Achieving fat score targets - the costs & benefits

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Abstract. The national Lifetime Wool project has quantified the production benefits that accrue to a breeding flock of Merino ewes from actively managing their fat score to a target of 3 at critical stages of the reproductive cycle. The GrassGro™ model was used to simulate the profitability of achieving three fat score targets (ie FS2.5, FS3 4% lambing and FS3 10% lambing) for a predominately grazing region (Yass) of NSW and a sheep/cereal region (Parkes). In both regions the FS3 10% flock had the highest gross margin but was also the riskiest option in terms of the variation in gross margin during the simulation period. In all cases the key driver of gross margin was the amount (and therefore cost) of supplement required to meet the fat score targets which highlights the importance of meeting the fat score targets using pasture and matching the breeding cycle to pasture availability. Merino producers can use this information to make informed decisions regarding whether or not to feed in dry years.

Keywords: Merino ewes, fat score targets, gross margin.

Introduction

Lifetime Wool is a national project developing guidelines for woolgrowers across Australia to optimise management of Merino breeding ewes (Thompson and Oldham 2004). The basis for the Lifetime Wool project is the fact that in addition to positive impacts on the ewe herself, optimised nutrition during pregnancy (based on ewe liveweight and body condition targets) has a significant positive impact on the developing foetus (Kelly *et al.* 1996) - progeny from better fed ewes produced more wool which was finer throughout their lives. Actively managing the nutrition of breeding ewes to meet the target of fat score 3 at critical stages of the reproductive cycle has been shown to have many positive benefits on the overall performance of a Merino flock. These include increased conception rates (Behrendt *et al.* 2006; Hatcher *et al.* 2006; Oldham and Thompson 2004), lower worm burdens in pregnant ewes, reduced ewe mortality during pregnancy, increased survival of progeny (particularly twins) (Behrendt *et al.* 2006; Ferguson *et al.* 2004a), higher progeny growth rates (Paganoni *et al.* 2004c), enhanced wool production and quality of the ewe (Behrendt *et al.* 2006; Paganoni *et al.* 2004b), improved progeny wool production and quality (Behrendt *et al.* 2006; Ferguson *et al.* 2004b) and increased progeny resistance to internal parasites (Paganoni *et al.* 2004a).

While many wool producers accept that optimised ewe management during the breeding cycle will have benefits for both the ewes and the lifetime performance of their progeny, they are questioning the economic benefits of achieving and maintaining the fat score targets. Preliminary economic modelling of early work in this area suggested that targeted nutritional management of breeding ewes at key times of the reproductive cycle can increase whole farm profit - potentially by more then $5 per ewe per year (Thompson and Young 2002). However the likely economic benefits from optimised nutritional management of breeding ewes will vary with region due to differing lengths of the pasture growth seasons, stocking rate and flock genetics (ie fine versus broader wool types).

This paper uses the GrassGro™ model to simulate the relative economic benefits of achieving the Lifetime Wool recommended fat score target of 3 during the reproductive cycle for 2 regions in NSW representative of predominantly grazing (Yass) or sheep/cereal (Parkes) enterprises.

Material and methods

The relative profitability of achieving the recommended Lifetime Wool Project target fat score of 3 compared to a fat score of 2.5 during the reproductive cycle of Merino ewes was modelled using a computer program (GrassGro version 2.4.3; (Moore *et al.* 1997). Simulations were conducted for Yass (southern NSW) and Parkes (central NSW). For each location the flocks were run on the same fertilised pasture comprising annual grasses and 10% legumes with available historical weather data (1971 - 2003 for Yass and 1971 - 2001 for Parkes) and soil types typical of the regions used to 'grow' the pasture. Joining in the Parkes simulations commenced in mid-February with the start of lambing occurring on 15th July, while at Yass joining was a month later in mid March with lambing beginning on the 15th August. Animal production and the subsequent financial results were generated over a 33 year period for Yass and 31 years for Parkes. The pasture growth generated by GrassGro has been validated against measured pasture production at the Yass site (Final Report to AWI Project EC245 Sustainable Stocking Rate decisions).

Each simulation was modelled using the same pasture, soil and weather parameters in a paddock of 100 ha with a stocking rate of 8 DSE/ha. The common inputs for each simulation are summarised in Table 1.

(insert table 1 near here)

Simulated fat score profiles

The following target fat score (FS) profiles were modelled: FS2.5; FS3 with a 4 % improvement in reproductive potential (lambing %) compared to FS2.5; and FS3 with a 10 % improvement in reproductive potential compared to FS2.5. For both FS3 simulations the wool production and quality of the ewes was adjusted to reflect the biological outcomes from the Lifetime Wool project. For the progeny of the FS3 ewes, this was +0.1 kg clean fleece weight (CFW) and -0.1 µm fibre diameter (FD).

Sensitivity analysis All initial runs used the wool and grain prices in Table 1. The wool prices are based on an average flock FD of 19 µm. The base grain price used for each region was $180/tonne, however the actual price used in the simulations was varied to take account of the inherent differences in grain prices in a grazing (ie Yass) versus mixed farming (ie Parkes) operation. The $40/tonne lower grain price for the Parkes region reflects the fact that grain would generally be available on-farm while producers in Yass would need to purchase their grain off-farm and pay an additional $30/tonne for transport and $10/tonne for agent's fees to access the grain on-farm.

The sensitivity of the gross margins for each simulation was determined by decreasing the base grain price from $180/tonne to $150/tonne (ie with appropriate on-costs this equates to $240 to $210/tonne for Yass and $200 to $170/tonne for Parkes) and varying the wool and meat prices by -10% and +10%.

Results

Yass region

<u>Rainfall and pasture growth</u> The average annual rainfall for the Yass region over the 33 year period was 758.3 mm. The average monthly rainfall ranged between 43 to 85 mm with the highest monthly falls occurring between July and October (Figure 1).

(*insert figure 1 near here*)

This average pattern of rainfall produces the first green 'pick' of pasture in April with a maximum green pasture availability of just over 2,800 kg/ha occurring in November (Figure 2a). The peak of green pasture is followed in January by a peak of 3,000kg/ha of dead plus litter availability which declines as the summer and autumn progresses (Figure 2b). The average duration of green pasture availability at Yass is 9 months (April to December). The percentiles for green (Figure 2a) and dead (Figure 2b) pasture availability for the best 10% of years and worst 10% of years clearly show the variation in the length of the growing season for Yass - from 11 months (February to December) in the best 10% of years to only 6 months (June to November) in the worst 10%.

(*insert figure 2 near here*)

<u>Target fat score profiles</u> In average years there was little difference between the FS2.5 and FS3 target fat score profiles from January to April. During this period both flocks lost nearly an entire fat score from their peak in December (Figure 2a).

Maintaining the fat score target of 3 required an average of 9 kg/ha more maintenance supplement than the FS2.5 flock (Table 2). There was little difference in the maintenance level of supplement fed between the two FS3 flocks.

(*insert Table 2 near here*)

<u>Income & costs</u> The FS3 10% flock generated the highest average income of $503.40/ha followed by the FS3 4% and FS2.5 flocks ($491.10 and $460.50/ha respectively). The differences between the three flocks were largely the result of the increased wool and meat income from both the ewes and their progeny in the FS3 flocks (Figure 3a), due to higher numbers of progeny shorn and sold in the FS3 flocks as well as the higher CFW and finer FD of the FS3 fleeces (Table 2).

The FS3 10% flock had the highest expenses of the three flocks followed by the FS3 4% and FS2.5 flock ($241.90, $237.5 and $214.00/ha respectively). The difference in costs between the three flocks was due to the higher amount (and therefore cost) of maintenance supplement fed to the FS3 flocks (Figure 3b).

(*insert figure 3 near here*)

<u>Gross margin</u> The FS3 10% flock had the highest average gross margin of the three flocks ($208.55/ha), followed by the FS3 4% ($200.58/ha) and the FS2.5 flock ($193.45) (Table 2). The FS3 10% flock was the 'riskiest' in terms of the variation in gross

margin over the 33 years. The standard deviation of gross margin for this flock was $108 compared to $105 and $98 for the FS3 4% and FS2.5 flocks respectively (Figure 4). Similar trends were evident for the coefficient of variation of gross margin.

(*insert figure 4 near here*)

<u>*Sensitivity analysis*</u> The average gross margin for each of the three flocks was more sensitive to fluctuations in wool and meat prices than to changes in grain prices. At both low and high grain prices the average gross margin was negative when market prices were low for all three flocks (Figure 5).

(*insert figure 5 near here*)

Parkes region

<u>*Rainfall and pasture growth*</u> The average annual rainfall for the Parkes region over the 31 year period was 656.6 mm. Compared to Yass, Parkes experiences less variation in rainfall distribution during the year (Figure 6) with a lower range in average monthly falls (40-73 mm).

(*insert figure 6 near here*)

This average pattern of rainfall produces the first growth of green pasture in April with a maximum green pasture availability of just over 2,100 kg/ha in October (Figure 7a). The peak of green pasture is followed in November with a peak of 2,000kg/ha of dead plus litter availability which declines as the summer and autumn progresses (Figure 7b). The average length of the green pasture availability for Parkes is 7 months (May to November). The percentiles for green (Figure 7a) and dead (Figure 7b) pasture availability for the best 10% of years and worst 10% of years show that the growing season in Parkes is shorter on average than that at Yass from 9 months (March to November) in the best 10% of years to only 4 months (July to October) in the worst 10%.

(*insert figure 7 near here*)

<u>*Target fat score profiles*</u> In average years the 0.5 difference in fat scores between the FS2.5 and FS3 flocks is maintained from February until August (Figure 7a). From November to January there is little difference in fat score between the flocks. The FS3 flocks required nearly 11.5 kg more maintenance supplement than the FS2.5 flock (Table 3)

(*insert Table 3 near here*)

<u>*Income & costs*</u> The FS3 10% flock generated the highest average income of $464.61/ha followed by the FS3 4% and FS2.5 flocks ($450.71 and $423.55/ha respectively). The differences between the three flocks were again mainly due to higher wool and meat income from both the ewes and their progeny in the FS3 flocks (Figure 8a).

The FS3 10% flock again had the highest expenses of the three flocks followed by the FS3 4% and FS2.5 flock ($325.74, $319.39 and $293.77/ha respectively). The difference in costs between the three flocks was due to the higher amount of maintenance supplement required by the FS3 flocks to maintain their condition relative to the target profile (Figure 8b).

(*insert figure 8 near here*)

<u>*Gross margin*</u> The FS3 10% flock had the highest average gross margin of the three flocks ($139.26/ha), followed by the FS3 4% ($120.09/ha) and the FS2.5 flock ($116.35). The FS3 10% flock was again the 'riskiest', the standard deviation of gross margin for this flock was $123 compared to $120 and $116 for the FS3 4% and FS2.5 flocks. Interestingly though the coefficient of variation of gross margin for the FS3 10% flock was actually lower than that of the other two flocks (88, 91 and 89% for the FS3 10%, FS2.5 and FS3 4 % flocks respectively).

(*insert figure 9 near here*)

<u>*Sensitivity analysis*</u> The average gross margins for each of the three flocks appear to be more sensitive to changes in market prices than to changes in grain prices (Figure 10).

(*insert figure 10 near here*)

Discussion

For both regions the FS3 10% flock had the highest gross margin but was also the most 'riskier' in terms of variability in gross margin. The key driver of gross margin for the various fat score target profiles across both regions was the amount of maintenance supplement required to achieve the fat score targets. There was a strong inverse relationship (r^2 = 0.93) between the amount of maintenance supplement fed and the resulting gross margin regardless of the particular target fat score profile or region (Figure 11). This highlights the importance of meeting the fat score targets using pasture and matching the breeding cycle to pasture availability.

(insert figure 11 near here)

As the amount of supplement fed was the principle cause of variation in gross margin any improvement in the efficiency with which supplements are fed to and utilised by a breeding flock will have a significant positive impact on the gross margin. Development of targeted feeding strategies based on the particular nutritional requirements of segments of the flock, single versus twin bearing ewes for example, at critical stages of the reproductive cycle is one option. A recent economic assessment of targeted nutrition for ewes and weaners using various e-sheep technologies indicated that the cost of feeding a thousand-ewe flock could be reduced from $14,000 for feeding all animals to $3,300 for targeted feeding of 25% of ewes requiring additional nutrition and 20% of weaners at risk of dying (Jordan *et al.* 2006). In the absence of e-sheep technologies, strategies like simply drafting off the lighter ewes and weaners in the mob and providing them with better pasture than the rest of the mob or added supplement will also be effective.

In order to put the impact of achieving the target fat score of 3 into perspective with other potential flock management decisions we compared the results of these simulations with the impact of reducing stocking rate. This was done for the Yass site using the average wool prices shown in Table 1 and a grain price of $240/tonne. The stocking rate of the FS3 4 % ewe flock was reduced until the cost of the maintenance supplement/ha was the same as that for the FS2.5 flock. This reduced the stocking rate by 1.7 ewes/ha to 6.3/ha and the gross margin by $33/ha (ie $168 versus $210/ha) compared to the feeding strategy to maintain fat score 3 and a stocking rate of 8/ha. It was also $30/ha less than the FS2.5 simulations (ie $168 versus $198/ha). The overall impact of reducing stocking rate is to reduce income in good years which more than outweighs the benefits of a lower stocking rate in the poor years.

For all these simulations a stocking rate of 8 DSE/ha was used as this is a reflection of the average district stocking rate for both the Yass and Parkes regions. However using the same stocking rate for each of the three target fat score profiles assumes that the optimum stocking rate for each is similar. It is possible that the optimum stocking rates are different which may result in an unfair comparison of an optimal with a sub-optimal system. To estimate the optimal stocking rate for each of the three target fat score profiles further simulations over the 31 year period were undertaken for the Parkes region using stocking rates ranging from 5.3 to 19.3 DSE/ha. The average gross margin was plotted against stocking rate and a polynomial trendline fitted to the data. The equation for each of the FS flocks was then used to calculate the optimum stocking rate (Fig 12a). Using this method the optimum stocking rates for the three simulated flocks were very similar (11.1, 11.0 and 10.8 for the FS2.5, FS3 4% and FS3 10% flocks respectively). An alternative method identified the stocking rate at which the SD of gross margin was greater than the average gross margin (Fig 12b) and found this point was reached at a similar stocking rate for the three fat score profile flocks - 11.3 DSE/ha. The average gross margin at the 'optimal' stocking rate was $168.21, $173.39 and $183.86 for the FS2.5, FS3 4% and FS3 10% flocks respectively which was between $45 (FS3 10%) and $53 (FS 3 4%) more than the average gross margin simulated at 8 DSE/ha for the simulations reported in this paper. Therefore although less than optimal stocking rates were used for the simulations reported in this paper, the impact on gross margin is likely to be similar for each of the three fat score profile flocks.

(insert Figure 12 near here)

The relative riskiness of managing Merino flocks to achieve fat score targets in different regions can be assessed by comparing the FS2.5 and FS3 fat score profiles for the ewes during the best 10% of years and the worst 10% of years (Fig 13). In 'good' years (ie 90% decile) there is little difference in the average fat score of the two flocks and the FS2.5 flocks are able to outperform their target and will more than likely realise most of the benefits of optimal ewe nutrition identified by the Lifetime Wool project with little additional supplement required in order to do so. However in 'bad' years (ie 10% decile) the 0.5 difference in fat score between the two flocks is maintained almost year round. In this situation the FS2.5 flock (and the FS3 flock) will require significantly more supplement with the subsequent negative impact on gross margin.

Producers can use this type of information to make an informed decision about the consequences of not feeding in dry (or riskier in terms of gross margin) years in order to manage year to year variation in gross margin. This decision will need to be made before joining and the break of the season. In dry autumns producers may need to accept a lower fat score target and acknowledge the production penalties (ie reduced conception and poorer ewe and progeny wool production and quality) that are likely to occur as a result with a view to balancing the impact of cost of supplements with gross margin/ha. In bad years the decision to feed should be controlled by ewe condition in relation to ewe survival especially if winter shearing is part of the management routine.

(insert figure 13 near here)

The FS3 10% flock outperformed the FS3 4% flock in both regions in terms of average gross margin. However it is important to recognise the importance of achieving the improvement in reproduction though increasing flock fertility rather than by simply increasing the bodyweight of the ewes. If the improvement in reproduction occurs with a concurrent increase in bodyweight this will have a negative impact on gross margin as stocking rate will necessarily be reduced.

An additional advantage of the 10 % reproduction rate that was not taken into account in these simulations is the greater rate of genetic progress that will occur in the FS3 10% flocks due to larger progeny numbers and resultant higher selection intensity. For 19μm wool, using the 2000 - 2005 wool prices, a 10% improvement in reproductive rate is worth $0.84 to $1.14/ewe from increased selection pressure (OFFM calculator ver.5).

Appendix

Table 1. Common inputs for the GrassGro simulations.

Wool prices				
Fibre diameter	18	19	20	21
Fleece price (c/kg)	1152	990	810	717
Average:fleece price	90%			
Commissions & tax	5%			
Lamb prices				
Carcase price	250 c/kg DW			
Carcase yield	40%			
Skin price	1			
CFA prices				
Carcase price	150 c/kg DW			
Carcase yield	40%			
Skin price	1			
Shearing costs	$5/hd			
Lamb shearing cost	$5/hd			
Husbandry cost	$5/hd			
Lamb husbandry cost	$3/hd			
Cost of replacements	$40/hd			
Cost of rams	$800/hd			
Commission on sales	4%			
Other sale costs	1.2/hd			
Maintenance supplement	Yass $240/tonne		Parkes $200/tonne	
Production supplement	$150/tonne			
Cost of pastures	$40/ha			

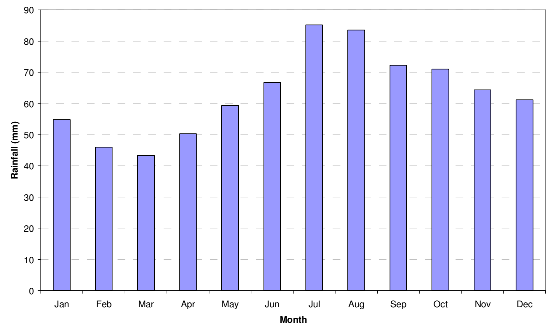


Figure 1. Average monthly rainfall for the Yass region (1971 - 2003)

Figure 2. Average available a) green and b) dead plus litter pasture (kg/ha) along with the 90 and 10% deciles for the Yass region (1971 - 2003)

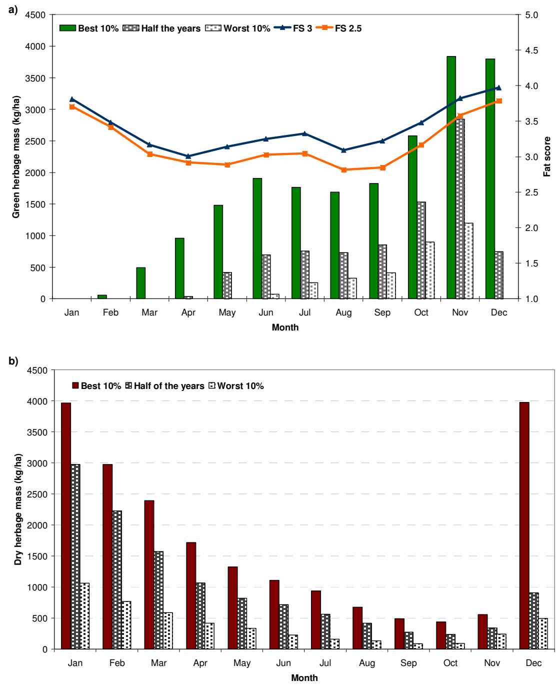


Table 2. Simulation outputs for Yass region

	FS 2.5	FS 3 4%	FS 3 10%
Ewes shorn	769	769	768
CFW (kg)	3.83	3.91	3.92
FD (μm)	19.48	19.40	19.41
Lambs shorn	635	660	695
CFW (kg)	1.15	1.18	1.18
FD (μm)	19.96	19.89	19.88
Wether lambs sold	318	330	348
LWT (kg)	29.9	30.2	30.0
Fat score	2.8	2.8	2.8
Ewe lambs sold	171	184	201
LWT (kg)	27.3	27.6	27.4
Fat score	3.0	3.8	3.0
Maintenance supplement fed (kg/ha)	28.3	37.1	37.4
Average Gross Margin ($/ha)	193.45	200.58	208.55

Figure 3. Breakdown of a) average income and b) average costs for the Yass region for the three fat score profile flocks (1971-2003).

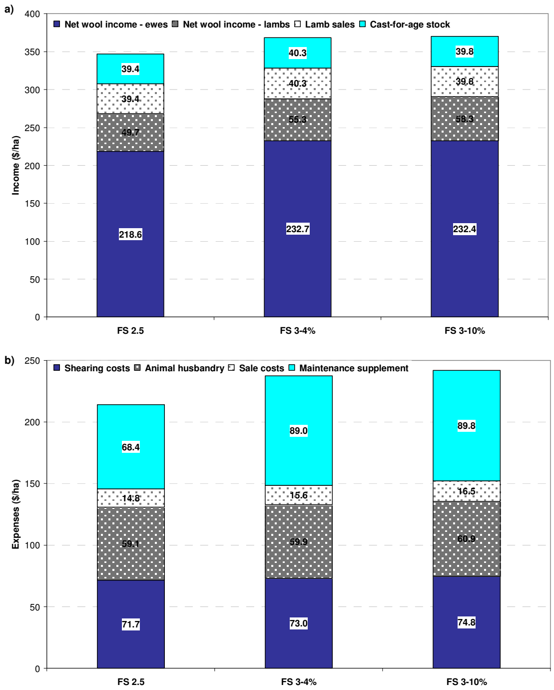


Figure 4. Variation in gross margin (SD and CV%) for the three flocks in the Yass region.

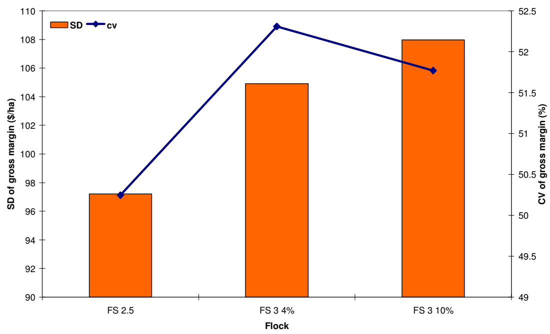


Figure 5. Sensitivity of average gross margin to grain and wool prices for the three flocks in the Yass region.

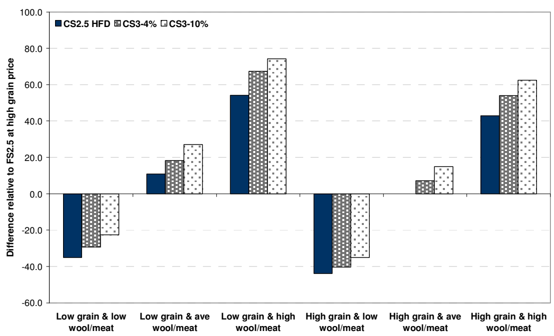


Figure 6. Average monthly rainfall for the Parkes region (1971 - 2001)

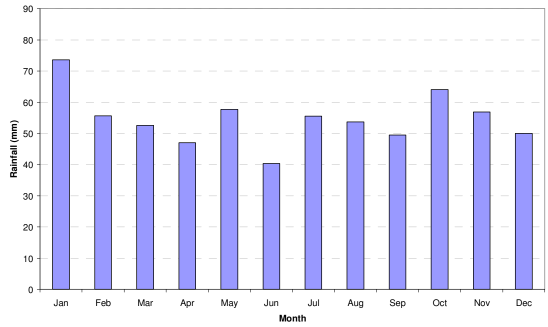


Table 3. Simulation outputs for Parkes region

	FS 2.5	FS 3 4%	FS 3 10%
Ewes shorn	708	707	710
CFW (kg)	3.34	3.42	3.42
FD (µm)	18.69	18.49	18.49
Lambs shorn	552	578	612
CFW (kg)	1.37	1.41	1.40
FD (µm)	19.68	19.46	19.43
Wether lambs sold	276	289	306
LWT (kg)	29.95	30.28	29.97
Fat score	2.3	2.1	2.1
Ewe lambs sold	148	160	177
LWT (kg)	27.4	27.29	26.99
Fat score	2.5	2.2	2.2
Maintenance supplement fed (kg/ha)	55.60	67.09	68.47
Average Gross Margin ($/ha)	130.23	131.71	139.26

Figure 7. Average available a) green and b) dead plus litter pasture (kg/ha) along with the 90 and 10% deciles for the Parkes region (1971 - 2001)

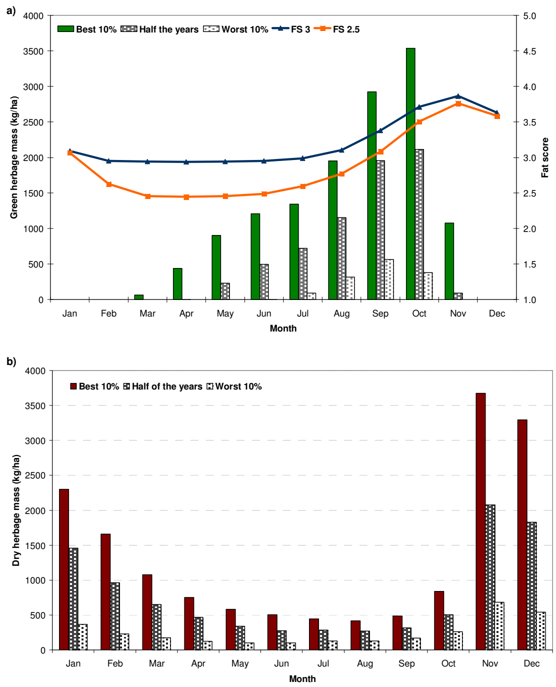


Figure 8. Breakdown of a) average income and b) average costs for the Parkes region for the three fat score profile flocks (1971-2001).

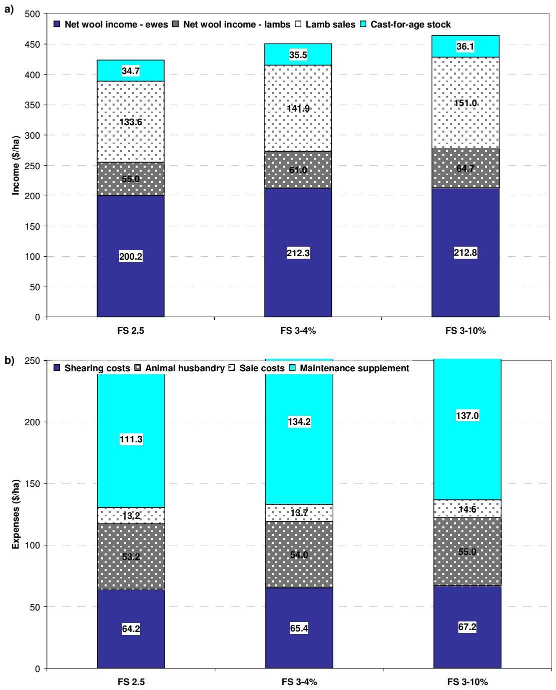


Figure 9. Variation in gross margin (SD and CV%) for the three flocks in the Parkes region.

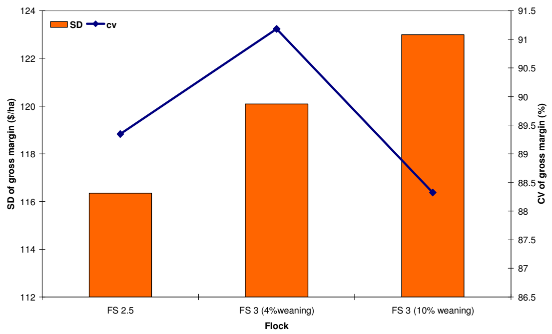


Figure 10. Sensitivity of average gross margin to grain and wool prices for the three flocks in the Parkes region.

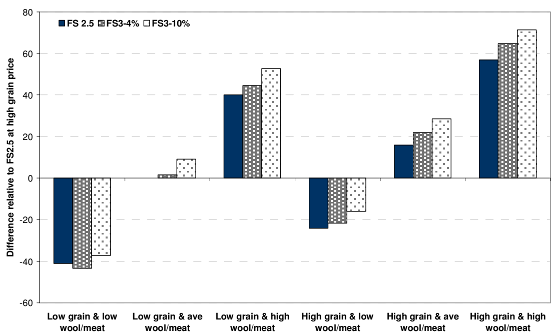


Figure 11. There is a strong inverse relationship between maintenance supplement fed and gross margin.

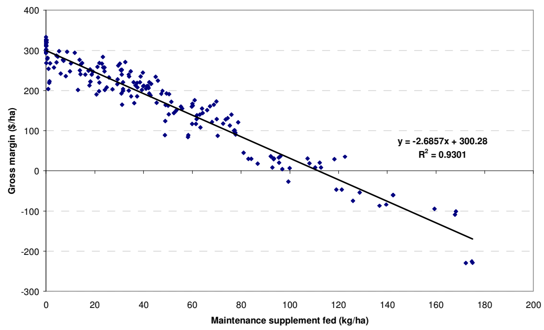


Figure 12. The optimum stocking rates calculated by either a) optimisation or b) gross margin variability were similar for each target fat score profile at Parkes.

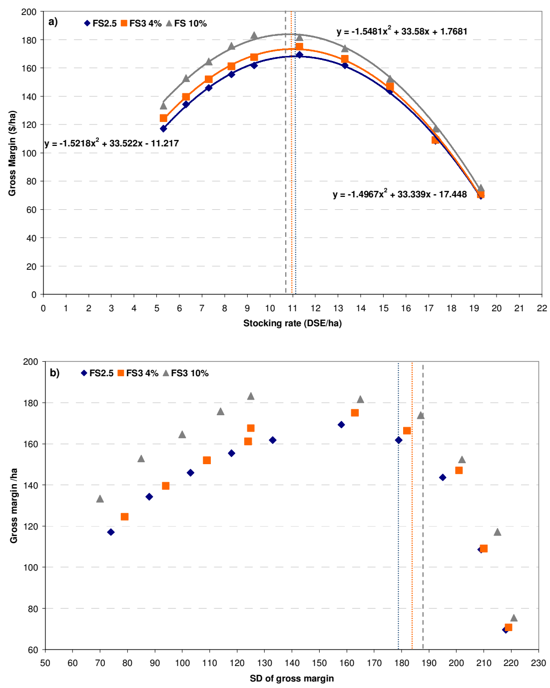
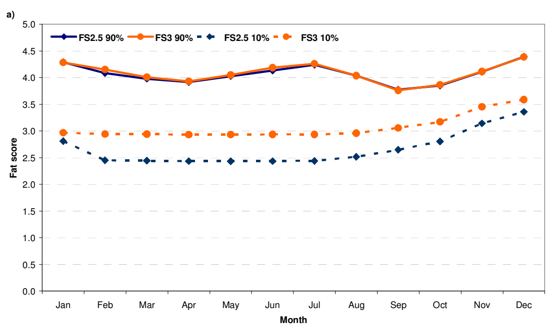
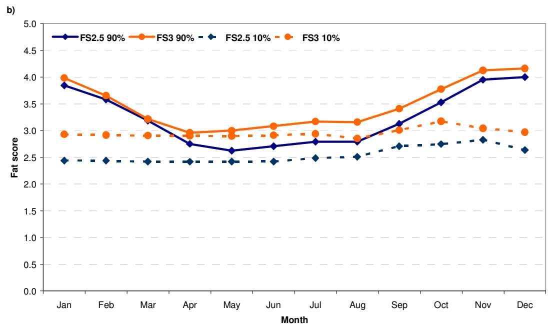


Figure 13. 90 and 10 % deciles for fat score profiles for FS2.5 and FS3 targets for a) Yass and b) Parkes





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Authors' Certification

We, Phil Graham and Sue Hatcher authors of this paper have undertaken the necessary steps for ethical clearance, where necessary, to conduct the research projects that gave origin to the results presented in this paper.

We also certify that this paper has not been published elsewhere before and that submitting it to *AFBM Journal* implies our concession in sharing copyright.

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