

## Financial evaluation of hill country pasture improvement

T.G. PARMINTER

Whatawhata Research Centre, MAF Technology, Private Bag 3089, Hamilton

### Abstract

Capital fertiliser dressings and intensified grazing management (to fully utilise available pasture) are shown to be essential components of hill country pasture improvement options when they were analysed by a computer simulation model. For calculations to be profitable, animal performance needed to exceed specified minima throughout the period of development. For traditional mixed livestock policies, these minima were that finishing cattle reach 300 kg carcass weights and breeding ewes achieve more than 100% lambing.

**Keywords** pasture improvement, gross margin, reseeded

### Introduction

Hill pasture improvement or renovation, including capital inputs, has been shown to be profitable (\$ net present value (NPV)/ha) when real interest rates are less than 7% (Frengley & Anderson 1989). Below this figure, including a herbicide application before reseeding had greater profitability than conventional hill pasture renovation by oversowing and topdressing alone. The most critical determinants of profitability were farmer skill and farm performance.

In this paper the relationships between pasture improvement options and livestock enterprise performance are studied further. Gross margins for the options are compared and used to rank the profitability of each alternative as a guide to establishing priorities for a successful pasture improvement programme.

### Methods

A base environment of moist to dry North Island rolling hill country was assumed, with 'runout' browntop pastures producing 5500 kg DM/ha annually (Lambert *et al.* 1983). A second base environment of ryegrass-dominant pastures producing 7300 kg and 12 000 kg DM/ha/year was also included.

Several fertiliser and oversowing policies (Table 1) were tested and the Stockpol computer program (Marshall *et al.* 1991) used to simulate expected animal performance responses. A Romney breeding ewe flock was compared with a 2-year Angus steer policy, and with a 50:50 combination of both. The cash flows generated were then compared using NPV and payback periods to identify the most profitable options.

Table 1 Pasture improvement policies used in the comparisons.

#### A. For browntop dominant low fertility pastures

1. Capital rates of fertiliser alone, with little change in pasture composition. Cost \$500/ha.
2. Capital rates of fertiliser and improved grazing management to improve pasture composition. Cost \$700/ha.
3. Seeding new high fertility species after herbicide treatment and grazing management to produce ryegrass-dominant pasture. Fertiliser applied at maintenance rates only. Cost \$439/ha.
4. Capital rates of fertiliser together with seeding of high fertility species, and improved grazing management. Cost \$939/ha.

#### B. For ryegrass-dominant pastures

1. Seeding cocksfoot into a low producing ryegrass pasture. Cost \$375/ha.
2. Seeding cocksfoot into a high producing ryegrass pasture. Cost \$375/ha.

In this study the browntop-dominant, low fertility pastures required maintenance fertiliser of 40 kg/ha/year of superphosphate. To improve their soil fertility, capital inputs of 2000 kg/ha of superphosphate over 3 years were required, after which maintenance requirements of 300 kg/ha/year of superphosphate were assumed.

High fertility ryegrass pastures produced 12 000 kg DM/ha/year (Grant *et al.* 1973; Gillingham *et al.* 1984), and oversowing with a predominantly cocksfoot seed mix added 500 kg DM/ha/year (Webby *et al.* 1990; Boom pers. comm.) to existing pasture production. Maintenance fertiliser for these pastures was again 300 kg/ha/year of superphosphate.

## Economic evaluation

Annual gross margins were calculated for each policy and level of animal performance. The capital costs of retaining extra livestock have been included as an annual charge of 10% of their capital value. Any benefits from improved land value have not been included. To evaluate profitability of the pasture improvement options, payback periods have been calculated to identify the year in which the income stream completely covers the costs of pasture improvement.

As most of the capital costs of pasture improvement occurred within a single 12-month period (the only exception being capital fertiliser), they were assumed to be unaffected by inflation. In the calculation of NPVs, future income streams generated were discounted to obtain a NPV using alternative real rates of return of 4% and 7%. Full stocking rate potentials were programmed to be achieved after year seven for fertiliser and combined fertilised and grazing examples, and year five for the others (Fregley & Anderson 1989).

## Results and discussion

Income obtained from pasture improvement depends on stocking rate and the associated level of animal performance. For both of these to be high requires skilled farm management in order to improve pasture utilisation and maintain animal performance even when increasing stocking rate.

### Stocking rate

Individual sheep performance was more sensitive to overall stocking rate than cattle performance. A 25% decrease in sheep stocking rate increased performance per animal by 40%, but the same decrease in cattle stocking rates increased individual animal carcass weights by 20%. Individual animal performance in the mixed sheep and cattle systems was influenced by the inclusion of the other animal species. A 25% decrease in stocking rate of the mixed sheep and cattle system increased cattle performance by 35% but sheep performance by only 25%.

The objective of an improvement programme may be to increase stocking rates. However, stocking rates above optimum will reduce breeding ewe and 2-year finishing cattle performance.

### Animal pasture utilisation

When a greater proportion of the available pasture has been consumed for animal production, pasture utilisation is increased. As well as increased farm productivity, pasture utilisation is also an important tool for maintaining

pasture composition (Sheath 1988). Cattle policies that have lower stocking rates to achieve greater animal intakes will have lower overall levels of pasture utilisation.

Decreasing the stocking rates of animals within sheep policies had different effects on pasture utilisation from decreasing stocking rates within cattle policies (Table 2). Grazing management of sheep can be manipulated to maintain almost constant levels of pasture utilisation across a range of stocking rates. This is achieved by increasing their intakes over late spring when there is a greater feed surplus available and, as a consequence, increasing subsequent breeding ewe productivity.

When farms have at least a 50% proportion of sheep stock units they are still able to maintain pasture utilisation at similar levels across a range of cattle and ewe performances. "The best farmers can achieve both higher stocking rates and per animal performance because of factors [including] better control of feed, and more appropriate stock policies" (Bryant & Sheath 1987). Mixed sheep and cattle policies give good levels of animal production from lower stocking rates, but without reducing pasture utilisation as much as lower stocking rates in cattle only policies.

Table 2 Effect of pasture composition and stocking rate on animal performance and annual pasture utilisation.

Animal class	Performance indicator	Stocking rate (su/ha)	Annual pasture utilisation (%)		
Sheep	Lambs weaned (%)	Percentage of highest stocking rate	Browntop	Ryegrass	
			80	70	70
			90	70	78
			100	70	78
	110	75	70	78	
Cattle	Carcass weight (kg)	100	87	75	
		87	60	67	
		45	55	60	
Sheep/cattle	(%/kg)				
			80/215	70	80
			90/265	67	77
			100/305	65	75
	110/305	67	65	75	

Ryegrass pastures had the potential to be utilised more efficiently than browntop dominant pastures mainly due to their greater winter growth. Thirty per cent more growth occurred in winter for the ryegrass pastures. A similar potential for utilisation was found with cocksfoot over sown pastures as for the ryegrass dominant pastures.

Table 3 Gross margins for livestock enterprises on ryegrass pasture producing 12 000 kg DM/ha.

Livestock enterprise	Animal performance		Stocking rate		Gross margin (Net of capital cost)	
	(Lambing %/carcass kg)	(su/ha)	(\$/ha)	(Relative \$/ha)	(\$/su)	(Relative \$/su)
Sheep	<b>80</b>	19	304	76	16	52
	90	<b>17</b>	332	83	20	65
	100	15	356	90	23	74
	110	14	375	94	27	<b>87</b>
Cattle	215	23	<b>178</b>	45	<b>8</b>	26
	265	16	259	65	16	52
	305	12	382	96	31	100
Mixed sheep and cattle	60/1215	21	147	37	7	23
	90/1265	<b>18</b>	319	80	<b>18</b>	58
	<b>100/305</b>	15	400	100	27	<b>87</b>
	110/1305	14	400	100	28	90

\* Relative comparisons are made with the most profitable option (\$/ha) or (\$/su).

All pastures were assumed to have the same palatability of their green leaf fraction.

### Livestock enterprise

Cattlegross income (\$/ha) was maximised at the median performance (265 kg carcass), but when capital costs were included within gross margin costs, the optimum stocking rate was the lowest of those studied (Table 3). The lowest cattle stocking rate also achieved the highest average individual performance level (305 kg carcass). Sheep policies had their greatest gross margin at the lower stocking rate (110% lambing). When the costs of capital stock had been included, in all the gross margins finishing cattle options had lower gross margins (\$/ha) than breeding ewes at comparable stocking rates.

In a mixed livestock policy, gross margins were maximum at the highest level of cattle performance, and the second highest sheep performance (100% lambing). Greater gross margins could be achieved with a mixed livestock policy than either dry cattle or sheep alone. The priority in mixed livestock policies should always be achievement of cattle performance targets. When cattle are on high growth rates extra net income can be derived from adding a complementary sheep policy to take advantage of what would otherwise be wasted feed.

### Capital fertiliser

The policy of applying development rates of fertiliser to increase the production of browntop-dominant pastures without altering grazing management to improve pasture composition, was uneconomic at all discount rates and for all animal enterprises (Table 4).

If more intensive grazing management is applied and the costs of greater subdivision included, this new

strategy had a payback period of 7 years for the best livestock enterprises and similar ultimate gross margins to that of the combined fertiliser and reseeding option.

Table 4 Economic returns of capital fertiliser policies.

Livestock enterprise	Payback period (years)		Stabilised gain in gross margins* above base (\$/ha/yr)
	4%	7%	
Development policy			
Fertiliser only			
Sheep	>50	>50	15
Cattle	>50	>50	0
Mixed livestock	>50	>50	34
Fertiliser and intensified grazing			
Sheep	7	7	182
Cattle	7	7	231
Mixed livestock	7	7	226

\* Excludes the cost of capital which was included in payback period calculations.

### Reseeding

Seeding browntop-dominant pastures after herbicide treatment with ryegrass and applying just enough fertiliser and grazing management to maintain the resulting pasture composition, resulted in a payback period of 7-8 years (Table 5).

Stocking rates were lower than those of other pasture improvement options and therefore gains in gross margin were lower.

When animal performance is good (110% lambing, 305 kg beef carcasses), improving ryegrass-dominant pastures by introducing cocksfoot was also profitable

Table 5 Economic returns of reseeding policies.

Livestock enterprise	Payback period (years)		Stabilised gain in gross margins* above base (\$/ha/yr)
Discount rate	4%	7%	
Development policy			
<b>Ryegrass</b> reseeding			
Low soil fertility			
Sheep	7	<b>8</b>	<b>101</b>
Cattle	7	<b>8</b>	<b>108</b>
Mixed livestock	7	<b>8</b>	105
Cocksfoot reseeding			
Mixed livestock	12	15	50
Low soil fertility levels			
Cocksfoot reseeding			
Mixed livestock	<b>8</b>	10	<b>71</b>
Low soil fertility levels			

\* Excludes the cost of capital which was included in payback period calculations.

with a payback period of 8-10 years. Introducing cocksfoot into low fertility **ryegrass** pastures diminished profits and increased the payback time to 12-15 years.

### Reseeding combined with capital fertiliser

The full programme of applying capital fertiliser and pasture renovation had the highest initial costs but rapidly reached stabilised stocking rate and income. It was equally profitable as the slower **fertiliser/intensification** option, but more sensitive to the discount rate used and level of animal performance (Table 6). The payback period was 7-10 years for optimal livestock policies. As this improvement option has the highest initial costs, it needs to be successfully completed and then rapidly reach its ultimate stocking rate to be as profitable or better than other options.

Table 6 Economic returns of reseeding combined with capital fertiliser policies for optimal livestock policies.

Livestock enterprise	Payback period (years)		Stabilised gain in gross margins* above base (\$/ha)
Discount rate	4%	7%	
Development policy			
Fertiliser and reseeding and intensified grazing			
Sheep	7	10	182
Cattle	7	10	231
Mixed livestock	7	10	226

\* Excludes the cost of capital which was included in payback period calculations.

Table 7 Economic returns of reseeding combined with capital fertiliser policies and intensification for suboptimal livestock policies.

Livestock enterprise	Animal performance (L%/cwt) <sup>1</sup>	Payback period (years)	Stabilised gain in gross margins <sup>2</sup> above base (\$/ha)
Discount rate		4%	
Sheep	so	30	0
Cattle	265	10	26
Mixed livestock	<b>90/265</b>	15	120

<sup>1</sup> For sheep, animal performance is lambing percentage, for cattle it is carcass weight (kg).  
<sup>2</sup> Excludes the cost of capital which was included in payback period calculations.

Low stock performance resulted in reduced profitability for all pasture improvement options and may even have been too low to cover annual capital costs (Table 7).

### Conclusions

From this study the profitability of pasture improvement can be maximised by:

1. Considering the inclusion of capital fertiliser dressings with every improvement programme.
2. Having sufficient grazing pressure to utilise available feed fully and to maintain or improve pasture composition.
3. Using intensive grazing management to increase pasture production based upon integration of mixed sheep/cattle livestock policies.
4. Maintaining high cattle carcass weights and a ewe performance of over 100% lambing during the development programme.

Capital fertiliser applications and intensified grazing can achieve results as profitable as those of reseeding options, with the advantage of lower financial risks if there should be a failure. Reseeding pastures without herbicide treatments or appropriate continuing fertiliser policies are unlikely to be profitable.

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