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Nutrition guidelines for Maternal Ewes

An estimation using INF coefficients

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Contents

Executive Summary

There has been a demand from industry for nutrition guidelines for Maternal breeds following on from the success of the LifetimeWool (LTW) research programme and the LifeTimeEwe Management (LTEM) extension programme that developed guidelines for nutrition profiles for Merino ewes. It has been hypothesised by people working in the maternal industries that the optimum management for maternal ewes will be different than that required for a merino ewe. This has been backed up by a survey completed by the SheepCRC that showed that many producers didn't believe that the merino guidelines are relevant for their flocks.

There are two main reasons that the merino guidelines will not be correct for maternal breeds. Firstly that the wool produced by merino progeny is more valuable than the wool produced by progeny of maternal breeds. Young *et al.* (2011) showed that about one third of the value of improved management of the nutrition profile of merino ewes occurs through improvements in the value of wool produced by the progeny. Secondly, the progeny of maternal breeds are more resilient and have lower death rates. The argument therefore is that the optimum profile for maternal ewes may include greater weight loss than the profile for merino ewes.

To date there hasn't been a research programme similar to LTW that has been targeted to maternal breeds so there hasn't been a source of the biological relationships required to develop the management guidelines. However, an estimate of these relationships has been made using the ewes being managed in the SheepCRC INF flocks (Paganoni *pers. comm.*). The relationships developed need further corroboration because the nutrition profiles of the ewes in the INF flock were not the result of different nutritional treatments, but rather what was volunteered by the animals in the different regional resource flocks while being managed to follow the nutrition guidelines for merino ewes from the LTEM programme.

The Hamilton version of MIDAS was selected as the modelling tool for this project because it represents the whole flock and it includes a powerful feed budgeting module that optimises animal and pasture management across the whole farm. MIDAS calculates the profitability of the whole flock based on the productivity of each class of stock and commodity prices and the farm carrying capacity calculated in the detailed feed budget. This makes MIDAS an efficient tool to examine different nutrition strategies for a flock.

The optimum profile identified for maternal ewes is:

a. Aim for CS 3 at joining.
b. Maintain weight to mid-pregnancy.
c. Gain weight in late pregnancy.

To achieve these targets it will be necessary for producers to feed more supplement in early pregnancy and at the break of the season, but this will be compensated by the extra carrying capacity and the reduction in competition for feed in the post weaning period. This outcome is linked to running a system with a high level of pasture utilisation and high levels of lamb production. In a system that is pushing productivity there is more competition between ewes and lambs during the post weaning period and therefore having ewes with a low requirement at this time of year is beneficial.

These results also indicate that a potential focus of further research is elucidating improved management for triplet bearing ewes. Currently producers actively manage the ewes so as to reduce the number of ewes conceiving triplets, however, greater certainty about the coefficients may allow a more robust package for triplet management to be developed and this may then allow producers to increase reproduction rates in maternals.

A further aspect of the results that is contrary to the current farmer practice is having single bearing ewes gaining weight in late pregnancy. This is expected to be associated with high levels of dystocia, however, this is not born out in the INF dataset. Therefore, there is an opening to determine if farmer experience is being correctly interpreted and whether feeding ewes in late pregnancy results in bigger lambs and more dystocia. This is important because dystocia sets the upper limit on feeding of ewes during pregnancy.

1. Background

There has been a demand from industry for nutrition guidelines for Maternal breeds following on from the success of the LifetimeWool (LTW) research programme and the LifeTimeEwe Management (LTEM) extension programme that developed guidelines for nutrition profiles for Merino ewes. It has been hypothesised by people working in the maternal industries that the optimum management for maternal ewes will be different than that required for a merino ewe. This has been backed up by a survey completed by the SheepCRC that showed that many producers didn't believe that the merino guidelines are relevant for their flocks.

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To date there hasn't been a research programme similar to LTW that has been targeted to maternal breeds so there hasn't been a source of the biological relationships required to develop the management guidelines. However, an estimate of these relationships has been made using the ewes being managed in the SheepCRC INF flocks (Paganoni *pers. comm.*). The relationships developed need further corroboration because the nutrition profiles of the ewes in the INF flock were not the result of different nutritional treatments, but rather what was volunteered by the animals in the different regional resource flocks while being managed to follow the nutrition guidelines for merino ewes from the LTEM programme.

2. Methods

This analysis was carried out using the Hamilton version of the MIDAS model (Young *et al.* 2011). MIDAS had previously been used to develop nutrition profiles for merino ewes and the Hamilton version was one of the regional versions used for that analysis. The merino analysis showed that the optimum profiles didn't vary greatly between regions, so it was considered sufficient to only include one region in this exploratory analysis and include further regions when improved production relationships are available.

2.1 MIDAS

The Hamilton EverGraze version of MIDAS (Young *et al.* 2004a) has been used to calculate the profitability for a range of nutrition profiles for reproducing ewes in the Hamilton district of Victoria. MIDAS is a computer model used to assess the impact of change in a farming system. It describes the biological relationships of a representative farm. This information is used to estimate the profitability of particular enterprises or management strategies. MIDAS was selected as the modelling tool for the economic component of this project because it represents the whole flock and it includes a powerful feed budgeting module that optimises animal and pasture management across the whole farm. This makes MIDAS an efficient tool to examine different nutrition strategies for a flock.

MIDAS calculates the profitability of the whole flock based on the productivity of each class of stock and commodity prices and the farm carrying capacity calculated in the detailed feed budget. Being an optimizing model it calculates the optimum stocking rate and optimum rate of grain feeding that will maximize profitability while achieving the targets specified for the ewes. The model also accounts for the change in ewe energy requirements that result from increasing lambing percentage and the number of ewes pregnant or lactating with singles, twins or triplets when ewe nutrition is altered. Account is also taken of the weaning weight of singles, twin and triplet born lambs and the amount of feeding required to get each rear class to a saleable weight.

The feed budgeting module in MIDAS is based on the energy requirement and intake capacity equations of the Australian Feeding Standards (SCA 1990), these are also the basis of the GrazFeed model. The feed year is divided into 10 periods and the feed budget is calculated in MJ of ME required per day for each period. With different targets for ewe nutrition the metabolisable energy (ME) requirement for the ewes can vary for each of the 10 periods. The model then calculates whether the most profitable way to achieve the required nutrition for the flock is by adjusting stocking rate, adjusting grain feeding or adjusting the grazing management of pastures and varying the severity of grazing at different times of the year to alter the pasture production profile.

MIDAS is a steady state model, so an implicit assumption is that any management change has been applied for sufficient time for the impact to have permeated the entire flock and that the sheep of one age group must finish the year at the same weight as the next age group started the year. Therefore the optimum profile cannot lose weight over the course of the year.

The supplementary feeding rates identified as the most profitable are much higher than are practiced by farmers. A major part of the reason for the difference is that MIDAS works on an average season and doesn’t consider variation between seasons. To represent this lower profit expectation and reduce the level of supplementary feeding back to commercial reality, the cost of supplement has been artificially increased. The cost added was calculated on a cost of 5.1c/MJ of ME.

2.2 The model farm

The following section outlines the main assumptions underpinning this analysis and the management of the property for the ‘standard’ ewe nutrition strategy.

2.2.1 Land management units

The model represents a ‘typical’ farm in the Hamilton region in south west Victoria. The total area of the farm is 1000ha and is comprised of 3 land management units (LMUs; Table 2.1).

Table 2.1: Description and area of each LMU on the model farm

Land Management Unit	Area (ha)	Description
Ridges	200	Well drained gravely soils at tops of hills.
Mid slopes	600	Moderately drained loams in the mid slopes
Flats	200	Clay soils in lower slopes that are often waterlogged.

2.2.2 Animal production system

The analysis is based on a maternal ewe genotype that is purchased as an 18 month old animal and all ewes are mated to a terminal sire. Lambing is July/August and shearing in March. All offspring are sold as finished lambs in December at 4.5 months of age. The average production for the genotype is outlined in Table 2.2.

All ewes are scanned and separated into groups based on their litter size. Each group can then be offered differential nutrition.

As described previously the feed budget is calculated in MJ of ME per day however, reporting of number of sheep run is done on the basis of DSE/ha. The values in Table 2.2 have been used to convert number of ewes into DSE. The DSE value has not been used to calculate the carrying capacity of the pasture.

Table 2.2: Summary of production assumptions for the sheep flock. The values represent the ewe flock averages (2, 3, 4, 5 and 6 year old) for ewes that are joined at 60kg liveweight and maintained through to lambing.

Standard reference weight (kg)	60
Fleece weight (clean kg/hd)	2.5
Mean fibre diameter (μm)	27
Scanning rate (%)	158
Weaning rate (%)	142

2.2.3 Pasture production

The pasture production is based on a moderately productive perennial ryegrass and sub-clover stand typical of pastures on farms based on top 20% of monitor farm project. This pasture is grown on all land management units.

The growth rate of the pasture has been based on simulations using the GrassGro model with climate data from the Hamilton weather station (Steve Clark *pers comm.*).

2.2.4 Farm management

Table 2.3: Production and management parameters for the 'standard' ewe nutrition profile (Join at 60kg and maintain to lambing).

Profit ($/ha)	358 604
Number of ewes	9 612
Stocking rate (DSE/WG ha)*	19.3
Supplementary feeding (kg/DSE)	18.0
(t)	347
Flock structure	
% ewes	100%
Sale age of CFA ewes	6.5
Buy-in age of young ewes	2
Lambing (%)	142%
Pasture growth (t/ha)	10.5
Pasture utilization (%)	53%
Wool income ($/ha)	13.57
Sale sheep income ($/ha)	49.31

* Stocking rate calculated using DSE ratings as outlined in the Farm Monitor Project, Dec 2001

2.3 Assumptions about progeny production

For this analysis the birth weight, survival and weaning weight of the progeny was adjusted based on the LW profile of the ewes (nutritional strategy). The adjustment was calculated using the coefficients derived from the statistical analysis of the Sheep CRC Information Nucleus Flocks (Beth Paganoni *pers. comm.*). A summary of the coefficients developed and a comparison of the equivalent merino coefficients from the LTW project are in Table 2.4. The coefficients were derived from the maternal live weight and changes in maternal live weight during pregnancy.

Table 2.4 : Coefficients fitted in the statistical model that explains progeny birth weight, survival and weaning weight from Ewe liveweight (LW) at joining (kg) and LW change (kg) during pregnancy and lactation using the Sheep CRC information nucleus flock database (Beth Paganoni *pers. comm.)*.

	Birth Weight (kg)			Survival* (%)			Wean Weight (kg)	
	INF		LTW	INF		LTW	INF	
	Mat.	Merino	Merino	Mat.	Merino	Merino	Mat.	Merino
Constant*	4.07	3.08	3.67	-4.19	-4.66	-9.64	16.31	9.02
Ewe LW - Joining	0.024	0.032	0.027				0.24	
Ewe LW change								
Day 0-90	0.021		0.033				0.259	
Day 90-lambing	0.034		0.045				0.086	
Birth class								
Single	0		0	0		0		
Twin	-1.04		-1.12	-0.41		-0.473		
Triplet	-1.85			-1.1				
Rear class								
11							0	
21							-2.56	
31							-3.46	
22							-4.95	
32							-6.30	
33							-8.31	
Progeny								
Female	0		-0.192	0		0.586	0	
Male	0.28		0	-0.25		0	1.35	
Age of Dam								
2	0						0	
3	0.14						3.45	
4	0.22						2.01	
5	0.21						2.60	
6	0.23						2.00	
Birth weight				2.44		4.32		
(Birth weight)^2				-0.21		-0.395		

* Constant is value fitted for the genotypes and management evaluated in the experimental flocks. For this analysis the constant has been replaced by values calculated in the MIDAS simulation model

** Equation for survival: Survival = 100 / (1 + EXP(-y)) where y = value predicted using above coefficients.

The INF & LTW coefficients that predict the impact of maternal liveweight and liveweight change on lamb birth weight are similar. The LifetimeWool coefficients are slightly larger, but for a typical merino profile the difference in the predictions is only 39g in BW and for the recommended merino profile the difference is only 3g in BW.

A comparison of the survival coefficients shows that the relationship developed from the INF is much less responsive to birth weight than the equivalent LTW relationship (Figure 2.1). Furthermore, this LTW relationship was adjusted because the observation in the paddock scale experiment was that the relationship from the small plot trial didn't explain the variation observed in the field. However, there is no equivalent on-farm component for the INF dataset to compare this effect in maternals to that in merinos.

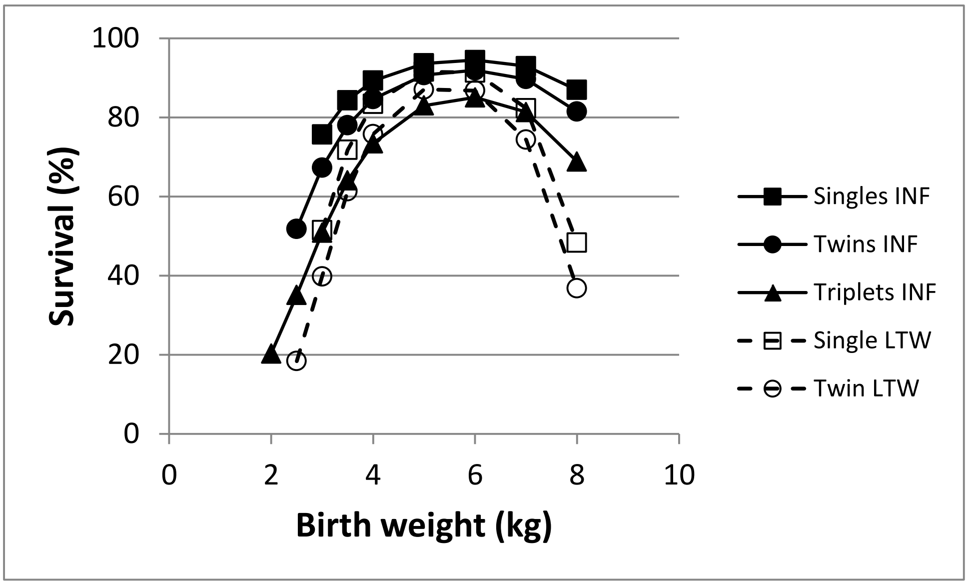

Figure 2.1: Relationship between birth weight and survival for single born (square), twin born (circle) and triplet born (triangle) lambs for Maternal breeds (solid symbols) and Merinos (open symbols).

A sensitivity analysis was carried out by varying the magnitude of a subset of the coefficients as outlined in table 2.5.

Table 2.5: Sensitivity analysis carried out on the coefficients from the statistical analysis.

Coefficient	Standard value	Sensitivity range
Birth weight		
Constant	4.07	-40%
Ewe LW Joining	0.024	0%, 150%
Ewe LW Change Join – D90	0.021	0%, 150%
D90-Lamb	0.034	0%, 150%
Weaning weight		
Ewe LW Joining	0.24	0%, 150%
Ewe LW Change Join – D90	0.259	0%, 150%
D90-Lamb	0.086	0%, 150%, 300%
Conception (Scanning %)		
Ewe LW Joining	3%	0%

The scenario was examined in which it was assumed that there was no effect of ewe LW profile on ;amb birth weight, survival or weaning weight and no effect of ewe LW at joining on the number of lambs conceived. In this scenario the impact of ewe nutrition profile are all due to the feed budget because productivity per head is not changing.

Other scenarios were examined where the coefficients were increased to levels similar to those measured in the LifeTimeWool research project.

2.4 The liveweight profiles

24 different LW profiles have been evaluated in this analysis for the dry, single, twin and triplet bearing ewes. Two of the 24 patterns evaluated for the drys differ from the equivalent pattern evaluated for the reproducing ewes during late pregnancy. The profiles examined vary in the amount of liveweight lost from joining through to mid pregnancy and then the amount of liveweight change from mid pregnancy to lambing (Figure 2.2). There are 3 alternate rates of liveweight loss to mid pregnancy (no loss, lose 3kg and lose 6kg) and 4 levels of liveweight change to lambing. For the

reproducing ewes the 4 levels are gain 6kg, gain 3 kg, maintain and lose 3kg. For the dry ewes the 4 levels are gain 3 kg, maintain, lose 3kg and lose 6kg.

The standard nutrition strategy is the pattern with ewes being mated at 60kg (CS 3) and maintaining condition through to lambing. The selection of this pattern as the standard doesn't alter the results of the analysis; it simply becomes the pattern that is not altered during the sensitivity analysis on the magnitude of the nutrition impacts.

The selection of the 24 patterns allows comparison of the effects on profitability of varying condition at joining, varying rate of loss of condition after joining and the rate of gain in condition prior to lambing. Each nutrition strategy examined has a similar pattern that varies in one of the above factors. This pairing of patterns allows the cost or benefit of varying the CS targets of ewes at different times of the reproductive cycle.

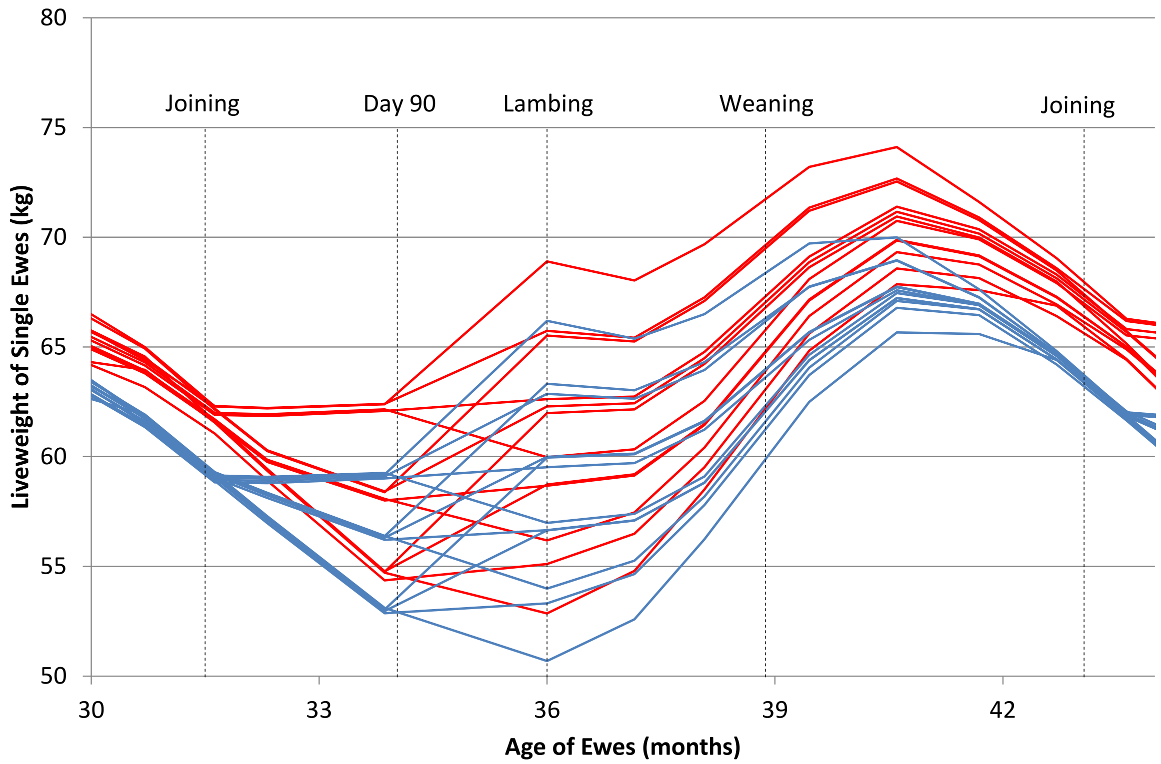

Figure 2.2: The 24 nutrition profiles examined in MIDAS.

For each profile the energy demands and the resulting production of the ewes was simulated using the MIDAS simulation spreadsheet. The production levels of the progeny were adjusted as described in the previous section. Table 2.6 outlines the calculated energy demand of the ewes for the different periods and the estimated change in ewe and progeny production for each of the different profiles.

Starting and finishing at a lower condition requires less energy for the entire year. Comparing the 'Join at 60kg, maintain to lambing' with 'Join at 63kg, maintain to lambing' the lower LW pattern requires 0.42MJ/d, 0.45MJ/d, 0.81MJ/d and 0.47MJ/d less during the periods joining to day 90, day

90 to lambing, lambing to weaning and weaning to next joining respectively. This is a reduction in the total energy requirement of 192MJ for the year.

Losing condition after joining reduces the energy requirement during that period but increases it in a later period depending on when the condition is regained (either before lambing or from lambing to next joining). Losing 3kg and regaining it before lambing requires approximately 37MJ more energy than maintaining weight through the entire period because of the metabolic inefficiency of losing and then gaining condition – that is, gaining weight requires more energy than losing weight generates. However, losing 3 kg and not regaining it until after lambing requires approximately 49MJ less energy than maintaining through to lambing. This reduction in energy requirement is because the inefficiency described above is outweighed by the saving in maintenance requirement because the animal is lighter for an extended period.

Starting and finishing at a lower (or higher) CS also affects ewe wool production, number of lambs conceived and progeny survival. Ewe wool cut and fibre diameter is closely correlated to energy intake so nutrition targets that require more energy produce more wool that is broader and the number of lambs conceived is proportional to condition at joining.

Progeny birth weight, survival and weaning weight are closely related to condition of the ewes at lambing, the higher the condition the higher the production. Each of these progeny measures are fine-tuned depending on whether condition was lost and then regained from joining to lambing or maintained throughout (see Table 2.6).

Table 2.6: ME required by single bearing ewes through the reproductive cycle to follow each of the 24 different profiles and average production of 2 to 5yo ewes and their progeny for each profile.

LW profile			ME Intake				Reproduction & survival			
Join Wt (kg)	Join-D90 (kg)	D90-Lamb (kg)	Join-D90 (MJ/d)	D90-Lamb (MJ/d)	Lamb-Wean (MJ/d)	Wean-Join (MJ/d)	Scan %	BW/Surv Single (kg/%)	BW/Surv Twins (kg/%)	BW/Surv Triplets (kg/%)
63	0	+6	11.1	18.3	22.7	12.7	164.9	6.1 / 94.4	5.0 / 76.4	4.2 / 76.4
		+3	11.0	16.0	22.8	12.9	164.5	6.0 / 94.4	4.9 / 75.0	4.1 / 75.0
		0	10.8	13.6	22.8	13.3	163.3	5.9 / 94.5	4.8 / 73.6	4.0 / 73.6
		-3	10.7	12.2	22.9	13.7	162.5	5.8 / 94.5	4.8 / 72.3	3.9 / 72.3
	-3	+6	9.5	18.3	22.8	12.9	163.2	6.0 / 94.4	5.0 / 75.6	4.2 / 75.6
		+3	9.3	15.9	22.8	13.3	163.0	5.9 / 94.5	4.9 / 74.1	4.1 / 74.1
		0	9.1	13.2	22.9	13.7	160.7	5.8 / 94.5	4.8 / 72.4	3.9 / 72.4
		-3	9.0	11.8	23.7	13.7	160.5	5.7 / 94.4	4.7 / 71.1	3.9 / 71.1
	-6	+6	8.2	17.9	22.8	13.3	161.3	5.9 / 94.5	4.9 / 74.6	4.1 / 74.6
		+3	8.0	15.5	22.9	13.7	160.8	5.8 / 94.5	4.8 / 73.0	4.0 / 73.0
		0	7.9	12.7	23.7	13.7	158.8	5.7 / 94.4	4.7 / 71.2	3.9 / 71.2
		-3	7.8	11.3	24.3	13.9	159.1	5.6 / 94.4	4.6 / 69.8	3.8 / 69.8
60	0	+6	10.7	18.3	21.9	11.9	152.2	6.0 / 94.4	5.0 / 75.7	4.2 / 75.7
		+3	10.6	15.9	22.0	12.4	152.0	5.9 / 94.5	4.9 / 74.2	4.1 / 74.2
		0	10.4	13.2	22.0	12.8	151.7	5.8 / 94.5	4.8 / 72.6	4.0 / 72.6
		-3	10.3	11.8	22.2	13.4	152.1	5.7 / 94.4	4.7 / 71.2	3.9 / 71.2
	-3	+6	9.5	17.9	21.9	12.3	152.4	6.0 / 94.5	4.9 / 74.9	4.1 / 74.9
		+3	9.4	15.5	22.0	12.8	152.0	5.8 / 94.5	4.8 / 73.3	4.0 / 73.3
		0	9.2	12.7	22.2	13.4	151.6	5.7 / 94.5	4.7 / 71.6	3.9 / 71.6
		-3	9.1	11.3	23.4	13.5	151.8	5.7 / 94.4	4.6 / 70.1	3.8 / 70.1
	-6	+6	8.2	17.4	22.0	12.8	151.8	5.9 / 94.5	4.9 / 73.9	4.0 / 73.9
		+3	8.0	15.0	22.2	13.4	151.6	5.8 / 94.5	4.7 / 72.2	3.9 / 72.2
		0	7.8	12.2	23.5	13.5	151.0	5.7 / 94.4	4.6 / 70.4	3.8 / 70.4
		-3	7.7	10.9	24.0	13.7	151.5	5.6 / 94.4	4.5 / 68.8	3.7 / 68.8

2.5 Standard Prices, Production and Sensitivity Analysis

Compared to the model used for the Merino analysis there have been changes in prices for this analysis based on improvements in the price of meat (see Table 2.6).

A range of meat price scenarios have been examined in this analysis in order to test the robustness of the optimal ewe LW targets (Table 2.7). Future prices are uncertain and therefore decisions made about LW targets for ewes will be made allowing for the range of prices that may be received.

Table 2.7: Standard price and production levels assumed in this analysis and the range of meat prices examined in the sensitivity analysis.

	Standard	Sensitivity Levels
Prices		
Wool Price		
(c/kg cln sweep the board)		
30µ	600	
Meat Price		
Lamb *($/kg DW)*	4.70	
Ewe Hgt *($/hd net)*	95	+/-33%
CFA Ewe *($/hd net)*	85	
Grain Price		
($/t fed out)		
Oats	240	
Lupins	300	
Time of Lambing	19 Jul-22Aug	
Pasture Production *(t/ha)*	10.4	

2.6 The Analysis

24 different LW patterns were evaluated for each of the Litter size groups (Dry, Single, Twin and Triplets). It was not computationally possible to evaluate all the combinations of LW patterns for the 4 groups so an alternative was selected based on the expectation that the optimum profile for one litter size group will be unaffected by the nutrition offered to the other litter size groups. This assumption was based on the results of the Pregnancy Scanning analysis carried out by the Sheep CRC (Young *unpub*).

To reduce the amount of computation required only a subset of options were examined and for each set of runs the nutrition profile of 3 of the 4 litter size classes was help constant while all 24 options were tested for the 4th class. The initial profiles for the single, twin & triplet bearing ewes were based on the optimum profiles for merino ewes identified in the LifetimeWool analysis. Having identified the most profitable of the 24 options for the dry ewes, this class was fixed with that nutrition profile and the single bearing ewes were tested with all 24 different profile. This process was continued for the twins and triplet bearing ewes. To give a total of 96 different profile options being examined.

3. Results and Discussion

3.1 The Optimum nutrition targets

The optimum profile for maternal ewes is to mate at about CS 3 (60kg) and maintain the ewes through early pregnancy and then gain weight if possible in late pregnancy on green feed (Table 3.1). This is similar to the optimum merino profile identified in the LifeTimeWool analysis except that for merinos it is optimal to allow slow weight loss in early pregnancy. The optimum profile for maternal ewes is determined mostly by the feed budget with the optimum profile being unchanged if the impacts of profile on conception, birth weight, survival and weaning weight are all turned off.

Table 3.1: Profit per hectare, difference from the profit of the optimum profile (expressed in $ per ewe), stocking rate and level of grain feeding for the 96 combinations of nutrition profiles examined. The most profitable LW profile for each litter size class is highlighted in bold for each scenario.

Litter size class	Join-D90 (kg)	D90-Lamb (kg)	Profit ($/ha)	Profit (Δ$/ewe)	S.R. (DSE/ha)	Supplement (kg/DSE)	Supplement (t)
Join 63kg, Single, Twin & Triplet LTW							
Dry	0	+6	282	-10.1	18.6	26.6	497
Dry	0	+3	282	-10.2	18.5	26.8	497
Dry	0	0	284	-9.9	18.6	26.6	498
Dry	0	-3	281	-10.2	18.6	26.7	499
Dry	-3	+6	215	-16.8	19.1	29.1	557
Dry	-3	+3	220	-16.3	19.0	29.2	558
Dry	-3	0	217	-16.6	19.0	29.3	559
Dry	-3	-3	216	-16.8	19.0	29.3	559
Dry	-6	+6	54	-31.3	20.4	35.9	738
Dry	-6	+3	46	-32.2	20.4	37.1	758
Dry	-6	0	42	-32.5	20.4	37.1	761
Dry	-6	-3	41	-32.6	20.4	37.2	763
Join 60kg, Single, Twin & Triplet LTW							
Dry	0	+6	320	-5.7	19.6	22.1	435
Dry	**0**	**+3**	**335**	**-4.2**	**19.6**	**21.3**	**419**
Dry	0	0	327	-5.0	19.6	21.8	430
Dry	0	-3	321	-5.6	19.6	22.1	435
Dry	-3	+6	243	-13.7	19.2	24.2	467
Dry	-3	+3	253	-12.8	19.2	23.9	460
Dry	-3	0	245	-13.5	19.2	24.3	468
Dry	-3	-3	243	-13.7	19.2	24.3	469
Dry	-6	+6	92	-27.2	20.6	31.1	644
Dry	-6	+3	106	-26.0	20.5	30.9	638
Dry	-6	0	101	-26.4	20.6	31.1	643
Dry	-6	-3	97	-26.8	20.6	31.2	645
Join 63kg, Dry Optimum, Twin & Triplet LTW							
Single	0	+6	292	-9.2	18.3	25.9	475
Single	0	+3	284	-9.9	18.6	26.6	498
Single	0	0	248	-15.0	17.1	26.3	452
Single	0	-3	209	-19.5	17.1	28.3	486
Single	-3	+6	256	-12.9	18.6	27.0	506
Single	-3	+3	220	-16.3	19.0	29.2	558
Single	-3	0	176	-20.8	19.1	31.1	597
Single	-3	-3	158	-22.5	19.3	31.8	616
Single	-6	+6	149	-22.5	20.0	31.5	634

Single	-6	+3	54	-31.3	20.4	35.9	738
Single	-6	0	29	-33.1	20.8	36.5	761
Single	-6	-3	18	-34.0	20.9	36.9	774
Join 60kg, Dry Optimum, Twin & Triplet LTW							
Single	**0**	**+6**	**375**	**-0.1**	**18.8**	**18.1**	**342**
Single	0	+3	335	-4.2	19.6	21.3	419
Single	0	0	282	-9.3	20.0	24.3	490
Single	0	-3	246	-14.4	17.8	23.1	415
Single	-3	+6	291	-8.2	20.4	23.7	486
Single	-3	+3	253	-12.8	19.2	23.9	460
Single	-3	0	205	-17.6	19.2	26.0	502
Single	-3	-3	192	-18.9	19.2	26.4	510
Single	-6	+6	212	-15.9	20.4	26.1	535
Single	-6	+3	106	-26.0	20.5	30.9	638
Single	-6	0	71	-28.9	20.8	32.2	673
Single	-6	-3	47	-30.8	21.0	32.8	692
Join 63kg, Dry & Single Optimum, Triplet LTW							
Twin	0	+6	226	-21.6	13.8	22.4	312
Twin	0	+3	292	-9.2	18.3	25.9	475
Twin	0	0	244	-15.3	17.2	26.4	456
Twin	0	-3	201	-20.2	17.2	28.1	487
Twin	-3	+6	205	-23.5	14.6	24.2	355
Twin	-3	+3	256	-12.9	18.6	27.0	506
Twin	-3	0	195	-18.7	19.2	29.8	575
Twin	-3	-3	173	-20.8	19.5	30.7	600
Twin	-6	+6	179	-21.9	18.0	28.9	521
Twin	-6	+3	149	-22.5	20.0	31.5	634
Twin	-6	0	125	-24.2	20.6	32.1	665
Twin	-6	-3	109	-25.4	20.9	31.9	669
Join 60kg, Dry & Single Optimum, Triplet LTW							
Twin	0	+6	302	-10.5	14.0	13.1	184
Twin	**0**	**+3**	**375**	**-0.1**	**18.8**	**18.1**	**342**
Twin	0	0	329	-4.7	19.8	21.4	427
Twin	0	-3	293	-8.3	19.9	22.8	455
Twin	-3	+6	262	-14.3	15.9	19.2	306
Twin	-3	+3	291	-8.2	20.4	23.7	486
Twin	-3	0	250	-13.0	19.1	23.4	449
Twin	-3	-3	237	-14.3	19.3	23.6	457
Twin	-6	+6	239	-14.1	19.3	24.3	470
Twin	-6	+3	212	-15.9	20.4	26.1	535
Twin	-6	0	198	-16.8	20.9	26.2	552
Twin	-6	-3	185	-17.9	21.1	26.0	551
Join 63kg, Dry, Single & Twin Optimum							
Triplet	0	+6	292	-9.3	18.2	25.9	472
Triplet	0	+3	292	-9.2	18.3	25.9	475
Triplet	0	0	292	-9.2	18.4	26.0	480
Triplet	0	-3	292	-9.2	18.5	25.9	481
Triplet	-3	+6	256	-12.9	18.5	27.0	503
Triplet	-3	+3	256	-12.9	18.6	27.0	506
Triplet	-3	0	257	-12.8	18.7	27.0	507
Triplet	-3	-3	257	-12.7	18.8	26.9	508
Triplet	-6	+6	169	-23.6	17.5	28.9	507
Triplet	-6	+3	179	-21.9	18.0	28.9	521
Triplet	-6	0	190	-20.0	18.5	28.8	536

Triplet	-6	-3	196	-19.1	18.8	28.7	544
Join 60kg, Dry, Single & Twin Optimum							
Triplet	0	+6	374	-0.3	18.7	18.1	339
Triplet	0	+3	375	-0.1	18.8	18.1	342
Triplet	0	0	376	0.0	18.9	18.2	346
Triplet	**0**	**-3**	**377**	**0.0**	**19.0**	**18.2**	**347**
Triplet	-3	+6	292	-8.2	20.3	23.6	483
Triplet	-3	+3	291	-8.2	20.4	23.7	486
Triplet	-3	0	292	-8.2	20.5	23.7	488
Triplet	-3	-3	292	-8.2	20.5	23.7	489
Triplet	-6	+6	234	-14.8	19.0	24.3	464
Triplet	-6	+3	239	-14.1	19.3	24.3	470
Triplet	-6	0	246	-13.1	19.6	24.3	478
Triplet	-6	-3	248	-12.9	19.7	24.2	480

The reason against weight loss in early pregnancy and for weight gain in late pregnancy is associated with the amount of energy required post-weaning in late spring and summer to get the ewes back to the joining targets. This result is different to the on-farm experience where producers report that the maternal ewes easily gain condition post weaning. However, there are major differences in the grazing intensity on the MIDAS farm compared with the majority of maternal producers.

The MIDAS analysis is indicating that lamb producers would be able to increase profit if they increased their stock numbers and altered their nutrition targets to have ewes following a flatter weight profile. This profile requires more supplementary grain feeding during pregnancy but then means less feed is required for the ewe component of the flock post weaning and this feed is available to more cheaply add weight onto the lambs.

After scanning when the ewes are divided into litter size classes, it is optimal to have the single and twin bearing ewes gaining as much weight as is possible on the pasture available. The calculations indicated that the triplet bearing ewes would be allowed to lose some weight in late pregnancy whereas the dry ewes would also be gaining weight. This is an unexpected result and occurs because triplet born animals have a low value because of their low weaning weight and therefore they are a low priority for feed, however, this conclusion is based on having no value on the animal welfare outcome.

Managing the nutrition of the single and twin bearing ewes is having the largest impact on the profitability of the farm. Altering the management of the triplet bearing ewes has little impact because there are very few triplet bearing ewes on the farm.

3.3 Cost of missing weight targets

If the target condition score profiles are not achieved then profit is reduced. Figures 3.1, 3.2 & 3.3 show the reduction in profit if the ewe condition targets are not achieved because too much weight is lost or not put back on. These values provide some insight into the importance of achieving the different LW targets.

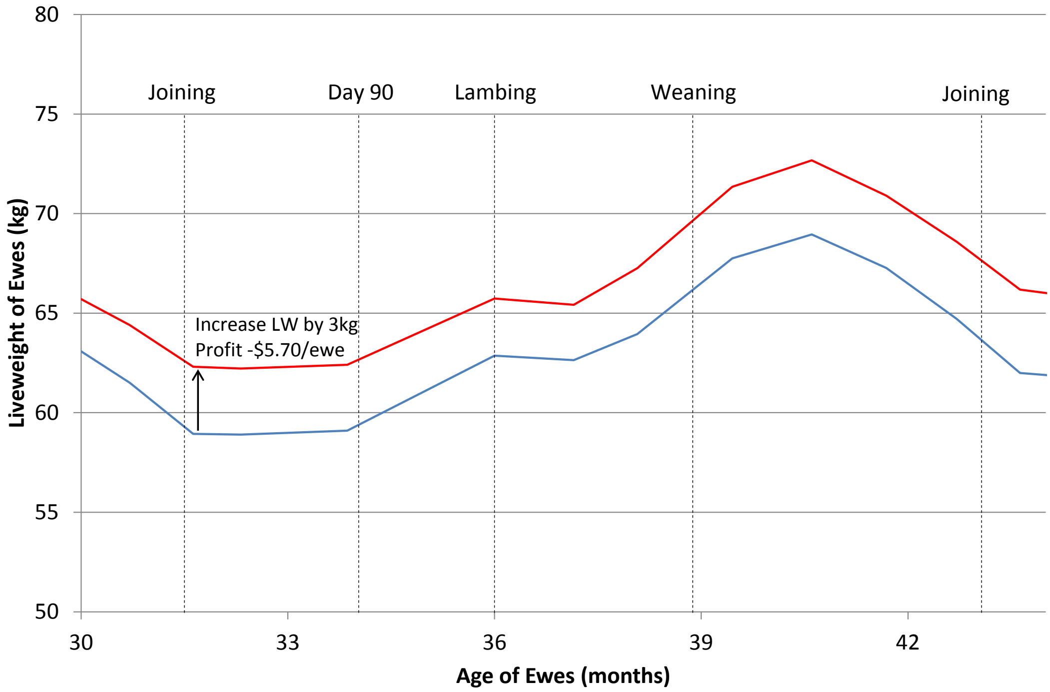

Figure 3.1: Change in value of profit if a sub-optimal profile is followed that maintains ewes in higher condition all year.

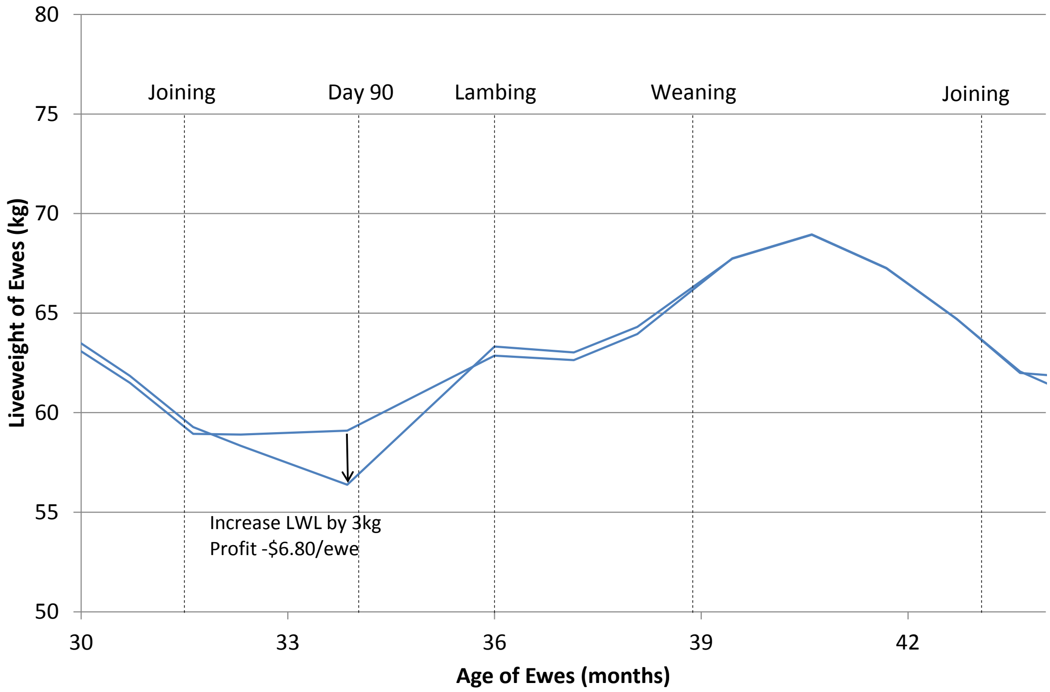

Figure 3.2: Change in profit if a sub-optimal profile is followed that is lower at the minimum in mid pregnancy.

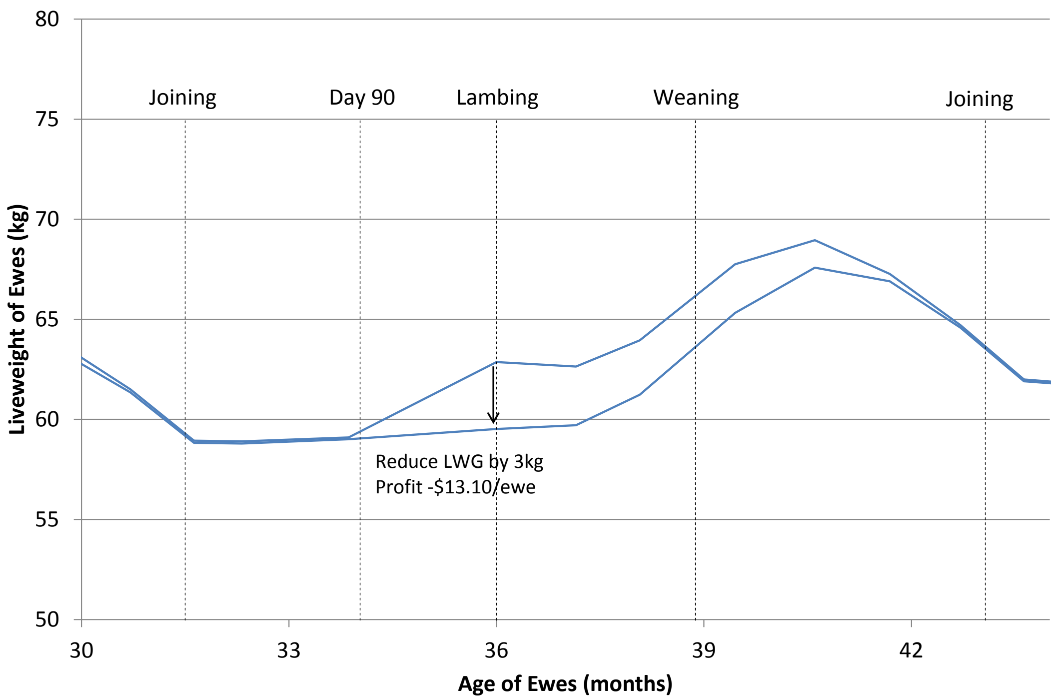

Figure 3.3: Change in profit if a sub-optimal profile is followed that produces leaner ewes at lambing.

Achieving the weight gain in late pregnancy ($13/ewe to gain 3kg) is the highest priority of the joining and pregnancy targets (Figure 3.1, 3.2 and 3.3), however, it is also the most difficult to achieve in a field situation. The practical implication is to achieve the maximum weight gain that can be achieved on green feed, up to the level at which dystocia will become a problem.

The joining and mid pregnancy targets are a lower value at $5.70 and $6.80 per ewe from being 3kg heavier at joining or 3kg lighter in mid pregnancy.

3.3 Sensitivity Analysis

The profitability of the 24 different patterns was examined over a range of meat price +/- 33%. Varying the meat price had a large effect on profit and on optimum stocking rate, however, the optimum nutrition profile for the ewes was not changed. This is consistent with the LifeTimeWool analysis that showed that the optimum profile was very robust to changing market conditions.

Sensitivity analysis on the coefficients used in the analysis also showed very little impact on the optimum profile. This is because the optimum profile with the standard coefficients is being determined from the feed budget and the profile results in high per head production. Therefore increasing the magnitude of the coefficients doesn't lead to a higher productivity pattern because the nutrition level is already high during that period of the year.

Conclusions

The optimum profile identified for maternal ewes is:

d. Aim for CS 3 at joining.
e. Maintain weight to mid-pregnancy.
f. Gain weight in late pregnancy.

To achieve these targets it will be necessary for producers to feed more supplement in early pregnancy and at the break of the season, but this will be compensated by the extra carrying capacity and the reduction in competition for feed in the post weaning period. This outcome is linked to running a system with a high level of pasture utilisation and high levels of lamb production. In a system that is pushing productivity there is more competition between ewes and lambs during the post weaning period and therefore having ewes with a low requirement at this time of year is beneficial.

These results also indicate that a potential focus of further research is elucidating improved management for triplet bearing ewes. Currently producers actively manage the ewes so as to reduce the number of ewes conceiving triplets, however, greater certainty about the coefficients may allow a more robust package for triplet management to be developed and this may then allow producers to increase reproduction rates in maternals.

A further aspect of the results that is contrary to the current farmer practice is having single bearing ewes gaining weight in late pregnancy. This is expected to be associated with high levels of dystocia, however, this is not born out in the INF dataset. Therefore, there is an opening to determine if farmer experience is being correctly interpreted and whether feeding ewes in late pregnancy results in bigger lambs and more dystocia. This is important because dystocia sets the upper limit on feeding of ewes during pregnancy.

4. References

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