EverGraze®: Pastures for Purpose

Dr Ralph Behrendt[1,2] and John Young[3]
[1] Department of Primary Industries, Hamilton, Vic.
[2] Future Farm Industries CRC
[3] Farming Systems Analysis Service, Kojonup, WA

Ralph is Senior Wool Research Scientist with the Department of Primary Industries at Hamilton. He has twenty years experience in research, development and extension within the wool and sheep industry. Research areas have included wool and sheep production from pasture, wool metrology, processing and wool marketing. Ralph worked within the team that delivered the nationally recognised Lifetimewool project that provided new management guidelines for Merino ewes. His current work is focused on improving Victorian lamb and sheep meat production systems. Ralph is the Proof Site Leader for the EverGraze Hamilton research site evaluating different perennial pasture systems for livestock production within the Future Farm Industries CRC. He is also a supervising scientist for the Sheep CRC Information Nucleus Flocks at Hamilton and Rutherglen, and involved in work improving weaner survival within the Sheep CRC.

Summary
Achieving profit from improving perennial pastures requires increasing stocking rate and efficient pasture consumption to capture the benefits through greater livestock production per hectare. Factors affecting how far stocking rate can be increased include: pasture utilisation and wastage, time of lambing, timing of extra pasture growth, and the reproductive rate and type of sheep enterprise being run. To maximise the potential gain producers must optimise winter ewe stocking rates with the trade off on lamb turn off weight relative to their seasonal pasture production profile. Summer-active perennial pastures modify the production profile and can increase pasture growth during summer, autumn or winter and this can significantly improve profit. Capturing benefits from this type of pasture improvement is maximised when utilised by lamb production enterprise achieving high reproductive rates.

Introduction

The EverGraze project has coined the phrase ‘Right Plant, Right Place, Right Purpose’ to summarise the requirements of pasture-based livestock systems that it has developed to be 50% more profitable than current systems while also significantly improving catchment health through increased groundcover and reduced recharge.

These systems also have potential to be more resilient to climate variability and climate change.

Intuitively, using the right plant in the right part of the landscape with appropriate soil types and rainfall levels suited to the species and cultivar makes a lot of sense. Previous papers by Avery *et al*. (2009) and Mirams (2009) have shown the benefits of this approach for pasture production. However, it is one thing to produce ample pasture; it is another to utilise it effectively by the profit-producing component of the farm system, the livestock production system.

'Right Purpose' refers to the profitable utilisation of pasture and this requires a sound understanding of the key drivers of livestock systems and the influence these have on the efficient utilisation of pasture. Nearly all pasture improvement relies in some way on the need to improve stocking rate to consume the extra pasture produced. However, there are other possible benefits for livestock production, particularly where the pasture can be used for a specific purpose such as the case for forages specifically used for lamb finishing. Other examples shown by the EverGraze project include the use for summer-active pastures for flushing ewes (King *et al. in press*) and perennial grass hedges for shelter at lambing (McCaskill, 2007; McCaskill *et al*., 2010).

This paper focuses on the nutritional requirements of different sheep enterprises, and how different control points influence productivity and profit, primarily through how the sheep system converts pasture to product; the 'right purpose'.

'Bottle neck' of autumn/winter pasture supply

For most pasture systems in Victoria, the autumn and winter pasture supply is a key determinant of stocking rates and ultimately livestock production. If one considers the analogy of a 'bottle neck' for this period, a farm's total stocking rate (or total livestock requirements) must fit through the 'bottle neck' to utilise the spring flush with normally excess feed conditions.

If this 'bottle neck' is considered to be all the feed resources available to the farmer at that point in time, there are a number of strategies that could be employed to either increase the opening by increasing the amount of feed resources available, or reducing the amount of feed required to be squeezed through the bottleneck by manipulating the amount of feed required by the livestock at this time. For example, strategies to increase the amount of feed available could involve the use of carry-over feed from spring as dry standing pasture, conserved fodder from spring to add to feed in autumn and winter and/or the purchase of additional supplementary feed to maintain livestock.

On the pasture side of the equation, pasture species/cultivar selection and/or management can be manipulated to increase pasture growth and autumn/winter feed reserves (e.g. application of nitrogen, deferred grazing). Each form of intervention

carries a cost and this needs to be carefully evaluated when considering the best way forward for an individual farm.

Pasture supply for most winter-active perennial pastures such as perennial ryegrass, are dominated by a spring peak (Figure 1) with slow winter growth in most winters and little growth during late summer and autumn. In contrast summer active pastures such as lucerne can offer some growth of quality feed in late summer and autumn (Figure 1 and 2).

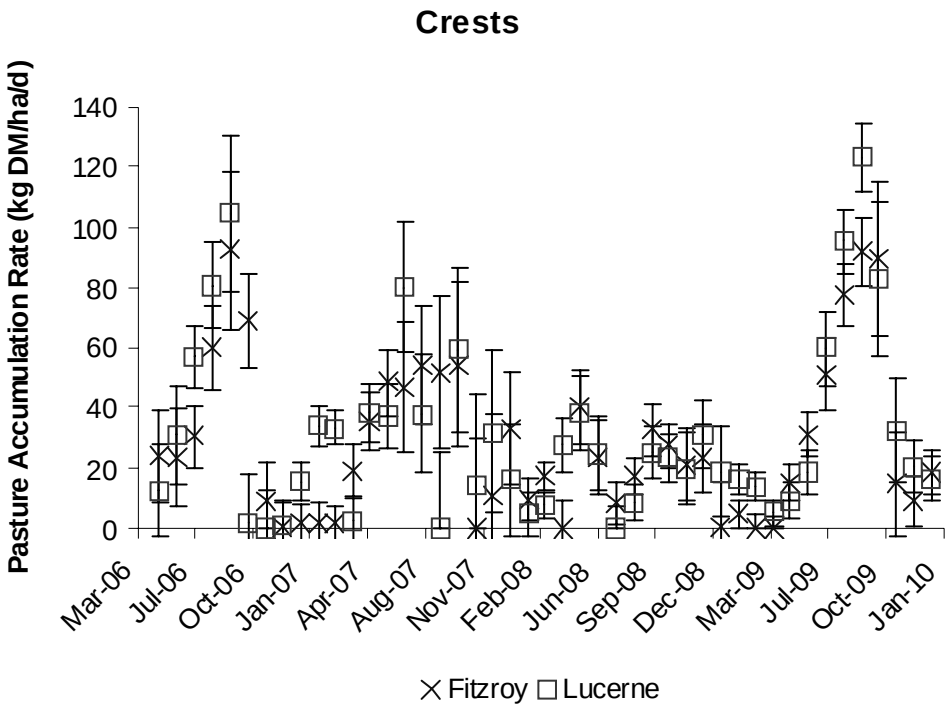

Figure 1. Pasture accumulation rates (kg DM/ha/day) for 2006, 2007, 2008 and 2009 for Fitzroy perennial ryegrass and SARDI Seven lucerne pastures sown on the crests of the perennial ryegrass and triple pasture systems respectively at the Hamilton EverGraze site. (Bars indicate least significant intervals; overlapping bars are not significantly different at 5%).

Contrary to traditional expectations, growth of pastures using modern cultivars of lucerne such as SARDI Seven, which has high winter activity (rating 7), do not have lower winter growth rates and have been comparable with perennial ryegrass pastures grown in the same part of the landscape (Figure 1). EverGraze has shown that

perennial pastures, particularly lucerne and summer-active tall fescue, are able to respond quickly to rains at the autumn break with strong pasture growth.

Figure 2. Dry Fitzroy perennial ryegrass pasture (left) and green SARDI Seven lucerne (right) in February 2009 at the Hamilton EverGraze site.

Manipulating Livestock Requirements

Sheep production from pasture is influenced strongly by the reproductive cycle. Ewe requirements for energy increase by 50% in late pregnancy and by more than 100% during lactation. By altering the time of lambing, producers can manipulate the timing of total energy (feed) requirements of their livestock system. By lambing later, the reproducing livestock will have their lowest energy requirements during the restricted feed period; this allows an increase in the number of livestock that can be taken though the 'bottle neck'.

For example, ewes that are dry or in early pregnancy will have a much lower requirement for energy than a ewe in late pregnancy or lactation. On a DSE (dry sheep equivalent) basis a 50 kg ewe in early pregnancy (first three months) will rate at 1.0 DSE. The same ewe in late pregnancy (last month) has a DSE rating of 1.3 if she is carrying a single and 1.5 if she has twins. During lactation the DSE rating increases to 2.5 for single-bearing ewes and to 3.4 for twins. Using the above example it can be

illustrated that if a farm has sufficient pasture to support 10 DSE/ha through the 'bottle neck', then 10 ewes/ha in early pregnancy could be carried through this period, compared with 7.7 single-bearing ewes/ha in late pregnancy or 4 single-bearing ewes/ha in lactation.

This is a simplified example, as producers could also allow sheep to lose weight during this period and/or feed supplement to decrease the feed deficits but these would come at a cost. Lifetimewool (www.lifetimewool.com.au) has defined optimum condition scores and feeding guidelines for different regions and lambing times. The guidelines provide a strategic year-in: year-out target for sheep systems that are related to typical seasonal pasture production and the production consequences of different condition scores at joining, during pregnancy and at lambing.

The lifetimewool guidelines account for the ability of ewes to gain weight after weaning of lambs and that the fat on their backs (condition) can be utilised through to joining and afterwards. The guidelines also indicate that the condition score target at lambing is the most important and has the greatest impact on profit. To achieve this target requires regaining any condition that was lost during early pregnancy and this is most economically achieved on green feed.

It is for these reasons that matching pasture supply to the reproductive cycle and lambing time is important for achieving high stocking rates but also for economically managing the level of supplementary feed required to meet condition score targets. Matching these nutritional requirements with peak pasture supply allows for the best fit. When this fit is optimised, winter stocking rate will be at its highest and the number of adult stock the property can carry is likely to be at its peak.

However, turning off stock at the right weight and to market specifications is also important. Therefore, the time of lambing and fit to finishing requirements and costs for lambs to meet market requirements, or weaners to reach weaning weight, also needs to be considered. The impact of this trade off heavily influences the optimum time of lambing for different sheep enterprises.

Sustainable grazing

Sheep grazing systems must also consider the impact of livestock grazing strategies on the ability to maintain groundcover (<30% bare ground) and feed-on-offer (FOO > 800-1000 kg DM/ha) in autumn to avoid potential for erosion and soil loss (Mason *et al.*, 2003). This means that sufficient dry matter must be produced in spring to have carry-over feed into autumn and allow sustained grazing without destocking. Perennial pastures are able to increase feed supply and provide greater residuals later in the season than short-term annual pastures.

EverGraze has also shown that summer active pastures are able to extend the time sheep can stay on pastures before destocking and reduce the time that sheep are

destocked once ground cover and FOO thresholds are reached in autumn (Table 1). EverGraze also utilises rotational grazing which has been shown to increase pasture growth and increase ground cover compared with set-stocking or continuous grazing systems (DPI, 2003; Mason *et al.*, 2003).

Table 1 shows the average length of time that pastures on the EverGraze Hamilton site were destocked over the last four years. This shows that summer-active pastures, particularly on the back of summer rain (2007), are able to maintain livestock on the pastures for longer. Table 1 also shows that where livestock systems have a higher DSE rating and higher stocking rate (i.e. Coopworth systems in 2009), that this will also increase the requirement for destocking unless stocking rate is reduced.

Table 1. The mean period (days) of destocking in summer and autumn for different pasture systems and sheep systems at the Hamilton EverGraze site in 2007, 2008, 2009 and 2010.

Sheep system*	Pasture system	Destocked period/ Time off system (days)# 2007	2008	2009	2010
Single Merino Or Merino prime lamb	Novel Ryegrass	0[a]	23.33[a]	31.67[ab]	57.67[a]
	Triple	74.33[b]	14.00[a]	38.67[abc]	18.67[b]
		0[a]	0.00[b]	29.00[a]	9.33[b]
Twin Merino or Coopworth prime lamb	Ryegrass	50.33[b]	28.67[a]	50.33[c]	27.33[b]
	Triple	0[a]	14.67[a]	47.67[c]	18.67[b]

* Single and Twin Merino systems run through autumn 2007 and 2008. Merino prime lamb and Coopworth prime lamb systems run through 2009 and 2010.
# Values with different superscripts are significantly different ($P<0.05$) for within year comparisons. Analysis performed on a log scale. Actual mean data presented. Stocking rates were similar within each sheep system for each type of pasture system.

Matching enterprise to pasture supply

Warn *et al*. (2006) used FOO and groundcover thresholds and modelled a variety of sheep systems in different environments. The study determined that the optimum time of lambing for the sheep systems was three months before end of the growing season (haying off) in self-replacing Merino systems, four months for store/trade lamb producing systems and four to five months for grain finished/export lamb systems. In this study, there was no benefit of lambing prior to June in any of the environments (Mortlake, Rutherglen, Cowra and Naracoorte) and sheep systems modelled. These results are clear outcomes of the interplay between income sources (meat vs. wool)

for different enterprises, the distribution of feed supply and the nutritional requirements of reproducing ewes and growing lambs.

Modelling by the EverGraze project (Young *et al.*, 2004) showed that whole farm systems with increased summer growth were more beneficial for meat producing enterprises than self-replacing wool systems. This was due to the use of summer-active pastures that extended the growing season allowing for lamb finishing, but also for later lambing that enabled a higher stocking rate and increased production per hectare.

Pasture utilisation

Utilisation of pasture is a measure of pasture consumed relative to the total pasture grown. It is dependent on the stocking rate, wastage that occurs from feeding and trampling and/or decay that occurs during the year. Increasing utilisation through increased stocking rate is consistently related to higher gross margins per hectare up to the level where supplementary feeding becomes excessive. Modelling by Young *et al.* (2010) and Warn *et al.* (2006) showed that gross margin or profit per hectare increased when stocking rate was optimised.

Reducing wastage can also be important, and rotational grazing that increases feed utilised and reduces wastage/decay can increase profit. Table 2 from the modelling conducted by Young *et al.* (2004) for the EverGraze project, shows that the benefits of increased pasture utilisation is greater for enterprises focussing on meat production, due to higher value of product produced per kilogram of pasture consumed, compared with wool enterprises. Reducing losses from trampling appears to be more important than reducing the rate of decay of the residual pasture. Further analyses by Young *et al.* (2010) have shown a similar effect of increased utilisation on profit in specialist first-cross and composite lamb production enterprises.

Table 2. Change in profit ($/ha of pasture) resulting from altering parameters associated with pasture utilisation for four different flock types/enterprises lambing in September (adapted from Young *et al.* 2004).

	Wool focused enterprises		Meat focused enterprises	
	Traditional fine wool genotype	Wool/Meat genotype	Wool-Meat to terminal	1st cross to terminal
Increase utilisation 10%.	16	31	54	29
Reduce trampling losses from 25% to 10%.	57	63	81	68
Reduce decay in summer/ autumn from 0.7% to 0.4%/day.	3	2	6	0

Time of lambing

Time of lambing is a vexed issue for many sheep farmers. Selecting a time of lambing for an enterprise is a compromise between many different factors including the type of enterprise (e.g. meat vs. wool, store vs. finished lamb), specific market requirements for wool and meat, breeding season of ewes and rams, typical seasonal patterns of pasture supply, the availability of other feed resources (e.g. forage crops, stubbles) and possible conflicts with other farming activities (Croker *et al.*, 2009).

Research and on-farm benchmarking (Lean, 2005; Sackett and Francis, 2006) has shown that gross margins can be increased by spring lambing, but despite this significant advocacy for spring lambing, little change has occurred in the time of lambing in the sheep industry(Croker *et al.*, 2009).

The profitability of lambing earlier or later in the year is a trade-off between the energy requirements of the ewes at the autumn break and during winter, versus the higher energy and protein requirements of younger lambs and weaners going into summer/autumn. Later lambing makes it possible to carry higher stocking rates through the feed shortage at the break of season and to have more animals available to graze the spring flush. However, it also means the lambs are smaller and younger at pasture hay-off, increasing costs of feeding in summer and autumn.

As described previously, Warn *et al.* (2006) showed an optimum time of lambing for different enterprises, with later lambing being suited to wool enterprises, and earlier lambing to lamb enterprises. This study also showed that to capture the benefits of a change to a later or more optimum time of lambing stocking rate would need to be increased. Other modelling by Young *et al.* (2010) has shown that time of lambing is less important for the profitability of lamb and meat-focussed enterprises. It is more critical to match genotype and system to whether lambs are store or finished, although lambing later generally increases profitability.

In modelling of the EverGraze project (Young *et al.*, 2004), using the triple pasture system (that includes perennial ryegrass, lucerne and summer-active tall fescue pastures) lambing in November instead of September increased profitability slightly in the flocks concentrating on wool production (Table 3). In contrast, lambing in November reduced the profitability of flocks with a focus on meat production. For wool systems, the energy requirements of lambs during summer were low because the target for the lambs was maintenance only.

The benefit of higher ewe stocking rates outweighs the extra costs associated with higher energy demands of the lambs in early summer. With ryegrass-based pastures, lambing later was less profitable due to lower summer activity. For the lamb systems, the cost of the extra energy required to finish later-born lambs outweighs the benefits of lower costs or higher stocking rates during winter. For these meat-focussed flocks, achieving maximum weight gain more cheaply on the spring flush was more important.

Table 3: Effect on profit ($/ha of pasture) of changing time of lambing for the four different flock/enterprise types run on the triple pasture system (Young *et al.*, 2004).

Lambing Time	Wool focused enterprises		Meat focused enterprises	
	Traditional fine wool genotype	Wool/Meat genotype	Wool-Meat to terminal	1st cross to terminal
September	226	265	397	290
November	236	276	333	190

Distribution of pasture growth

Given the chief bottle neck for pasture supply is autumn/winter, it would be expected that the value of extra pasture growth achieved during winter is more valuable than that achieved in spring. This is the case for all sheep enterprises (Table 4, Young *et al*. 2004). Increasing summer digestibility and pasture growth is more valuable for meat-focussed systems than wool-focussed systems. Further modelling by Young *et al*. (2010) has shown similar responses where extra growth during winter allows increased whole farm stocking rates and higher profit per hectare. In this study, pasture growth in early summer was also of more value for later lambing flocks.

Table 4. Increase in profit ($/ha of pasture) achieved from varying pasture growth and herbage digestibility parameters for four different flock/enterprise types (from Young *et al.*, 2004).

	Wool focused enterprises		Meat focused enterprises	
Component	Traditional fine wool genotype	Wool/Meat genotype	Wool-Meat to terminal	1st cross to terminal
20% improvement in pasture growth rate for one week.				
Winter	2.70	2.40	2.60	2.50
Early Spring	1.60	1.60	2.00	2.45
Late Spring	0.60	1.20	2.10	3.15
Summer	0.10	0.45	0.70	0.45
Autumn	0.10	0.10	0.25	0.01
Reduced rate of digestibility decline in summer	6	10	16	35

Reproductive rate

The reproductive rate of sheep systems can be improved by increasing fertility (the number of ewes pregnant per ewe joined), prolificacy (the number of lambs born per ewe lambing) and survival (the number of lambs weaned per lamb born). The extra profit from increasing reproductive rate is a trade off between the extra income achieved by having a flock with more surplus animals for sale and the extra costs associated with meeting the energy demands associated with more ewes pregnant or more ewes lactating.

A variety of methods can be used to increase reproductive rate. Flushing ewes on pasture can achieve higher ovulation rates and ultimately scanning percentages (King *et al., in press*). Improving condition score at joining will also increase the scanning percentage while improved condition scores during pregnancy and at lambing can increase lamb birth weight and lamb survival (www.lifetimewool.com.au). In these examples, summer-active pastures through increased quality and quantity of feed could allow these increases in reproductive rate to be achieved.

Increasing reproductive rate is more valuable on the triple pasture systems incorporating summer-active pastures and for meat-focussed enterprises (Table 5. Longer growing seasons mean that more lambs can be finished more cheaply and a greater focus on meat increases the value of extra lambs. Improved pasture systems than the current pastures also allow for higher impact of the increase in reproductive rate.

Table 5. Increase in profit ($/ha of pasture) achieved from producing an extra 10% of lambs weaned for the four flock/enterprise types on current pasture systems, the high performance perennial ryegrass system and the triple pasture system (Young *et al*., 2004).

	Wool focused enterprises		Meat focused enterprises	
Pasture System	Traditional fine wool genotype	Wool/Meat genotype	Wool-Meat to terminal	1st cross to terminal
Current	8	17	26	23
High Perennial Ryegrass	14	28	40	30
Triple	13	30	44	27

Conclusions

Achieving high pasture utilisation and the impact of improved pastures on the sheep production system is important for farm profitability. Increasing stocking rate is a key way in which pasture improvements are captured for greater livestock production and profit. While time of lambing is important for profitability, it is less critical than the

cost of finishing in lamb production systems. However, producers must optimise winter stocking rates with the trade off on lamb turn-off weight for their pasture production profile. Summer-active perennial pastures can modify the herbage production profile and increase pasture growth during autumn, winter and summer, which can significantly improve profit if this additional feed-on-offer is utilised. Capturing benefits from such pasture improvement is most likely when utilised by a lamb production enterprise achieving high reproductive rates.

Further information and tools

Further information and tools, such as the MLA feed demand calculator, are available for the sheep industry to assist in optimising and utilising feed supply. Please refer to the following websites; www.evergraze.com.au, www.lifetimewool.com.au and www.makingmorefromsheep.com.au.

Acknowledgements

EverGraze is a Future Farm Industries CRC, Meat and Livestock Australia and Australian Wool Innovation research and delivery partnership.

References

Avery A, Saul G, Sanford P, Behrendt R, Friend M, Mitchell M, Virgona J, Badgery W, Lodge G 2009. EverGraze – Right plant, right place, right purpose. *Proceedings of the 50th Annual Conference of the Grassland Society of Southern Australia Inc. 2009,* pp 59-68.

Croker K, Curtis K, Speijers J 2009. Wool Desk Report–February 2009. Times of lambing in Australian flocks: 2005 to 2007. *Department of Agriculture and Food, Western Australia, Issue No. 010*. www.agric.wa.gov.au.

DPI 2003. Grazing Management for Productive Hill Country Pastures. The Broadford Grazing Experiment 1998 – 2002. *Department of Primary Industries*.

King BJ, Robertson SM, Wilkins JF, Friend MA 2010. Short term grazing of lucerne and chicory increases ovulation rate in synchronised Merino ewes. *Animal Reproduction Science (in press).*

Mason W, Warn L, Cahill G 2003. Towards sustainable grazing – a professional producers guide. *Meat and Livestock Australia*.

McCaskill MR 2007. Evergraze 5. Tall wheatgrass hedges cut wind speeds. *Proceedings of the 48th Annual Conference of Grasslands Society of Southern Australia Inc. 2007,* p 104.

McCaskill MR, Behrendt R, Clark S 2010 EverGraze®: Hedges and climate change reduce lamb chill. *This proceedings.*

Mirams C 2009. Woomargama Station – using the right plants in the right place for the right purpose. *Proceedings of the 50th Annual Conference of the Grassland Society of Southern Australia Inc. 2009,* pp 69-74.

Lean G 2005. Victoria Wool Industry Analysis. November 2005. *A report prepared for Australian Wool Innovation Limited by Dr Graham Lean,* Graham Lean and Associates.

Sackett D, Francis J 2006. Integration of wool, meat and cropping systems. Wool meets Meat (Eds. PJ Cronje and D Maxwell) *Proceedings of the 2006 Australian Sheep Industry CRC Conference,* pp 204-209.

Warn L, Webb Ware J, Salmon L, Donnelly J, Alcock D 2006. Analysis of the Profitability of Sheep Wool and Meat Enterprises in Southern Australia. *Final Report for Project 1.2.6.* Sheep CRC February 2006.

Young J, Bathgate A, Saul G, Clark S, Sanford P, Friend M 2004. MIDAS insights on profitably utilising perennial plants in Hamilton, Victoria. *Report to the CRC for Plant Based Solutions to Dryland Salinity. 28 August 2004.*

Young JM, Thompson AN, Kennedy AJ 2010. Bioeconomic modelling to identify the relative importance of a range of critical control points for prime lamb production systems in southwest Victoria. *Animal Production Science (in press).*