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MFS MONARO FARMING SYSTEMS

Getting Value from Fertilising Monaro Pastures. (Nov 2013)

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Introduction

After four years of MFS Soils Club activity there is a large data base of soil test information accumulating which begins to give members confidence in the soil fertility trends and hence the likely response to increasing available soil Phosphorous (P) and Sulfur (S). While it is clear that there will be pasture growth response to increased soil fertility producers also need to make sure that any investment in fertiliser will also give the most efficient economic return. The “5 Easy Steps” tool gives graziers an excellent framework for prioritising P use but up to 80% of paddocks tested to date show some degree of S deficiency yet there remains insufficient research to build a similar tool for S.

Luckily there is six years of data from the Monaro Grasslands Research and Demonstration Project (MGRDP) which provides information about the response of native pasture based systems to both P & S. This data has allowed us to develop robust farm systems for the GrassGro decision support tool which closely represent the response to the fertilisers applied to the various treatments.

We have used these model systems in previous analysis about the MFS wether trial as well as for the seasonal outlook. In this analysis these farm systems will be used to explore the economics of P and S use on the basalt soils typical of the central Monaro.

This analysis seeks to answer questions about;

- the economic response to fertilizing with S and combinations of S & P
- the relative merits of various types of fertiliser
- the potential effect of sulfur leaching if gypsum is applied every second year.
- The impact of livestock genetics on returns from lifting soil fertility.
- Sensitivity to increases in fertiliser price.

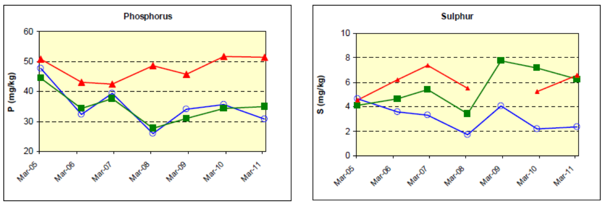
Method

While GrassGro modelling is easily used to explore the difference between systems in steady state it is not as simply applied to explore the economics of making progressive changes to farm systems such as building soil fertility over time or redevelopment through sowing of new pastures. Typically these analyses have been done through a partial/cash flow budget using a nominal average enterprise performance which is not cognisant of the risks inherent in seasonal variation. In this work we have used GrassGro to define the extent of the seasonal variability in systems running at different fertility levels and then used this in a secondary stochastic model to determine the range of potential economic outcomes from a suite of possible fertiliser and pasture sowing treatments.

Pasture Systems modelled

The basis for comparison was the native pasture treatments from the Bungarby MGRDP site. Soil test data from these treatments are shown in figure one. This basalt soil has a PBI of 200 indicating a critical P level around 40. Over the longer term treatments without added phosphorous have Colwell P around 8 ppm below the critical P level.

Figure 1. Sequential soil tests for the Bungarby trial site from 2005 to 2011. Blue line is Nil fertiliser treatment, green line is 125kg/ha/yr Gypsum (S treatment), red Line is 125kg/ha/yr Super Phosphate plus 125kg/ha/yr Gypsum (S & P treatment).



At the same time the unfertilised treatment sustained KCl Sulfur levels around 3ppm while the target level is generally accepted to be around 8ppm. By comparison the Gypsum treatment managed to lift the soil test to around 7 ppm over time while the combined S & P treatment with its higher rate of S reached similar levels somewhat sooner.

Production data from this site demonstrates an unfertilised carrying capacity of around 3.7 dse/ha. A GrassGro farm system was calibrated to this stocking rate in order that similar ground cover was achieved to that measured on the trial site. To achieve this level of production the fertility scalar was set to 0.75.

The carrying capacity realized by the S treatment in the Bungarby trial was 5 dse/ha while the S&P treatment achieved 6 dse/ha. In order that the GrassGro model simulate this eve of production the fertility scalar was set to 0.86 and 0.93 respectively. It was assumed that when moving from an unfertilised system to the fertilised system, stocking rates would shift half way to the final stocking rate in year one and be at the final stocking rate in year 2. Evidence from the MGRDP Bungarby site suggests this should be possible and data published by Alcock et al (2012) suggest that rapid increase in stocking rates is essential to the economic success of any increase in fertiliser usage.

Animals modelled

Although the actual trial ran wethers the simulations represented here are merino breeding enterprises using the same enterprise structures used in the MFS wether trial analysis while the base genotype was bloodline 3 since this was a bloodline common on the Monaro representing median performance from the wether trial.

As stocking rates increase the cost of livestock capital was determined as the interest cost at a purchase price of $100 per breeding ewe. This is at odds with other economic modelling looking at cash flow which typically apportions the full capital cost of extra stock. In this instance we calculate cumulative profit so only the interest cost of the livestock capital has been allocated assuming that the inventory value of the stock is about the same as the original purchase value.

Fertilser Strategies

A range of fertiliser strategies were tested. P strategies sought to add an average of 11kg of P per year for 4 years in a buildup phase and then7 kg of P per year thereafter while S strategies added 20kg of S per year over the 10 years. Fertiliser P and S content and price are shown in table 1, while the annual application rates tested are shown in table 2.

Table 1. Price[a] and nutrient content of commonly available fertilisers.

Fertiliser	P%	S%	Cost $/t
Gypsum (Gyp)	-	16	95
Sulphur Bentonite (S B)	-	90	675
Single Super (SSP)	8.8	11	330
SuPer26S (SP26)	7	26	406

a) Bulk prices delivered on farm (supplied by Cooma Rural 19/11/2013)

Modelling process.

Farm systems were modelled at fertility scalars 0.75, 0.86 and 0.93 to represent the unfertilised, S and S & P treatments running at their potential stocking rates of 3.7, 5 and 6 dse/ha. Systems were also run for fertility scalar 0.8 at 4.4 dse/ha and fertility scalar 0.84 at 4.8 dse/ha to represent the first year productivity of the S and S & P strategies respectively.

Each simulation ran from 1971 to 2012 using silo data drill weather data. The annual profit data was representing the variation in enterprise performance was then used in a purpose built stochastic annual profit model to generate percentiles for 10 years of cumulative profit compared to the unfertilized system.

The stochastic model produced 40 sequences of annual enterprise profit based on the assumption that each iteration over the 10 year projection was independent and could be like any one of the 42 years in the relevant GrassGro simulation. In this fashion the risk of unfavourable seasonal conditions occurring was included in the cumulative profit distribution. Each annual profit is the profit from the randomly selected year from GrassGro minus the fertiliser cost for that year.

Table 2. Fertilser strategies (annual rates) for a range of products and their combinations

	1	2	3	4	5	6	7	8	9	10
Gyp	250		250		250		250		250	
S B	66			66			66			66
SP26	157	157	157	100	100	100	100	100	100	100
SP26 biennial	314		314		200		200		200	
SSP +S B	125 +66	125	125	125 +66	160		160 +66		160	+66

Table 3. Progressive stocking rates (dse/ha) for pasture improvement and improved pasture rundown.

Year	1	2	3	4	5	6	7	8	9	10
S B	4.8	6	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
SP26	4.8	6	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Rundown	8.6	8	7.5	7.1	6.7	6	4.8	4.8	4.8	4.8

Effect of Sulfur leaching

Sources of sulfate sulfur like gypsum and super phosphate leave the sulfur subject to leaching through the soil profile leaving the top soil impoverished. This effect is the subject of an MLA PDS project that has been undertaken by MFS over the past few years. Data from the trial sites suggest that sulfur leaching is a real issue indicating the use of a slower releasing form of elemental sulfur may be a useful alternative to Gypsum where the practicalities of spreading mean Gypsum will most likely be spread every second year.

A simulation was conducted in which enterprise performance in every second year was set to the performance expected in the first year after sulfur application (half the potential response in soil test and stocking rate). This was done to simulate the production response on a property where only half the fertilized pastures were fertilised with gypsum each year at 250kg/ha

Pasture Improvement

Fertiliser use was also tested in the context of its value to fully improved pastures on the same soil type. It was assumed that the fertility scalars should be set to the same level for the Nil, S and S & P treatments to simulate similar fertiliser strategies. Stocking rate (table 3) for improved pasture systems was determined using the 70:70 ground cover rule at each fertility scalar for stock grazing a pasture with a mix of Phalaris, annual grasses and sub. clover.

Simulations were then conducted to determine the cumulative profit from moving from an unfertilized native pasture to a fully improved pasture also the consequence of choosing not to fertilise an already fully improved pasture running at critical soil test levels.

The cost of improving the pasture was assumed to be $400/ha to the point of first grazing but after discussions at the Nimmitabel forum it was decided that this would not be sufficient to include the value of lost grazing assuming the pastures would not be grazed in their first year after sowing. To this end a further $70/ha has been added (equivalent to the average annual profit from the unfertilized native system it was replacing).

The cost of ceasing fertiliser use on already established pastures was assessed on the basis that carrying capacity would be diminished in line with the soil test. Stocking rates are shown in table 3.

The value of animal genetics

To test the importance of having high performing livestock bloodline 3 was substituted with the lowest performing bloodline (6) simulated in the wether trial analysis reported last month with its attendant reduction in profit per dse.

The impact of higher fertiliser price.

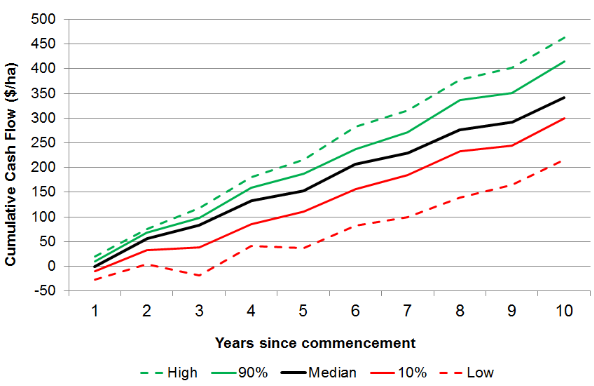
Since the price of Sulfur fertilisers have been relatively low and stable over the past decade it was decided not to conduct price sensitivity for this element. Price sensitivity was conducted for the SP26 native pasture strategy by increasing the price per tonne by 20%, 40% and 60% above current prices. Lower prices were not considered since the current price is at the low end of the range experienced over the past 5 years.

Results

Native Pasture Strategies.

Figure 2. shows the cumulative profit from the use of Gypsum on native pastures using a biennial application of 250 kg/ha assuming there is no suppression of pasture performance in the intervening years.

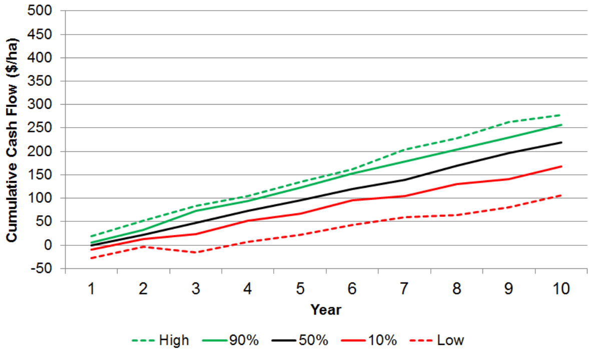
Figure 2. Cumulative profit after beginning the use of Gypsum on unfertilized native pasture.



The black line is the median of the stochastic modelling showing it would be reasonable to expect a 10 year cumulative profit of around $350/ha. If a third of an 800ha farm was treated in this fashion this would yield an extra $80,000 dollars to the farm bottom line over the ten years.

The other lines on the graph represent the potential variation around this median. The solid red line is the 10th percentile, there is only a 10% chance the cumulative profit would be less than this line over the ten years. The solid green line is the 90th percentile and there is only a 10% chance that cumulative profit will exceed this line throughout the 10 year period. Dotted lines are the best and worst case scenario for the 40 random 10 year sequences

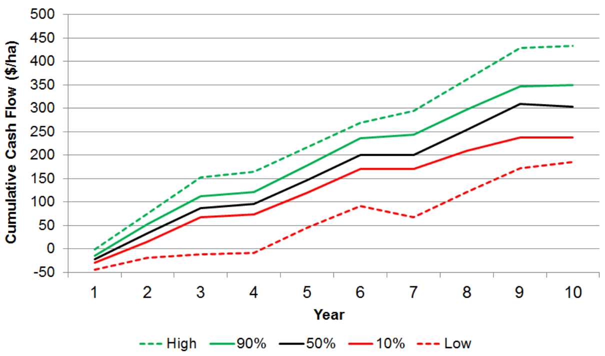
Figure 3. Cumulative profit from biennial application of Gypsum *assuming only half the impact on production every other year.*



The potential impact of sulfur leaching on the cumulative profit is shown in fig 3. With an every second year application of gypsum the 10 year profit is only $220/ha or $53,000 over the farm, $27,000 less than if no leaching was to occur.

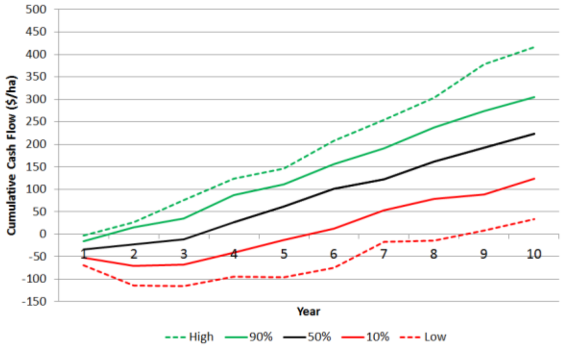
One option to allow irregular application of sulfur without loss of production in between application is to use a product with lower solubility and longer term pay out. The option used in this analysis is the S B product which incorporates elemental sulfur of a range of fineness in a prill with Bentonite clay. Figure 4. Shows the profit from use of such a product assuming productivity is equivalent to annual use of Gyp but at a higher cost per tonne and per unit of Sulfur. Over the ten year period this strategy yields $19,000 more profit for the farm than the biennial Gyp application when the effects of sulfate leaching is accounted for.

Figure 4. Cumulative profit from triennial application of Sulphur Bentonite assuming consistent sulfur nutrition is maintained between years.



Data from the MGRDP trials at Bungarby indicate that further production increases result from phosphorous in addition to sulfur and figure 5. shows the cumulative profit from the application of SP26 which has three times the amount of S as SSP when applied at the same rate of P.

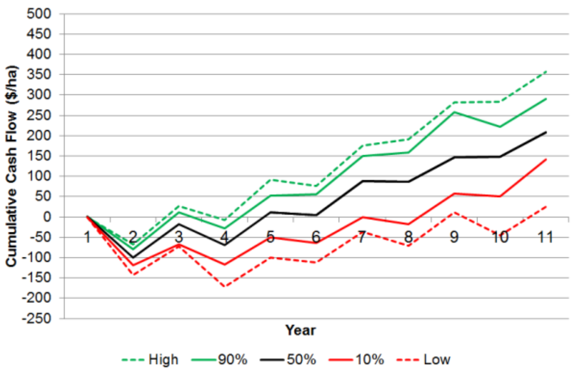
Figure 5. Cumulative profit from annual application of SuPer26S.



Despite the application of SP26 being profitable the 10 year cumulative profit is just $220/ha, $18,000 less than the use of S B on a whole farm basis. In addition this fertiliser strategy does not break even until Yr. 4 after the first application and there is a 10% chance the strategy will not break even until Yr. 6.

Biennial application of SuPer26S at the same overall rates of S & P was also tried Fig.6. and while the median 10 year cumulative profit is similar to the annual application strategy there is added risk which stems from the coincidence of poor years with the cost of double rates of fertiliser applied and also the expenditure on half the fertiliser cost a year earlier than in the annual application scenario. This results in similar 10 year profits but longer time to break even.

Figure 6. Cumulative profit from biennial application of SuPer26S.

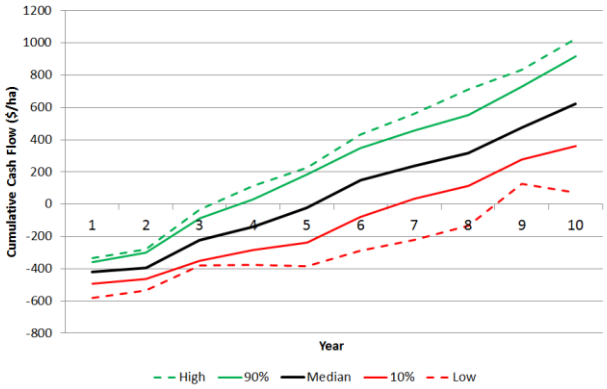


The application of the same rates of S & P using separate applications of SSP and Gypsum was also tested and despite the slightly lower cost of fertiliser the extra spreading costs offset this such that there is little difference in the 10 year cumulative profit or the time to break even. (data not shown). The convenience a single spreading pass at easily managed rates with SP26 which has a component of more persistent elemental sulfur makes this the obvious choice.

Improved pasture strategies.

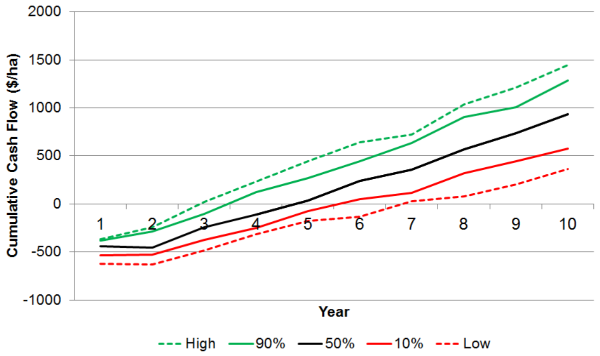
Since the soil P levels are already close to the critical levels for the soil modelled it would be possible to choose to improve a pasture with the only ongoing nutrient supplied being sulfur. Of course this would be subject to ongoing monitoring of soil P over time there would be a need to replace the P being removed at the higher stocking rates. Figure 7. shows that while the strategy doesn't break even until year 6 the cumulative profit over 10 years would be about double that from the use of the same rate of fertiliser on the existing native pasture.

Figure 7. Cumulative profit from pasture improvement with ongoing application of Sulphur Bentonite.



Unlike the situation for the native pasture the addition of P as well as higher rates of S in the fertiliser strategy yielded extra profit over using S alone (Fig. 8.)

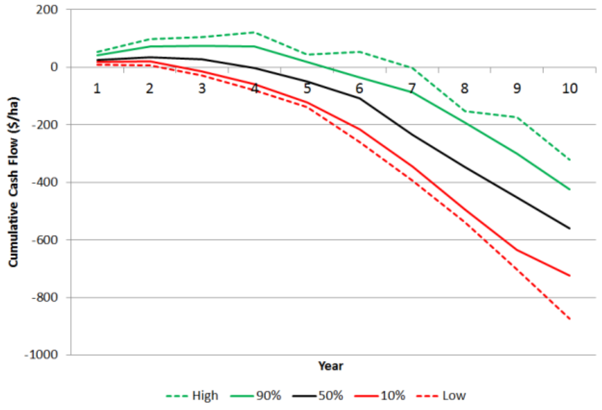
Figure 8. Cumulative profit from pasture improvement with ongoing application of SuPer26S.



The time to break even is similar to the S B application but the 10 year cumulative profit is over $900/ha so only a third of the area (80ha) would need to be developed compared to the use of S B on native pasture in order to make the same $72,000 difference to the 10 year farm profits.

Of course the profits shown above are dependent on the ongoing application of fertiliser. This begs the question whether fertiliser dollars might be better spent on fertilizing native country once the more arable country is fully developed. Figure 9. shows the result of allowing available S and P to diminish through cessation of the maintenance fertiliser program.

Figure 9 Cumulative profit/loss from ceasing ongoing maintenance application of SuPer26S.



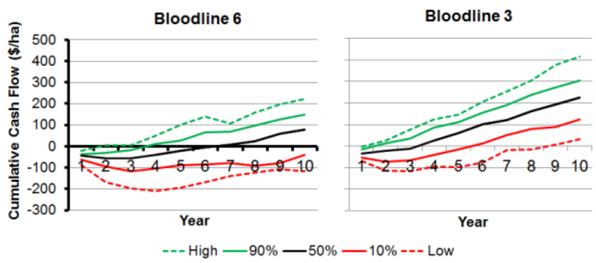
It can be seen that while the fertiliser saving in the first 2 years can at least compensate for any loss in production by the fifth year there is about a 90% chance of being behind the maintenance fertiiser scenario and by Yr. 10 the cumulative loss is almost double the cumulative profit from applying S B to a native pasture.

Higher performance genetics increase returns from fertiliser.

It has long been understood that the productivity of animals per dse influences the returns possible from pasture improvements and fertiliser use.

Figure 10. indicated the difference between using two bloodlines represented in the recent MFS wether trial. The relative 10 year cumulative profit from applying SP26 to native pastures if around $140/ha less for the property running bloodline 6 compared to the original scenario running bloodline 3.

Figure 9 Cumulative profits from annual application of SuPer26S to native pasture grazed by different bloodlines



Not only is the total profit less but the median time to break even has extended to Yr. 7 compared to the original break even time of 4 yrs.

Sensitivity to fertiliser price.

The economics of any change in management is contingent on the price relativity between the input costs and the value of the commodities sold. Over the past 5 – 10 years there has been considerable volatility in the price of phosphorous fertilisers with speculation that the price is likely to escalate. Despite this the price of Sulfur fertilisers has been relatively stable.

Figure 10 Cumulative profit from annual application of SuPer26S to native pasture for the current fertiliser price compared to a 20%, 40% and 60% higher price.

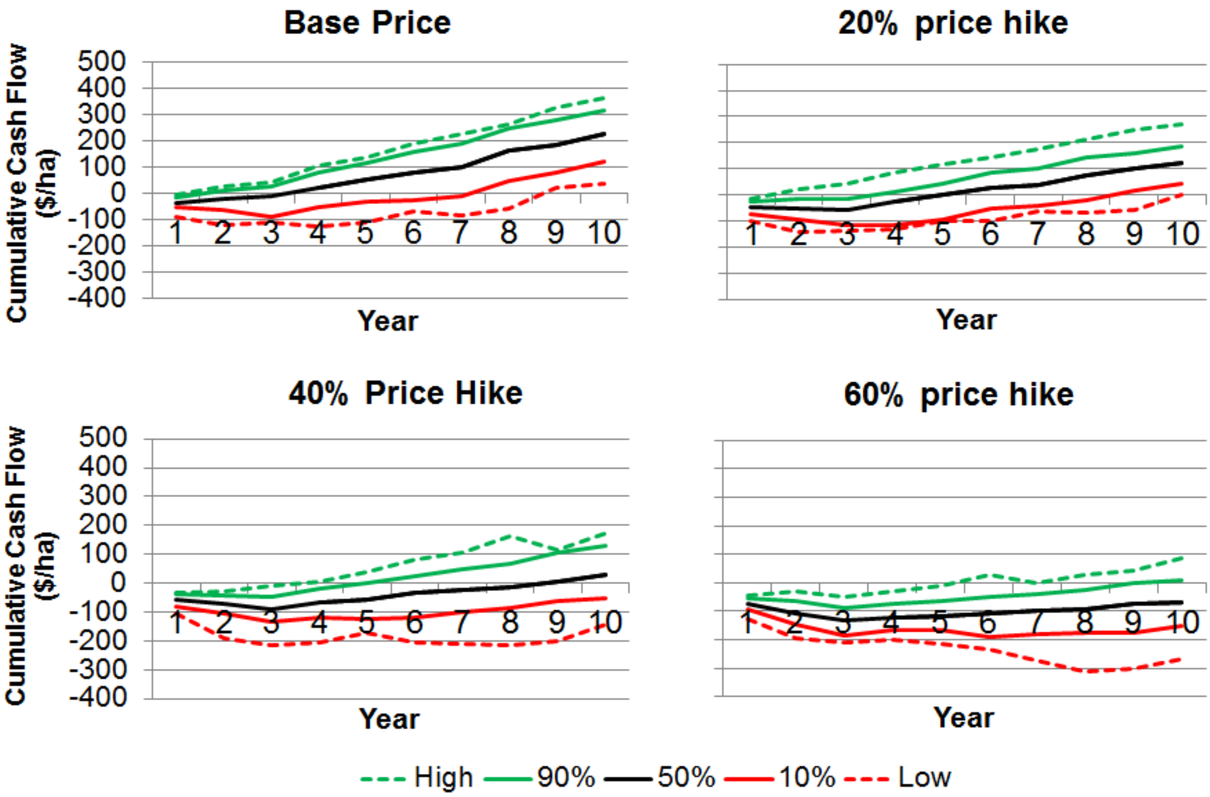


Figure 10. shows the impact of a 20%, 40% and 60% increase in the price of SuPer26S on the economics of fertilising a native pasture. A 20% increase in the price of fertiliser over the full ten year model approximately halves the cumulative profit; a 40% price hike leaves the median 10 year profit at break even while at a 60% price increase the investment will make a loss 9 times out of 10.

This result is undoubtedly an exaggeration in that wool and lamb prices are unlikely to remain stagnant in the face of rising costs nor is the fertiliser price likely to lift by 60% and remain there for a 10 year period. However the largest costs occur in the first 3 years (build up phase) so with P prices at more modest levels it is unlikely there will be a better time to start a fertiliser program.

Conclusions.

Soil test information is the key to making decisions about fertiliser priorities and the likely return to investment in fertiliser. Many MFS members have begun building a very useful database of soil tests for a range of paddocks representing different pasture types and management histories. Now the trends are emerging it is time to start using them to your advantage.

Use partial budgets and the information and tools at your disposal to make informed decisions about the options which give the greatest and/or the most rapid returns. For an enterprise with limited availability of cash more modest and more immediate returns might be appropriate while enterprises with liquidity might choose to invest in strategies that have longer periods of negative cash flow but give higher overall return. The right combination of fertiliser choices will be unique to your farm what matters is using a robust and objective decision making process like 5 easy steps.

If for biosecurity reasons you choose to breed up rather than buy in stock it is important to ensure you do not fertilise more than you can utilise while your numbers steadily build. This will lead to understocking relative to carrying capacity which while reducing seasonal risks increases financial risks.

Clearly the return on investments in pasture and fertiliser is heavily influenced by the productivity of the animals in your system. You cannot afford to simply be a good stockman nor can you afford to just be good at your pasture agronomy. Truly profitable enterprises are top performers in both fields. With increasing costs and risks in your farm systems it is critically important that your animals turn every kg of pasture consumed into more dollars.

Above all don't use the possibility future poor seasons as an excuse for inaction. In almost all scenarios modelled even with the poorest sequences of seasons the use of fertiliser will still yield a profit over the 10 year period.