Improving on-farm profitability of sheep and deer systems using pasture renewal in the southern South Island

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Abstract

A cost benefit analysis of pasture renewal for sheep and deer systems is presented for cultivatable land in Otago and Southland. Pasture renewal was costed at between $400/ha (direct drilling) and $550/ha (full cultivation). The benefits from new pastures were assumed to peak at between 2 and 4 years after sowing and to last for 10 years. Sheep farm productivity was improved by up to 132%, and deer production by 60% with these models. The cost benefit analyses showed that net income increased by $409/ha and $184/ha when sowing improved ryegrass pastures for sheep and deer systems, respectively. The inclusion of chicory increased the advantage to $503/ha and $304/ha for sheep and deer systems, respectively. Increasing annual pasture renewal rate from 5% to 10%, 15% and 20% on a sheep and beef property improved net returns per hectare by $191/ha, $332/ha, $370/ha and $409/ha respectively. In conclusion, when actively managed by farmers, pasture renewal benefits gained through improved seasonality of supply and increased pasture quality are highly profitable when realised through higher stocking rates and per head performance.

Keywords: cost:benefit, deer, modelling, pasture renewal, profitability, sheep

Introduction

The popularity of all-grass farming, coupled with the downturn in product prices through the 1980s, led to a marked decline in pasture renewal throughout Otago and Southland. Pasture quality and production declined in this period as pastures reverted to unimproved species with lower fertiliser inputs. During this period, new pasture cultivars with improved seasonality, digestibility and palatability continued to be developed (Anderson 1982; Widdup & Ryan 1992).

While the extra pasture production from pasture renewal is easily measured, quantifying this potential as on-farm performance is more difficult. Stocking rate analyses are often modelled simply using annual pasture production without considering seasonality of feed production. Information on animal performance, stocking rate changes and pasture production over time are all required to place the cost of pasture renewal in a whole farm context. This paper uses both per head performance and stocking rate data collected from sheep trials around Southland, and deer research trials around New Zealand to assess the value of pasture renewal for improved animal performance.

This paper models the benefits of pasture renewal based on measured animal performance from improved pasture quality and flow-on improvements in pasture supply in autumn and winter.

Methods

Costs of pasture renewal

Costs of pasture renewal were estimated from current practice and pricing for pasture renewal from grass to grass (Table 1). An increase in initial fertiliser application for direct drilling was added to balance the lower mineralisation of nutrients in the soil compared with cultivation. Glyphosate was recommended for use in the conventional cultivation programme to remove the potential for re-establishment of high endophyte (*Neotyphodium lolii)* perennial ryegrass (*Lolium perenne*), and other persistent weed grasses. An increase in seed cost of $6/ha was used for the addition of 2 kg/ha chicory substituted for 4 kg/ha of ryegrass. No value has been placed on the pasture not grown during the

Table 1 Costs of pasture renewal on a per hectare basis.

	Direct Drilling ($)	Conventional cultivation ($)
Glyphosate – 5l/ha @ $13.50/l	67.5	67.5
Application	25	25
Drilling	65	69
Ploughing		75
Power harrowing		65
Rolling		65
Fertiliser – 250 kg/ha and 150 kg/ha DAP respectively	140	80
Seed		
16 kg/ha ryegrass @ $4.50/kg	72	72
4 kg/ha white clover @ 8.00/kg	36	36
TOTAL	**406**	**555**

establishment period. This is because the pasture renewal process is one method used by farmers to control feed during late spring, ensuring pasture quality is maintained on the rest of the farm. Over the first year of a new pasture, the production lost should be only that during cultivation and the initial 8–12 weeks of establishment. Therefore, it can be debated that this process actually benefits whole-farm productivity.

Sheep production assumptions

The economic benefits of pasture renewal were modelled using improved lamb growth rates and the flow-on effects of changing average slaughter date on standing pasture mass in autumn and winter. The following assumptions were made. The Unimproved resident system is similar to current Southland and Otago intensive sheep systems at a stocking rate of 12 ewes/ha, tailing 125% and selling lambs at 15.5 kg. Lambing percentage increased at 1.8% lambs per kg extra ewe liveweight at the cost of 6 kg pasture DM or 60 MJME/kg ewe liveweight gain (ARC 1980). The flushing effect was modelled on the extra pasture grown between the average lamb selling date of the improved systems and the selling date of the current system, and assumed that the maintenance requirement of the ewe was already met. The rate of pasture growth was estimated at 30 kgDM/ha/d for the Improved Resident and Ryegrass plus Chicory systems and 40 kgDM/ha/d for the Improved Ryegrass system (Stevens unpub. data). A weaning weight effect of 1.5 kg lamb liveweight/100 kg extra pasture cover at lambing (Litherland *et al.* 1999) was calculated after adding in extra pasture grown in March, April and May to the winter feed supply, increasing pre-lambing pasture cover. Increases of 5, 15 and 10 kgDM/ha/d were used for the Improved Resident, Improved Ryegrass and Ryegrass plus Chicory respectively in March and April. Extra growth in May was added at 5, 10 and 5 kgDM/ha/d for the Improved Resident, Improved Ryegrass and Ryegrass plus Chicory respectively. This advantage was reduced in Years 4 and 5 with the Improved Ryegrass being the same as the Ryegrass plus Chicory system.

Improved lamb growth and stocking rate values were derived from Southland research funded by Meat New Zealand (Table 2) and were used in Table 3 to model animal performance increases. Lamb carcass weight was valued at $2/kg. No wool response or value

Table 2 Lamb growth rate and stocking rate data collected from experiments in Southland which were used as the basis of increases in the sheep production system.

	Resident	Improved Resident	Improved Ryegrass	Ryegrass plus chicory
Lamb growth (g/d)				
Stevens & Turner (1994)	85	140	-	200
Stevens (1993)	-	185	215	260
Stevens (1994)	-	175	180	190
Stocking rate (lambs/ha)				
Stevens & Turner (1994)	na	na	-	na
Stevens (1993)	-	21	26	28
Stevens (1994)	-	22	27	34

Table 3 Average annual sheep meat production increases from pasture renewal over a 5-year period.

	Unimproved Resident[5]	Improved Resident[6]	Improved Ryegrass[7]	Ryegrass plus Chicory[8]
Flushing effect (extra lambs weaned/ha)	0	2.5	2.5	2.0
Weaning weight (kg)[1]	24	25.8	31.0	28.6
Post-weaning stocking rate (lambs/ha)[2]	15	21	25	27
Post-weaning growth rate (g/d)[3]	110	170	200	230
Selling date	12 April	15 March	15 March	15 March
Carcass weight (kg)[4]	15.5	17.1	19.7	20.0
Value ($/ha basic performance)	465.00	465.00	465.00	465.00
Value ($/ha Stocking rate increase)		115.50	264.60	375.50
Value ($/ha extra per head)		139.20	255.30	239.00
Average Annual Value ($/ha)	465.00	719.70	984.90	1079.50
Average Annual Cost ($/ha)	0.00	0.00	111.00	112.00
Net Benefit ($/ha)	0.00	254.70	408.90	502.50

Assumptions made in this model:

1 Weaning weight on December 15.

2,3 from Stevens & Turner 1994; Ryan & Widdup 1997; Table 2.

4 Carcass weight based on a dress-out of 42%

5 The Unimproved Resident is based on lamb growth measured from poor quality browntop, sweet vernal and dogstail pasture (Stevens & Turner 1994) and a stocking rate of 12 ewes/ha at 125% lambing.

6 The Improved Resident is based on increasing grazing management intensity, improving pasture quality in summer and increasing ryegrass content and pasture growth in autumn.

7 The Improved Ryegrass is based on new nil-endophyte ryegrass cultivars.

8 The Ryegrass plus Chicory is based on the Chicory component contributing significantly to extra lamb growth and stocking rate in Year 1 and 2. This advantage is reduced in Year 3. The Ryegrass plus Chicory and Improved Ryegrass systems are identical by Year 5.

was used in the model, assuming that wool value would remain constant over the range of options.

The sheep model was calculated over 5 years to reflect the changes in pasture production and quality that occur over this time. Data to estimate changes in pasture production as the pasture ages was taken from a pasture rate-of-growth trial at Mona Bush, Southland (Radcliffe 1974). Pasture production peaked at 2–4 years after sowing and declined 5–7 years from sowing.

Deer production assumptions

Improvements in the birth date and liveweight gain of calves was used to calculate the effects of incorporating new pasture species as velvet is not very sensitive to nutrition once maintenance requirements are met (Pearse *et al.* 2000). The model used the following assumptions. Calving date was advanced by approximately 6 days with improved nutrition (Asher *et al.* 2000) improving weaning weight by 310 g/d (Asher & Adams 1985) or 1.9 kg. Sowing improved pastures increased the calf growth in late lactation and post-weaning in autumn and spring (Table 4, Beatson *et al.* 2000). Assumptions made in this model were 15 deer stock units/ha wintered, 3.25 weaners per hectare are sold, a dressing out percentage of 52% and a value of $5/kg carcass weight for carcasses under 50 kg and $6/kg for carcasses over 50 kg. Economic performance was calculated on a payback period basis for this model because data regarding the longevity of animal and pasture responses were unavailable for deer systems.

Table 4 Improvements in red deer performance on new pastures.

	Pasture Type		
	Standard Pasture	Improved Ryegrass	Plus Chicory or Red Clover
Growth Rate (g/d)			
Late Lactation (mid January to early March)[1]	220	400	550
Autumn (March to late May)[2]	100–150	150–200	240–250
Winter (to 1 September)[3]	50–100	100–150	100–150
Spring (to 1 November)[4]	230–270	270–300	300–350
Estimated liveweight at 1 November (kg)	83	98	110
Annual value ($/ha)	699	994	1115
Net Average Return over five years ($/ha)	-	184[5]	304[6]
Payback Period (yrs)	-	1.9[5]	1.3[6]

[1,2] Beatson *et al.* 2000
[2,3,4] Barry *et al.* 1998
[5] Calculated using a pasture renewal cost of $555/ha
[6] Calculated using a pasture renewal cost of $561/ha

Modelling the rate of pasture renewal

The model was based on a 100-hectare property with a 5% base rate of pasture renewal in Otago and Southland, under a double cropping programme. This practice is effectively a 20-year pasture renewal programme. Changes in the amount of each pasture type were calculated for the increasing amount of pasture renewal (Table 5). Data from Table 3 were used for the financial responses and multiplied by the amount of the farm in any specific pasture type. It was assumed that pasture production continued to decline to that of the original resident after year 10.

Results and discussion

A model of the effect of pasture renewal on a sheep meat production system (Table 3) used a combination of increased stocking rate and per-head performance to calculate the total and net benefits over a 5-year period. The total and net increases in revenue were $520 and $409/ha, respectively, for an improved ryegrass pasture. Improvements came from an extra 2.5 lambs/ha, and an increase in carcass weight of 4.2 kg/head. Increases for ryegrass plus chicory systems were $515 and $503/ha for total and net income, respectively. Lambing percentage increased lamb numbers tailed by 2/ha while extra weaning weight and post-weaning growth rate increased carcass weights by 4.5 kg/head in the chicory plus ryegrass system. Benefits came from the value of extra carcass weight and extra lambs. Stocking rate during summer provided an increase of $265 and $376 for improved ryegrass and ryegrass plus chicory systems, respectively. Increased per head performance resulted

Table 5 Examining the economics of increasing pasture renewal rate on a model 100 ha intensive sheep property in Southland.

	Rate of pasture renewal (% per annum)				
Pasture type (ha)	0	5	10	15	20
Unimproved	100	40			
Improved Resident		35	50	25	
Improved Ryegrass		25	50	75	100
Annual Return ($)[1]	46500	68412	85230	91860	98490
Pasture renewal cost ($)	0	2775	5550	8325	11100
Net Return ($/annum)	46500	65637	79680	83535	87390
Annual Advantage to Renewal	-	19137	33180	37035	40890

[1] Calculated from Table 2.

in an extra return of $255 and $239 in improved ryegrass and ryegrass plus chicory systems, respectively.

The net benefits were achieved both through increased per head performance and increased stocking rate. Per head performance increases alone accounted for 40–55% of the extra benefit. An important part of this was capturing extra autumn feed in a higher lambing percentage. This highlights the importance of both recognising and capturing the potential benefits of growing extra feed, and can be applied to any decision such as subdivision or fertiliser policies, not just pasture renewal. Improving the resident through strategies such as intensive grazing management and subdivision provided an excellent return, and further returns not documented here can be available on-farm. The extra costs of these practices were not modelled because they vary greatly for individual cases.

Pastures tend to revert with time, depending on soil fertility, grazing management and significant events such as drought. Any changes following this depend on the grazing management and fertiliser policies of the farmer. The actual timing of these declines are also governed by the success of the establishment. Poor cultivation or misuse of herbicides when direct drilling will accelerate the rate of decline.

The renewal of pastures in a deer system modelled an increase in liveweight at 1 November from 83 kg to 110 kg in male weaners through the sum of the benefits (Table 4). The response of females would be approximately 80–85% of this (Suttie *et al.* 1987). The improvements in weaner liveweight at 1 November were converted to carcass weight and compared to the cost of pasture renewal. Improving the performance of a deer system has an estimated pay-back period of 1.9 years and 1.3 years using Improved Ryegrasses or Ryegrass plus Chicory or Red Clover, respectively (Table 4).

Red deer calve in summer when pasture quality is at its lowest. The use of pasture renewal does provide economic benefits through improving per head performance. As with sheep, it is important to recognise those benefits and capture them appropriately. The use of pasture renewal gives the opportunity to improve the management of a pasture by having it in ryegrass and white clover, with more defined reproductive growth and improved regrowth quality. The inclusion of highly preferred species such as chicory and red clover (Hunt & Hay 1990) does improve weaner growth and overall profitability. The expected lifetime of these species is yet unknown, but their inclusion with other less-preferred species such as tall fescue has been noted to lead to poor persistence (Stevens *et al.* 1992).

The standard pasture renewal profile of 5% per annum (Table 5) was compared with increasing rates of pasture renewal. Increasing the rate of pasture renewal changed the profile of pasture types, as pastures do not run down to the point of the unimproved control. This generated a much greater net benefit. Increasing pasture renewal to 10% per annum and expenditure to $5500 produced a gain of $14 043 and gave a 506% return on the extra $2775 investment. The extra production will be gained incrementally over time, as more pastures are renewed until the property is at the point where no pasture is more than 10 years old. Modelling the 15 and 20% rate of renewal showed that the law of diminishing returns applied. These increases did not include the extra performance that may be gained from the inclusion of extra high quality components such as chicory and red clover.

Though the benefits of pasture renovation are high per hectare renewed, it is important to relate that increase to whole farm profitability. The relative amount of pasture renovation that occurs over the property in any one year has a distinct impact on the effects of that renovation overall. To capture the benefits of specialist finishing feeds such as chicory, lambs should be grazed on them for periods of 3 weeks or more (Stevens & Turner 1994). This means that significant quantities of this type of feed are needed to maximise the response. With a short life of only two to four summers in the cool moist Southland and Otago conditions, a pasture renewal programme with 10% of the farm area under renewal is more likely to maximise the benefits from such inclusions in the seed mix. The economics of such a programme did provide an advantage. It must be remembered that these values have been calculated for a finishing system. Capturing the benefits of pasture renewal in breeding or store stock systems would need different assumptions with more emphasis being placed on increasing the number of lambs or red deer calves weaned and on their weaning weight.

Conclusions

In summary, some farmers are currently tapping the benefits from pasture renewal. However there is still a much greater profitability in pasture renewal unrealised by the sector. Recognising and capturing the benefits of extra pasture growth and quality at each time of year with the right stocking enterprise is important for making pasture renewal economic. Increasing the rate of renewal and choosing new pasture species when renewing can improve the net worth of pasture renewal. The move toward higher lambing percentages and higher carcass weights will need to be met by pastures of greater yield and better quality. Increasing weaner deer growth rates to provide carcasses in the October/

November period is profitable. Pasture renewal can be a major tool to economically provide the feed for these enterprises.

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