have potential carrying capacities over 3 SU/ha
- The economic viability of liming depends on soil pH being able to be raised by 0.1 with an application of 500 kg lime/ha
- Applying no lime and reducing stocking rates in keeping with the resultant fall in pasture production and quality will impact less on financial returns in the long run than applying lime at effective rates.

Background

This study is the result of a workshop that considered the options for a large area of oversown and topdressed Blackstone Hills Soils with an average pH of 5. Typically, low pH soils support a browntop dominant pasture that is difficult to keep in a vegetative form. While the tawny seed head fits aesthetically with the high country landscape, it is associated with low carrying capacities. Declining pH and increased Al levels are therefore, a serious productivity issue.

The study assumes that liming will increase pH and improve both pasture production and pasture quality. The usual rule of thumb for shifting pH is 1t/ha per 0.1 pH, so a shift from pH 5 to pH 5.5 (3–5t lime/ha) would only result in a 5% increase in pasture production. Improvement in pasture quality is harder to predict and depends on a range of physical and management factors. However, increasing the pH is likely to alter the pasture species mix, reducing browntop and increasing clover (red and white), sweet vernal, and cocksfoot.

Method

A full financial budget was prepared for the study farm based on current and historical expenditure, debt servicing and personal drawings. Wool prices were based on the 15 year average. Sheep prices were based on the three year average.

We assumed that stock carrying capacity had declined by 25% already and that the farmer would raise pH by 0.2; a point just before the threshold where the rapidly increasing effect of Al toxicity starts to occur. Increasing pH any further only has a minor effect on increasing pasture production and the economic benefit of this is already known to be poor.

The benefits of increasing the pH to below the threshold where aluminium levels start to increase were calculated on a range of potential carrying capacities from 1.8 to 3.2 SU/ha. A range of lime requirements from 0.5 to 1.25 t/ha was also considered, providing 32 possible combinations. The farm budget was run for 10 years with every combination of potential stocking rate and lime requirement (per 0.1 movement in pH). Each 10 year cashflow combination was then compared with the option of 'doing nothing'.

Finally the farm profit (before tax) for the liming option was removed from the 'do nothing option' to provide the net gain from liming. This provided a 10 year cashflow which was used, along with the capital invested initially in lime, to calculate an internal rate of return (IRR).

Results and Discussion

If lime is not applied and pH drops by 0.005 each year, stocking rates and farm profitability will fall. Figure 1 summarises the decline for each stocking rate. Clearly, if we assume that the Blackstone Hill Soil is carrying a high stocking rate, as in the 3.2 SU/ha scenario, then the decline in profitability will be high (a reduction of \$11,000 or 13%). In the 1.8 SU/ha scenario this area is less significant in the total feed supply and therefore has less impact (a reduction of \$6000 or 7%). It also shows that at higher stocking rates, the potential profit from investing in lime is higher.

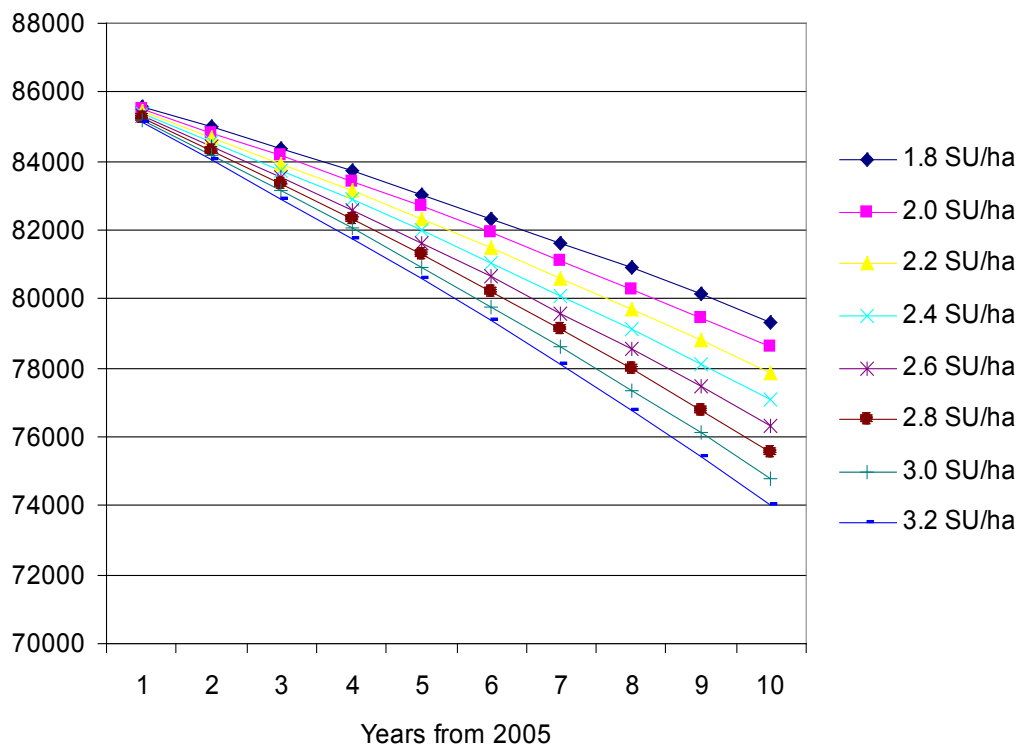


Figure 1. The effect of decreasing pH on farm profit over 10 years for 8 stocking rates.

Studies of all 32 combinations of stocking rates X rates of lime show that:

- No combination provided a positive IRR if it took 1 tonne of lime/ha or more to raise pH by 0.1
- At 0.75 tonnes of lime/ha the only positive IRR was on land capable of running 3 SU/ha
- To achieve an IRR near the current rate of borrowing funds (8%–8.5%) land would need to have the capacity to run 3 SU/ha or more and the shift in pH would need to be achieved by adding no more than 0.5 tonnes of lime/ha/0.1 pH.

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Conclusions

The best IRR was 10.1% for the combination of 0.5 tonnes of lime needed to shift pH 0.1 on land capable of running 3.2 SU/ha. This is above the current cost of borrowing (in 2005). However, it is at the edge of what we can reasonably expect for stocking rates on high country oversown and topdressed land. It is however, reasonably optimistic to hope that 0.5 tonnes of lime will raise soil pH by 0.1.

This study confirms it is the cost of liming that is the key determinant of whether liming will provide a reasonable return. The cost of liming is made up of the application cost of transporting and flying it on (87% of total cost) and the cost of the lime itself (13%). The application cost is therefore the most important factor.

It is therefore doubtful whether applications of lime at maintenance rates throughout the last 20 years would have achieved a better IRR for the study farm than doing nothing—the cost would just have been annualised.

There may however, be an opportunity to increase the pH of Yellow-Grey Earths and Yellow Grey/Brown Grey intergrade soil types, where the main limitation to plant growth is sulphur. Finely ground elemental sulphur is usually applied with superphosphate as a carrier, as it can be explosive on its own. However, most of these soils would benefit more from lime than from phosphate, and if sufficient quantities of lime (instead of superphosphate) could be applied with the sulphur, application costs would be substituted for the superphosphate which is already being applied.

A number of highly processed lime products that react more rapidly than agricultural lime are available. However, the speed of the reaction is not the issue, it is the total amount of calcium carbonate that must be applied to increase soil pH. Given that these more reactive forms are more expensive per unit of calcium carbonate they may simply make the economics worse.

The implications for the productivity of those properties which cannot economically apply lime are serious. If lower cartage costs cannot be achieved, clover productivity may decline to the point where the lack of nitrogen means stocking rates become as low as 15% of potential.

References

Edmeades D.C.; Smart C.E.; and Wheeler D.M. 1983 Aluminium toxicity in New Zealand soils: preliminary results on the development of diagnostic criteria. *NZ Journal of Agricultural Research* Vol 26: 493–501.

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Appendix 1. Assumptions and parameters used

Table 1. General price parameters used in farm budget.

Wool weights	kg
Ewes	2.9
Hoggets	2.0
Wool Price	\$
Ewes (18.1 micron)	13.50
Hoggets (17.0 micron)	18.70
Livestock prices	\$
Cull ewes	45.00
Wether hoggets (18.7kg @\$4.2/kg carcass wgt)	78.00
Cull Ewe hoggets	65.00
Merino cull lambs	38.00
Merino cull wether lambs	45.00
Black face lambs (store)	52.00
Lambing %	90

Table 2. Stock numbers wintered on the study farm.

	Numbers
Ewes	6600
Hoggets	3000
Cows	102

Table 3. Study farm financial budget.

Farm Revenue	2005
<i>Sheep</i>	
Sales — Purchases	285000
Wool	342500
Total Sheep	627500
<i>Beef</i>	
Sales — Purchases	13100
Total Beef	13100
Gross Farm Revenue	640600
Farm Expenditure	
<i>Working Expenses</i>	
Wages	55000
Shearing	63658
Hay and silage	59400
Animal Health	50722
Breeding	1000
Forage crops	43900
Total Variable Costs	273680
Weed and Pest	45000
Fertiliser	60000
Lime	5000
Nitrogen	5000
Electricity	6000
R & M	10000
Freight	6000
Administration	15000
Irrigation energy	
Contract	
Vehicles	14000
Interest	29750
Total Farm Working Expenses	469430
<i>Standing Charges</i>	
Insurance	6000
Rates	12000
Rent	
Sundry	12000
Total Standing Charges	30000
Total Farm Expenditure	499430
Farm Profit (before tax)	141170
Personal drawings	60000
Farm Cash Surplus	81170