Cost benefit analysis comparing the performance of multi species with rye and vetch pasture.

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Background

This cost benefit analysis uses case study data from a demonstration conducted by the Barossa improved grazing group (BIGG) at Matt Nelder's property at Maranga, South Australia. The intention is for this information to be used in conjunction with the case study information that can be located here.

The demonstration consisted of a single five hectare paddock sown with two different pasture treatments. As there was no fence splitting the different pasture treatments there was no way of assessing differences in livestock intake (consumption) between treatments. There was also no way of assessing the differences in pasture growth rates or wastage rates between treatments, all of which could be responsible for differences in biomass measurements between treatments.

Observations of livestock grazing suggested the livestock grazed the multi species pasture in preference to the ryegrass pasture. A further anecdotal observation suggested that out of season rainfall in late November delivered greater production from the multi species pasture when compared to the ryegrass. These observational differences have not been accounted for in the following analysis as there are no data demonstrating the extent of the differences.

Analysis

In the absence of stocking rate data, this analysis assumes that each of the pastures were grazed at the same stocking rate and the same consumption levels between treatments. This approach allows for animal intake and pasture wastage assumptions to be used to reverse engineer pasture growth rates. Protein differences did result in differences in intake between treatments when using Grazfeed analyses however as the differences were relatively minor consumption estimates are based on intakes of 0.9 kilograms dry matter per DSE. DSE ratings per head differ based on lambing percentage and weight gain.

Table 1. Pasture growth and livestock intake data from the Ryegrass and vetch treatment

Ryegrass + vetch treatment

Treatment	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	**Total/average**
Graze date in	10-Jun-2023	17-Jun-2023	3-Aug-2023	15-Aug-2023	5-Oct-2023	
Graze date out	17-Jun-2023	3-Aug-2023	15-Aug-2023	5-Oct-2023	25-Oct-2023	
Livestock class	Lactating ewes		Lactating ewes		Weaners	
Lambs % ewes	115%		172%		Wt gain	
DSE rating (DSE/hd)	3		3.5		1.6	
Paddock area (ha)	2.5		2.5		2.5	2.5
Proportion grazing area	50%		50%		50%	
Number grazed on total area (5ha)	163		76		300	
Period	7	47	12	51	20	137
SR (DSE/ha)	98		53		96	
DSE days/ha	685		638		1,920	3,243
Consumption (kg DM/DSE/day)	0.9		0.9		0.9	
Consumption (kg DM/ha/grazing period)	616		575		1,728	2,919
Wastage (% consumption)	40%		40%		40%	
Wastage (kg DM/ha/grazing period)	246	0	230	0	691	1,167
Biomass in (kg DM/ha)	1,930	1,249	2,472	2,255	3,420	
Biomass out (kg DM/ha) reverse engineered	1,249	2,472	2,255	3,420	2,256	
Imputed pasture growth over period (kgDM/ha)	182	1,223	587	1,165	1,255	4,412
Imputed pasture growth over period (kgDM/ha/day)	26.0	26.0	48.9	22.8	62.8	32.2
Average annual stocking rate (DSE/ha)						8.9

Table 2. Pasture growth and livestock intake data from the Multi species treatment

Multi species treatment

Treatment	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	**Total/average**
Graze date in	10-Jun-2023	17-Jun-2023	3-Aug-2023	15-Aug-2023	5-Oct-2023	
Graze date out	17-Jun-2023	3-Aug-2023	15-Aug-2023	5-Oct-2023	25-Oct-2023	
Livestock class	Lactating ewes		Lactating ewes		Weaners	
Lambs % ewes	115%		172%		Wt gain	
DSE rating (DSE/hd)	3		3.5		1.6	
Paddock area (ha)	2.5		2.5		2.5	2.5
Proportion grazing area	50%		50%		50%	
Number grazed	163		76		300	
Period	7	47	12	51	20	137
SR (DSE/ha)	98		53		96	
DSE days/ha	685		638		1,920	3,243
Consumption (kg DM/DSE/day)	0.9		0.9		0.9	
Consumption (kg DM/ha/grazing period)	616		575		1,728	2,919
Wastage (% consumption)	40%		40%		40%	
Wastage (kg DM/ha/grazing period)	246	0	230	0	691	1,167
Biomass in (kg DM/ha)	1,900	1,174	2,090	1,790	3,840	
Biomass out (kg DM/ha) reverse engineered	1,174	2,090	1,790	3,840	1,876	
Imputed pasture growth over period (kgDM/ha)	136	916	504	2,050	455	4,062
Imputed pasture growth over period (kgDM/ha/day)	19.5	19.5	42.0	40.2	22.8	29.7
Average annual stocking rate (DSE/ha)						8.9

Note – the closing biomass in this analysis at the end of grazing period 1 has been imputed (calculated). The calculation assumes the opening biomass of grazing period 2 is different to the closing biomass of period 1. This calculation delivers a more plausible estimate of pasture growth (26 kilograms dry matter per hectare per day) over grazing and recovery period 1 than the data presented.

The feed quality tests collected on the 13 September 2023 and 11 October 2023 have been used to investigate the marginal difference in grazing value between multi species and ryegrass pastures.

As livestock were not differentially grazed between treatments and no livestock weights were recorded, the Grazfeed program was used to investigate the relative difference in lamb growth

rate between pastures based on quality differences. Biomass levels in the model were assumed to be the average of the opening and closing at the time of grazing. No differential value was applied to the first grazing as no pasture quality data was available.

The feed test conducted in September was applied to the feed produced for the grazing in August (Twinning ewes and lambs). Grazfeed showed a slightly higher production benefit from the twin ewes and lambs grazing the ryegrass vetch mix when compared to the multi species mix. The difference over the 12 day grazing period was 1.7 kilograms per hectare carcase weight in favour of the ryegrass vetch mix equating to a value of $12 per hectare at $7 per kilogram carcase weight.

The same methodology was applied to the October grazing treatment. The aim was to examine the impact of grazing pasture of the same metabolizable energy content (10.2 MJME/kg DM) but with differing levels of protein. Grazfeed showed that the low protein (9.9%) of the Ryegrass vetch pasture was found to significantly limit production generating only 0.110 kilograms of liveweight per head per day. In contrast the multi species pasture had protein levels of 14.5% delivering 0.193 kilograms liveweight per head per day.

At the stocking rates of 300 lambs per 5 grazed hectares for a period of 20 days grazing between the 5th and 25th October this equated to a difference of 45 kilograms of carcase weight per hectare in favour of the multi species pasture. This equates to a difference in grazing value of $321 per hectare in favour of the multi species mix assuming a lamb price of $7 per kilogram carcase weight.

The net benefit of the multi species mix compared with the Rye vetch pasture mix has been calculated by deducting the sum of the net benefit of grazing period No 2 (-$12/ha) and the benefit of grazing period No 3 ($321/ha) from the difference in seed cost between the pastures ($303/ha). This equates to a net benefit of $6 per hectare or 2 percent return on investment.

Table 3. There is very little difference financially between the Multi species mix and Rye vetch mix

Treatment	Rye + vetch (RV)	Multi species (MS)	MS v RV
Opening biomass (kg DM/ha)	1,930	1,900	-30
Closing biomass (kg DM/ha)	2,347	1,876	-471
Opening date	10 Jun 23	10 Jun 23	
Closing date	25 Oct 23	25 Oct 23	
Growth period (days)	137	137	
Stocking rate (DSE days/ha)	3,243	3,243	
DM consumption (kg DM/ha)	2,919	2,919	
Assumed wastage (kg DM/ha @40% intake)	1,167	1,167	
Surplus (kg DM/ha)	417	-24	
Pasture growth (kg DM/ha/grazing period)	4,503	4,062	-441
Average daily pasture growth rate (kg DM/ha)	33	30	-3.2
	Vetch + rye	Multi species	
Seed cost ($/ha)	$80	$383	$303
Feed production (kg DM/ha)	6,433	5,962	-471
Date of feed quality test	13 Sep 23	13 Sep 23	
Crude protein (%)	20.4	26	
Metabolisable energy (MJME/kg DM)	12.2	12.1	
Average biomass availability (kg DM/ha)	2363.5	1940	
Digestibility	84%	83%	
Ewe	151	130	
Lamb	0.246	0.234	-0.012
Lamb production (kg cwt/ha)	35.6	33.8	-1.7
Lamb production value ($/ha)	$249	$237	-$12
Date of feed quality test	11 Oct 23	11 Oct 23	
Crude protein (%)	9.9	14.5	
Metabolisable energy (MJME/kg DM)	10.2	10.2	
Average biomass availability (kg DM/ha)	2838	2858	
Digestibility	72%	72%	
Production (kg lwt/lamb/day)	0.11	0.193	0.083
Intake (kg DM/hd/day)	1.33	1.8	0.47
Lamb production (kg cwt/ha)	60.7	106.5	45.8
Lamb production value ($/ha)	$425	$746	$321
Price ($/kg cwt)	$7.00		
			MS:RV
Net difference in sowing cost ($/ha)			$303
Net difference in lamb production value ($/ha)			$309
Net benefit of sowing multi species ($/ha)			$6

Sensitivity analysis

Figure 1 shows that the outcome of the analysis is dependent on lamb price. The analysis shown in Table 3 has been conducted assuming lamb prices of $7 per kilogram carcase weight and no difference in cost structure between lambs grazing either pasture type.

The outcome is also dependent on the relativity in protein content between pastures however the Grazfeed model does not allow sensitivity analysis to protein to be conducted.

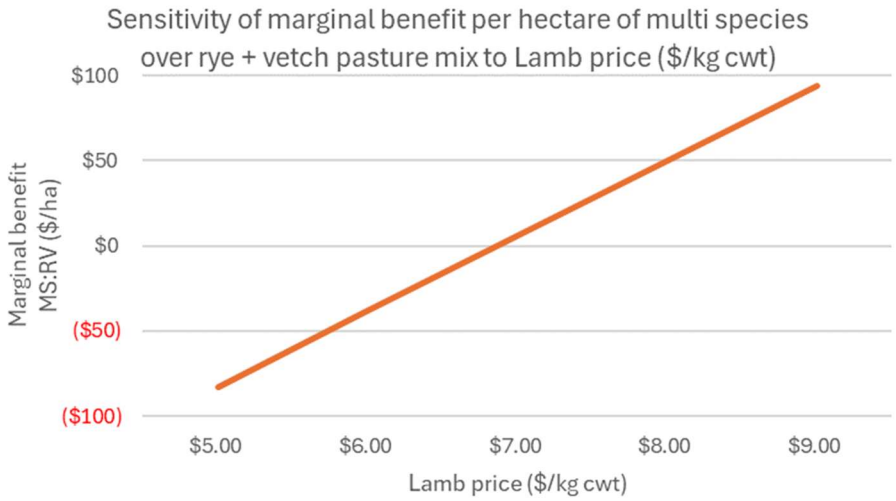

Figure 1. The benefit of multi species mix compared with rye vetch mix is dependent on lamb price.

Valuing persistence

A longer term analysis was conducted to establish the additional value that might be accrued by multi species pasture compared to vetch and rye should there be differences in persistence between pasture types. Local experience suggests that the multi species pasture is likely to have a life of 5 years compared with ryegrass and vetch having a life of 2 years (ie sown every 3rd year).

A partial budget has been used to compare the additional costs and benefits of multi species pastures when compared with vetch rye pastures. The cashflow, cumulative cashflow, discounted cashflow and discounted cumulative cashflow are presented in Table 4.

The long term analysis has applied the value of the production benefit of improved feed quality delivering higher relative weight gains in multi species pastures over ryegrass pastures in each year over the five year period to calculate the marginal benefit.

Costs of sowing the vetch and rye pasture exclusive of the $80 per hectare seed cost are assumed to be $333 per hectare (based on pesticide, fertiliser, contract sowing and contract spraying costs). Annual fertiliser cost in the multi species pasture is assumed to be $0 per hectare (as per farm case study practice).

The analysis following shows that there is a very high marginal return on investment in sowing multi species pasture seed where the persistence of the multi species pasture exceeds that of vetch and ryegrass. Even if the persistence of the vetch and ryegrass increases to 5 years then the return on investment in multi species remains high (100%). This suggests that most of the value in sowing multi species pasture when compared with vetch rye pasture is due to the pasture quality rather than the additional persistence. While the additional persistence adds some additional value it is small relative to the value of the feed quality.

The cost of the second sowing of the vetch rye pasture can be seen in the greater relative difference in the cumulative discounted cashflow from year 2 to 3 (Figure 2).

The sensitivity analyses suggest that the analysis is particularly sensitive to lamb price (Figure 3 and Figure 4). While not shown, the analysis is also highly sensitive to protein content of the pasture in the October period which drove relative differences of in lamb growth rate of 75%.

Table 4. Returns of multi species pastures are very high when compared with vetch rye pastures.

Marginal benefit of Multi species lasting 5 years versus Vetch & rye resown biannually

Year	Cashflow	Cumulative cashflow	Discounted cashflow	Discounted cumulative cashflow
0	-$303	-$303	-$303	-$303
1	$309	$6	$268	-$35
2	$309	$314	$233	$199
3	$721	$1,035	$474	$673
4	$309	$1,344	$176	$849
5	$309	$1,653	$153	$1,003

Discount rate	15%
Rate of return (IRR)	115%
Net present value	$1,003

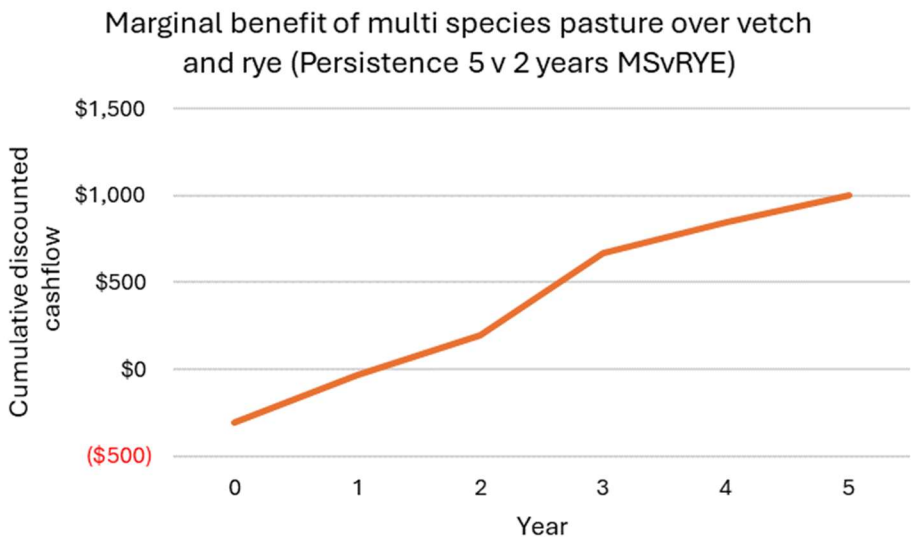

Figure 2. The marginal benefit of multi species pastures is high where vetch and rye need more frequent sowing

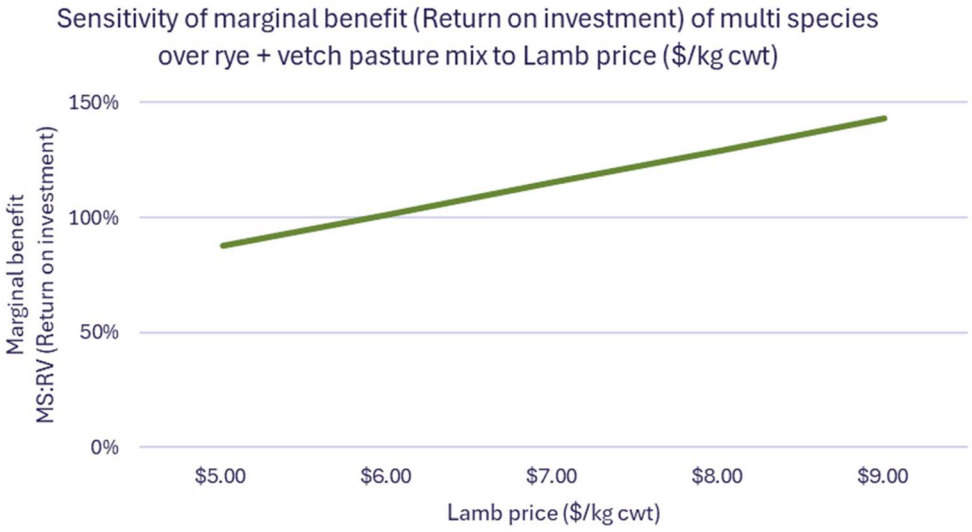

Figure 3. The value of multi species pastures increases with increased lamb prices.

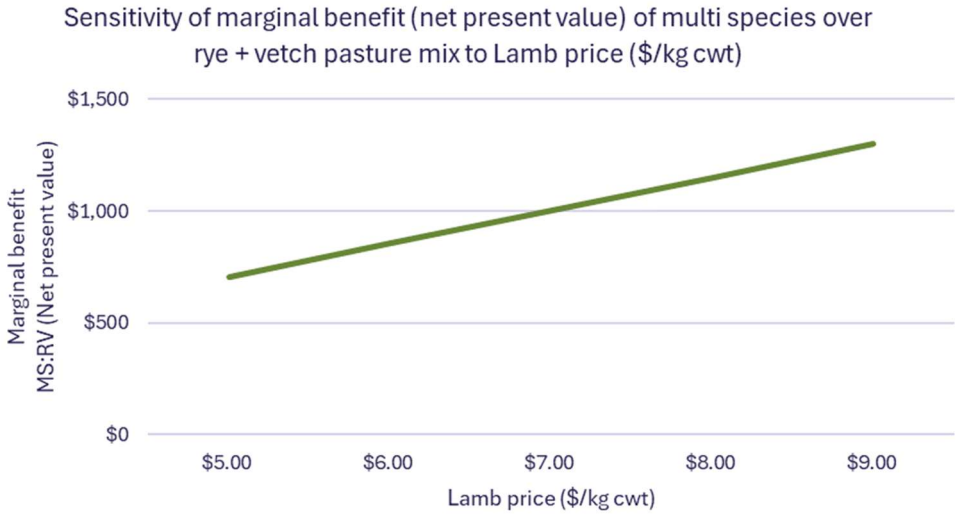

Figure 4. Return on marginal investment in multi species pastures is sensitive to lamb price.

Discussion and qualifications

This analysis shows a very small benefit of sowing a multi species pasture mix when compared with a mix of ryegrass and vetch as an annual pasture system but a very large marginal benefit when sown as a longer term pasture system.

The outcome delivered in this case study are specific to this demonstration and may not be replicated due to any number of factors that could have influenced the results.

The benefit of multi species pasture mixes are high when compared with vetch and rye over the long term primarily due to the high value of the difference in pasture quality between pasture types. While the persistence of the multi species pasture is significantly greater than that of the vetch and rye this did not significantly influence the outcome.

This case study showed that despite sowing 35 kilograms per hectare of vetch, very little vetch was present at the time of pasture biomass assessment two years post sowing (see figure 3 from the BIGG case study shown below). This is plausibly due to the competitive nature of the ryegrass and the poor seed set of vetch due to consumption by livestock. It is possible that small changes in the composition of ryegrass and vetch to other possible legume species could deliver large changes in protein content thereby limiting the large difference in lamb production without significantly higher cost.

This analysis holds true assuming the pastures are sown annually. Outcomes of this analysis will change based on relative pasture longevity as the annualised cost differential between pasture types will change.

Figure 2: Mixed-species pasture section of Matt's paddock on 13/9/23

Figure 3: Ryegrass-based pasture section of Matt's paddock on 13/9/23

What this means to you

This demonstration shows the importance of feed testing to understand the quality of pastures and their impact on the production of the livestock grazing them. The analysis shows that there was little value of sowing multi species pasture mixes as an annual pasture when compared to vetch and rye pastures.

Where sown as a long term pasture (5 years) multi species pastures can deliver higher marginal benefits than ryegrass dominant pastures where there are high differences in protein and the pastures are used for lamb production. Most of the value in this analysis was a function of additional production rather than pasture persistence.

This analysis did not consider options outside of those presented in this case study demonstration. It is possible that there are alternative means of delivering higher returns on investment that weren't examined in this demonstration.