lifetimewool

more lambs, better wool, healthy ewes

Implications of Lifetimewool for On-farm Management in the Great Southern of WA

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Executive Summary

The Lifetimewool project (EC298) is a flagship project for AWI and aims to determine the optimal allocation of feed resources and then develop profitable ewe management guidelines for woolgrowers across Australia. The project has included a phase of plot scale research with progeny being born in 2001, 2002 and 2003. This was followed by a paddock scale phase which tested the robustness of the findings from the plot scale trials.

These trials have shown that managing ewes condition score through the reproductive cycle results in;

a. Increased lamb/weaner survival and weaning percentages
b. Increased progeny fleece weight and decreased fibre diameter.
c. Improved ewe health and survival
d. Increased ewe wool production and tensile strength
e. Improved ewe reproduction

The role of the farm modelling component in this project was to:

a. Quantify the value to producers of the information generated in this project.
b. Identify optimum CS targets for producers in five regions in Australia.

Altering the target condition score profile of ewes impacts on wholefarm profitability through a combination of four mechanisms:

a. Impacts on the future production of the surviving progeny
b. Variation in the survival rate of the lambs born
c. Varying production achieved from the ewes including CFW, FD and number of lambs conceived.
d. Varying energy demands of ewes which results in changes in stocking rate and grain feeding

The statistical analysis carried out on the results from the small plot trials has quantified the relationship between the ewe condition at different times in the reproductive cycle and the first 3 of these mechanisms. These biological relationships have been used to quantify the effects of a range of different condition score targets on flock productivity. Quantitative feed budgeting with MIDAS has been used to examine the impacts on stocking rate and supplementary feeding. Combining the flock productivity and the feed budgeting allows the impacts on wholefarm profit to be examined.

This report describes the analysis carried out addressing the above goals and reports on optimum CS targets for producers in the Great Southern region of WA.

The Great Southern version of MIDAS was selected as the modelling tool for this economic component of the 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 is a computer model used to assess the impact of change in a farming system. It describes the biological relationships of a representative farm and 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 changes in flock structure and the change in ewe energy requirements that result from increasing lambing percentage and the number of ewes pregnant or lactating with singles or twins when ewe nutrition is altered.

Including the biology that has been quantified as part of the Lifetimewool project in economic analyses, alters the outcome about the most profitable nutrition strategy for spring lambing ewes but not for autumn lambing ewes. For spring lambing flocks the optimum profile identified when including the progeny effects is between $10 000 and $15 000 more profitable than the profile that was thought to be optimal without Lifetimewool. This range in value for the Lifetimewool information is related to the range of values examined for the increase in progeny survival achieved from ewes that follow an improved nutrition profile. The optimum profile is robust and the only impact of altering prices or production was on the target at joining, the pattern of condition change during gestation wasn't affected.

The optimum profile for autumn lambing flocks is unchanged by inclusion of the Lifetimewool effects. This is because there are only limited opportunities to adjust the ewe profiles other than by using grain feeding and grain feeding is more costly than the benefits received from improved survival and production from the progeny.

For the spring lambing flocks the benefits from the improved ewe nutrition profiles identified in this analysis are similar to the benefits that producers can achieve from increasing stocking rates by 1 DSE/ha. This indicates that producers adopting the Lifetimewool findings should do it as part of a package aimed at achieving high rates of pasture utilisation.

The optimum profile for spring lambing flocks in the Great Southern region in WA is:

a. to allow moderate loss of condition from joining to day 90, provided the condition can be regained prior to lambing
b. aim for CS2.6 or above at joining

To achieve these targets it will be necessary for producers to increase their rate of supplementary feeding by about 10%. The grain should be targeted at the period after joining to reduce the rate of loss of condition and also to achieve deferment of pasture at the break of season to allow gain in condition on green feed.

The most important target is regaining before lambing any condition that was lost between joining and day 90. Meeting this target increases profit by $11/ewe/CS. This is more than the benefit of allowing animals to lose condition up to day 90 (approx $6/CS/ewe). Therefore, if condition cannot be regained on green feed during the period day 90 to lambing then it will be more profitable to maintain condition from joining to lambing.

The optimum profile for the autumn lambing flocks is:

a. to allow moderate loss of condition from joining to day 90 and then maintenance of condition through to lambing and then regain the condition after lambing.
b. aim for CS2.6 or above at joining

It is not profitable for producers to aim to regain condition prior to lambing because the cost of feeding is greater than the increase in the production achieved.

1. Introduction

The Lifetimewool project (EC298) is a flagship project for AWI and aims to determine the optimal allocation of feed resources and then develop profitable ewe management guidelines for woolgrowers across Australia. The project has included a phase of plot scale research with progeny being born in 2001, 2002 and 2003. This phase allowed very tight control of the nutrition of the ewes and has resulted in relationships between ewe condition score at different times of the year and the clean fleece weight, fibre diameter and survival of the progeny of these ewes. The second phase was paddock scale trials that included larger numbers of ewes but with less control of the condition score targets. This phase tested the robustness of the findings in the plot scale trials.

These trials have shown that managing ewes condition score through the reproductive cycle results in;

a. Increased lamb/weaner survival and weaning percentages
b. Increased progeny fleece weight and decreased fibre diameter.
c. Improved ewe health and survival
d. Increased ewe wool production and tensile strength
e. Improved ewe reproduction

An initial analysis (Young *et al*., 2004) showed that actively managing ewes' condition can have large positive effects on the profitability of the wool producing enterprise. It can also improve pasture utilisation and stocking rates without detrimentally impacting on ewe and progeny performance.

Altering the target condition score profile of ewes' impacts on wholefarm profitability through a combination of four mechanisms:

a. Impacts on the future production of the surviving progeny
b. Variation in the survival rate of the lambs born
c. Varying production achieved from the ewes including CFW, FD and number of lambs conceived.
d. Varying energy demands of ewes which results in changes in stocking rate and grain feeding

The statistical analysis carried out on the results from the small plot trials has concentrated on developing statistical models that quantify the relationship between the ewe condition at different times in the reproductive cycle and the first 3 of these mechanisms. These biological relationships can then be used to quantify the effects of a range of different condition score targets on flock productivity. Feed budgeting allows the impacts on stocking rate and supplementary feeding to be calculated. Then combining the flock productivity and the feed budgeting allows the impacts on wholefarm profit to be examined.

The role of the farm modelling component in this project was to:

a. Quantify the value to producers of the information generated in this project.
b. Identify optimum CS targets for producers in five regions in Australia.

This is report describes the MIDAS analysis carried out addressing the above goals and reports on optimum CS targets for the Great Southern region of WA.

2. Methods

2.1 MIDAS

The Great Southern version of MIDAS (Young 1995) has been used to calculate the profitability for a range of nutrition profiles for reproducing ewes in the Great Southern region of WA. 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 changes in flock structure and the change in ewe energy requirements that result from increasing lambing percentage and the number of ewes pregnant or lactating with singles or twins when ewe nutrition is altered.

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 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. This is important in this analysis because altering the ewe nutrition strategy will take a number of years before the impacts on progeny wool production will have worked through the entire flock. A full investment analysis would account for the interest cost of money and discount the future benefits achieved from altering ewe nutrition now, however, this is not possible within the MIDAS framework and hasn't been included in this analysis. The discounting, has however, been included in the decision tools being developed to complement the MIDAS analysis.

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. Further detail is presented in Appendix 1.

2.2.1 Land management units

The model represents a 'typical' farm in the Great Southern region of Western Australia. The total area of the farm is 1000ha and is comprised of 5 land management units (LMUs) (Table 2.1). The pasture production profile varies on each LMU.

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

Land Management Unit	Area (ha)	Description	Past. Growth (% of S4)
S1 - Saline Soils	100	Shallow saline sands over heavy gleyed or mottled clay.	55
S2 - Waterlogged soils	150	Deep sands often waterlogged over grey gleyed clay.	85
S3 - Deep Sands	50	Deep sands but not waterlogged over mottled clay.	90
S4 - Sandy Gravels	500	Gravels and sandy gravels to 50cm over clay or gravelly clay.	100
S5 - Sandy Loams	200	Sandy loam, loamy sand over clay. Rock outcropping in landscape.	105

2.2.2 Animal production system

The analysis is based on a self replacing merino wool producing flock utilising a medium wool ram source. Surplus ewes and all wethers are sold as hoggets off shears at 1.5 years old. Details on the productivity of the flock are in Appendix 1. A spring lambing and an autumn lambing system have been compared. The feed profile is quite different for each time of lambing so the ewe nutrition profiles compared are quite different (see section 2.4).

Table 2.2: Summary of production assumptions for the sheep flock. The values represent the ewe flock averages (2, 3, 4 and 5 year old).

Standard reference liveweight (kg)	50
Fleece weight (clean kg/hd)	3.0
Mean fibre diameter (μm)	20.0
Weaning rate (%)	87

2.2.3 Pasture production

The pasture production is based on a mixed sub-clover, annual grasses and herbs pasture typical of farms in the region. This pasture is grown on all land management units. Further details on the pasture productivity assumptions are presented in Appendix 1.

2.2.4 Farm management

Table 2.3: Production and management parameters for the 'standard' ewe nutrition profile (Join in CS3 and maintain to lambing).

	July/Aug	May
Profit ($/ha)	156	59
Number of ewes	6490	3660
Stocking rate (DSE/WG ha)[1]	14.2	11.4
Supplementary feeding (kg/DSE)	38	67.1
(t)	535	540
Flock structure		
% ewes	65	65
Sale age of CFA ewes	5.5	5.5
Sale age of surplus young ewes	hoggets	hoggets
Sale age of wethers (yrs)	hoggets	hoggets
Lambing (%)	89	88
Crop Area (%)	0	30
Pasture growth (t/ha)	7.9	6.3
Pasture utilization (%)	58	48
Wool income ($/ha)	319	241
Sale sheep income ($/ha)	187	150

2.3 LTW statistics & progeny production assumptions

For this analysis the production of the progeny was adjusted depending on the ewe nutrition strategy. The adjustment was calculated using the coefficients calculated by the statistical analysis of the Astral Park 2001 and 2002 progeny (Kearney *pers. comm*), see Table 2.4. The adjustment was applied to all age groups of progeny because the weight of evidence supports the progeny effects being permanent (Thompson *pers. comm.*). The production of the ewe component of the flock was also adjusted, because those animals are the progeny of the ewes from the previous generation, and it is assumed that the ewe nutrition strategy has been applied and the flock has achieved a steady state.

The base levels of production (CFW, FD, staple strength and reproductive rate) for each age group and class of sheep was calculated using the MIDAS simulation model and the calculated value varies with the nutrition strategy of that class of stock (see Table 2.5 for the differences in ewe production for each nutrition profile). This simulation calculates wool cut as a linear function of ME intake, FD as a function of wool growth rate and staple strength as a function of minimum FD and average FD.

[1] Stocking rate calculated using 1.5 DSE/ewe & 1DSE/hd for hoggets.

Table 2.4: Coefficients fitted in the statistical model that explains progeny production from Ewe LW at joining (kg) and LW change (kg) during pregnancy and lactation using the Austral Park 2001 and 2002 progeny.

	CFW (kgs)	FD (μ)	Birth Weight (kgs)	Survival (%)
Constant[2]	2.87	17.34	3.67	-9.64
Ewe LW at Joining	0.010		0.027	
Ewe LW change				
Day 0-90	0.019	-0.031	0.033	
Day 90-lambing	0.019	-0.036	0.045	
Birth class T	-0.143	0.128	-1.12	-0.473
Rearing class TS	-0.274	0.482		
Rearing class T		0.286		
Progeny Female			-0.192	0.586
Birth weight				4.32
Birth weight squared				-0.395

The change in progeny clean fleece weight and fibre diameter measured in the paddock scale experiments was similar to that measured in the plot scale experiments (Behrendt *pers. comm.*). However, the impact of ewe nutrition on progeny survival was greater in the paddock scale experiments than the plot scale experiments. For this reason two levels of progeny survival have been examined in this analysis, they are referred to as 'Paddock Scale' and 'Plot Scale' (see Table 2.5 for the differences in survival for the 2 scenarios). The 'Paddock Scale' is considered the best bet estimate of the result that most farmers will achieve in their paddocks (Thompson *pers. comm.*) because the response in survival in the small plot trials was compromised due to the frequent management interventions.

2.4 The CS patterns

Fifteen different nutrition profiles have been evaluated for each of the lambing times evaluated in this analysis.

2.4.1 July/August lambing profiles

The profiles examined vary in the condition of the ewes at joining and the amount of condition lost from joining to day 90 and then the amount of condition regained from day 90 to lambing (Figure 2.1). There are 3 joining conditions (2.6, 3.0 and 3.4), 3 rates of condition loss from joining to day 90 (no loss, lose 0.4CS and lose 0.8CS) and 2 rates of condition gain after day 90 (no gain and gain 0.4CS). The loss of condition is occurring during the dry feed phase of the year and the gain in condition is occurring during the period after the break of season.

The standard nutrition strategy is the pattern with ewes being mated at 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 Lifetimewool impacts.

[2] Constant is value fitted for the genotypes and management evaluated in the LTW small plot trials. For this analysis the constant has been replaced by values calculated in the simulation model.

The selection of the 15 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 condition score targets of ewes at different times of the reproductive cycle.

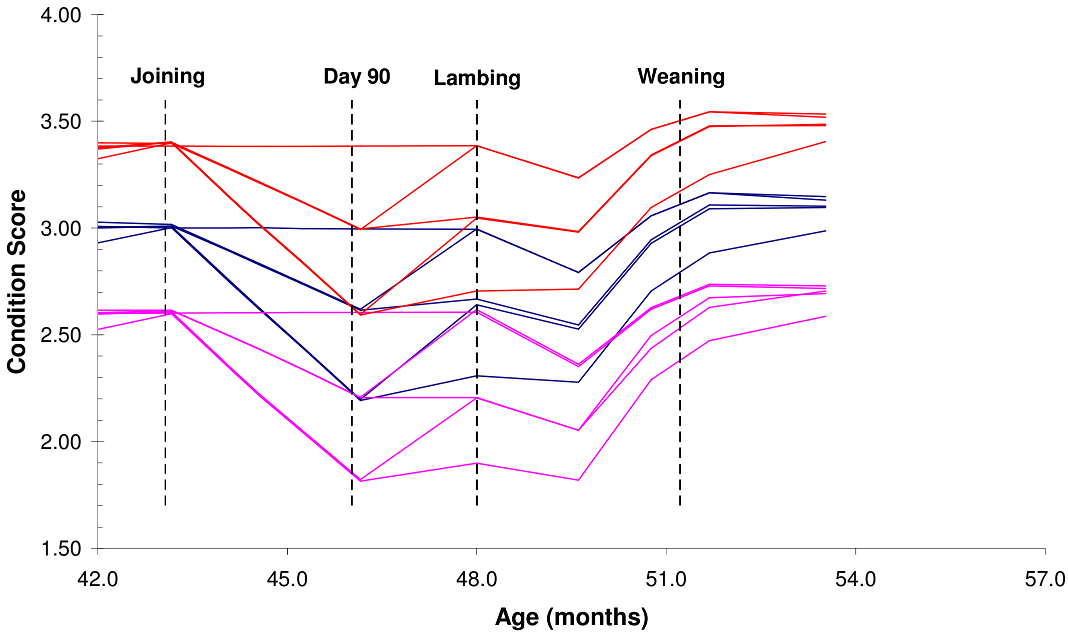

Figure 2.1: The 15 nutrition profiles for July/Aug lambing ewes examined in MIDAS.

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 2.5 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 'CS2.6 maintain to lambing' with 'CS 3 maintain to lambing' the lower CS pattern requires 0.45MJ/d, 0.48MJ/d, 0.73MJ/d and 0.34MJ/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 170MJ 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 0.4CS and regaining it before lambing requires approximately 58MJ more energy than maintaining condition through the entire period because of the metabolic inefficiency of losing and then gaining condition – that is, gaining condition requires more energy than losing condition generates. However, losing 0.4 CS and not regaining it until after lambing requires approximately 38MJ 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. Losing more condition, increases the net saving in energy requirement by approximately 46MJ, losing 0.8CS and regaining 0.4 by lambing only requires 4MJ more energy than maintenance and losing 0.8CS and not regaining until after lambing saves a total of 84MJ.

Starting and finishing at a lower (or higher) condition score also affects ewe wool production, number of lambs conceived, progeny wool production 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 clean fleece weight, birth weight and survival are closely related to condition of the ewes at lambing, the higher the condition the higher the wool cut, birth weight and survival. However, progeny fibre diameter is only related to change in ewe condition from joining to lambing, with loss of condition during this period increasing the fibre diameter. Each of the progeny measures are fine-tuned depending on whether condition was lost and then regained from joining to lambing or maintained throughout.

Table 2.5: ME required by July/Aug lambing single bearing ewes through the reproductive cycle to follow each of the 15 different profiles and production of ewes and progeny relative to ewes joined at CS 3 and maintaining condition to lambing.

Joining Condition Score		2.6					3.0					3.4				
Loss to Day 90		0	0.4		0.8		0	0.4		0.8		0	0.4		0.8	
Gain to Lambing		0	0.4	0	0.4	0	0	0.4	0	0.4	0	0	0.4	0	0.4	0
ME intake																
Joining to D90	MJ/d	8.14	6.9	6.9	5.64	5.66	8.59	7.4	7.41	6.03	6.06	9.08	7.85	7.87	6.53	6.55
Day 90 to Lamb	MJ/d	10.52	13.41	9.89	12.52	10.01	11	13.67	10.9	13.57	10.8	11.54	14.24	11.43	14.14	11.33
Lamb to Wean	MJ/d	16.01	16.01	16.42	16.73	16.68	16.74	16.74	17.29	17.29	17.29	17.29	17.29	17.84	17.84	17.84
Wean to Join	MJ/d	8.72	8.7	9.29	9.12	9.57	9.06	9.06	9.39	9.39	9.88	9.38	9.38	9.79	9.78	10.34
Ewe Production																
CFW	%	-0.16	-0.11	-0.19	-0.15	-0.23	0.00	0.05	-0.02	0.02	-0.06	0.16	0.21	0.15	0.19	0.11
FD	μ	-0.27	-0.15	-0.28	-0.17	-0.3	0.0	0.11	0.01	0.11	-0.03	0.25	0.35	0.26	0.37	0.24
SS	N/kT	-1.3	-3.5	-2.6	-8.3	-7.6	0.0	-2.4	-1.7	-8.1	-7.4	1.1	-1.5	-0.7	-6.9	-6.2
Mortality	%	1.5	1.7	3.6	4.4	5.6	0.0	0.1	0.6	1.5	2.0	-0.4	-0.4	-0.2	0.2	0.5
Preg. Rate	%	-7.9	-7.6	-7.7	-7.8	-8.1	0.0	0.3	0.2	0.1	-0.1	7.7	8.0	8.0	8.1	7.9
Progeny Prod'n																
CFW	kg	-0.04	-0.02	-0.12	-0.10	-0.17	0.00	0.02	-0.06	-0.05	-0.12	0.04	0.06	-0.02	-0.01	-0.08
FD	μ	-0.01	-0.06	0.13	0.08	0.20	0.00	-0.05	0.09	0.06	0.19	-0.02	-0.06	0.08	0.05	0.18
Survival																
Paddock Scale																
Singles	%	-3.3	-1.7	-8.8	-6.8	-13.2	0.0	1.2	-3.2	-2.0	-7.7	2.7	3.6	0.0	1.2	-3.4
Twins	%	-7.2	0.5	-17.6	-9.0	-22.2	0.0	6.5	-5.5	-0.2	-11.7	6.4	12.2	1.5	6.5	-4.0
Plot Scale																
Singles	%	-0.4	-0.2	-1.0	-0.8	-1.5	0.0	0.1	-0.4	-0.2	-0.9	0.3	0.4	0.0	0.2	-0.4
Twins	%	-3.7	0.2	-8.8	-4.6	-11.2	0.0	3.2	-2.8	-0.1	-5.9	3.2	6.1	0.7	3.2	-2.1

2.42 May lambing profiles

For the May lambing the profiles examined vary in the condition of the ewes at joining and the amount of condition lost from joining to day 90 and whether the condition is regained from day 90 to lambing (Figure 2.2). There are 3 joining conditions (2.6, 3.0 and 3.4), 3 rates of loss of condition from joining to day 90 (no loss, lose 0.2CS and lose 0.4CS) and 4 rates of condition change after day 90 (gain 0.4CS, maintenance, lose 0.2CS and lose 0.4CS). The difference in nutrition profiles examined for the May lambing and the July/August lambing is because with May lambing there is seldom green feed to allow gain in condition leading up to lambing. So the focus has been on the pattern of loss of condition.

The standard nutrition strategy is the pattern with ewes being mated at CS 3 and maintaining condition through to lambing.

The selection of the 15 patterns allows comparison of the effects on profitability of varying condition at joining, varying rate of loss of condition after joining through day 90 to lambing and whether it is profitable to feed supplement to gain condition prior to lambing.

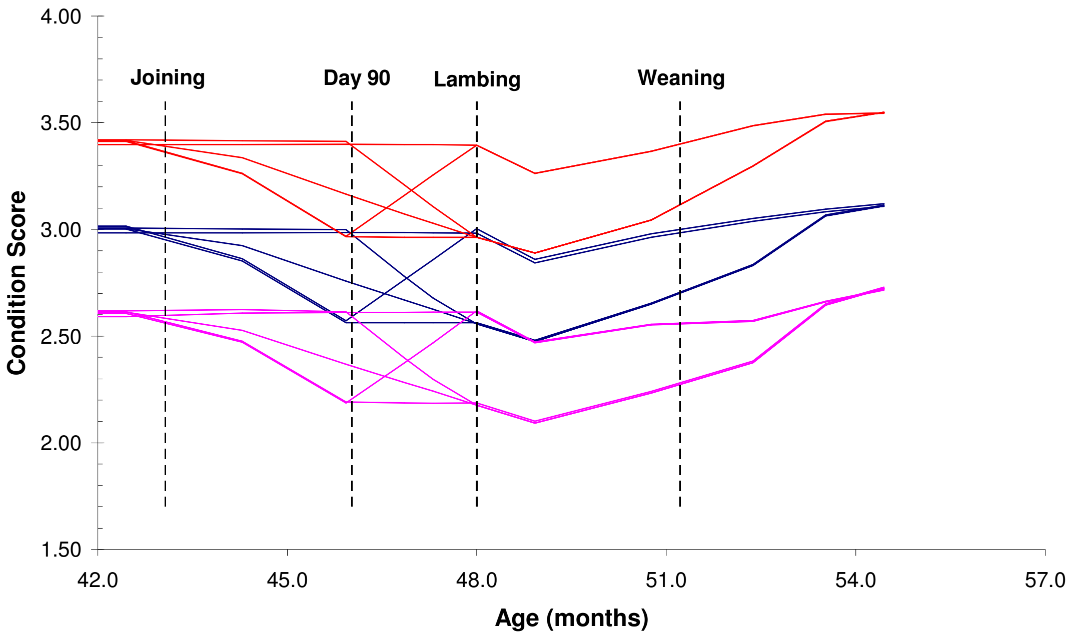

Figure 2.2 The 15 nutrition profiles for May lambing ewes examined in MIDAS.

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.

As for July/August lambing starting and finishing at a lower condition requires less energy for the entire year. Comparing the 'CS2.6 maintain to lambing' with 'CS 3 maintain to lambing' the lower CS pattern requires 0.35MJ/d, 0.41MJ/d, 0.73MJ/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 176MJ 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 0.4CS from joining to lambing reduces the energy requirement during this period by approximately 130MJ, the saving is slightly greater if the condition is lost earlier (before day 90) and slightly less if it is lost later (after day 90). When examined on a full year basis losing the condition prior to lambing and regaining the condition after lambing requires more energy than maintaining condition throughout. This is because the inefficiency of gaining condition outweighs the benefits of energy saved from losing the condition and the lower maintenance requirement during the period the animal was lighter.

All the small plot trial work was based on spring lambing ewes so there is no information to calculate the Lifetimewool progeny responses, however, it is assumed that condition score profile has a similar effect on ewe and progeny performance for a May lambing flock as for a July/August lambing flock.

Table 2.6 ME required by May lambing single bearing ewes through the reproductive cycle to follow each of the 15 different profiles and production of ewes and progeny relative to ewes joined at CS 3 and maintaining condition to lambing.

Joining Condition Score		2.6					3.0					3.4				
Loss to Day 90		0		0.2	0.4		0		0.2	0.4		0		0.2	0.4	
Change to Lambing		0	-0.4	-0.2	0	+0.4	0	-0.4	-0.2	0	+0.4	0	-0.4	-0.2	0	+0.4
ME intake																
Joining to D90	MJ/d	8.65	8.54	7.94	7.51	7.61	9.00	8.94	8.37	7.9	8.01	9.47	9.41	8.83	8.35	8.46
Day 90 to Lamb	MJ/d	10.59	8.72	9.47	10.04	13.35	11.00	9.15	9.9	10.5	13.82	11.48	9.61	10.37	10.98	14.26
Lamb to Wean	MJ/d	14.41	14.41	14.41	14.41	14.41	15.14	15.14	15.14	15.14	15.14	15.61	15.61	15.61	15.61	15.61
Wean to Join	MJ/d	9.07	10.13	10.08	10.05	8.97	9.54	10.6	10.56	10.52	9.46	10.24	11.31	11.27	11.23	10.16
Ewe Production																
CFW	%	-0.16	-0.13	-0.14	-0.15	-0.11	0.00	0.04	0.03	0.02	0.07	0.2	0.24	0.23	0.21	0.26
FD	µ	-0.29	-0.19	-0.23	-0.25	-0.17	0.00	0.09	0.07	0.05	0.13	0.32	0.41	0.38	0.37	0.43
SS	N/kT	0.5	-2.2	0.4	0.5	-0.3	0.0	-2.3	0.0	0.2	-0.9	0.1	-3.3	-0.1	0.2	-0.7
Mortality	%	1.5	4.0	4.2	4.4	2.1	0.0	1.2	1.3	1.4	0.1	-0.6	-0.1	-0.1	-0.1	-0.7
Preg. Rate	%	-7.7	-7.3	-8.0	-8.3	-8.4	0.0	0.4	-0.2	-0.7	-0.5	8.3	8.7	8.1	7.6	7.6
Progeny Prod'n																
CFW	kg	-0.04	-0.12	-0.12	-0.12	-0.02	0.00	-0.08	-0.08	-0.08	0.02	0.04	-0.04	-0.04	-0.04	-0.03
FD	µ	-0.01	0.15	0.13	0.12	-0.07	0.00	0.16	0.14	0.12	-0.06	-0.02	0.14	0.12	0.11	0.11
Survival																
Paddock Scale																
Singles	%	-3.1	-11.4	-9.9	-8.7	-1.4	0.0	-6.6	-5.4	-4.5	1.6	2.8	-2.5	-1.6	-0.8	3.8
Twins	%	-6.5	-21.4	-19.1	-17.1	0.9	0.0	-13.2	-11.1	-9.3	7.0	6.6	-5.3	-3.4	-1.8	12.5
Plot Scale																
Singles	%	-0.4	-1.3	-1.2	-1.0	-0.2	0.0	-0.8	-0.6	-0.5	0.2	0.3	-0.3	-0.2	-0.1	0.0
Twins	%	-3.3	-10.7	-9.6	-8.6	0.5	0.0	-6.6	-5.5	-4.6	3.5	3.3	-2.6	-1.7	-0.9	1.1

2.5 Standard Prices, Production and Sensitivity Analysis

A range of scenarios have been examined in this analysis in order to test the robustness of the optimal ewe condition targets (Table 2.7. Future prices are uncertain and therefore decisions made about condition targets for ewes will be made allowing for the range of prices that may be received. The results of the Lifetimewool project will be easier to extend and implement if the optimum profile is not affected by market changes. A sensitivity to pasture production and flock structure was also carried out to examine whether the optimum ewe condition targets are altered by these factors.

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

	Standard	Sensitivity Levels
Prices		
Wool Price (c/kg sweep the board)		
18µ	1044c/kg	+33%, -33%
19µ	942c/kg	
20µ	850c/kg	
21µ	796c/kg	
FD premium	As above	+50%, -40%
Meat Price ($/hd net)		
Ewe Hgt	$34/hd	+25%, -25%
CFA Ewe	$32/hd	
Wether	$46/hd	
Grain Price ($/t fed out)		
Oats	$163/t	+100%, +25%, -25%
Lupins	$222/t	
Flock Structure		
Sale Age of Wethers	17 months	5mo, 29mo, 41mo
% ewes	66%	79%, 56%, 48%
Pasture System	Sub-clover	Lucerne

Note: Sale sheep price is an average price including ncv's.

3. Results & Discussion July/August Lambing

3.1 The implications of Lifetimewool & Optimum targets

To examine the implications of the biology that has been quantified in the Lifetimewool project an analysis was carried out including and excluding the effects of ewe nutrition on progeny fleece value and progeny survival. The comparison of these 2 sets of results provides the potential value of the project.

The most profitable condition score targets for July/August lambing ewes if Lifetimewool effects are ignored is to join ewes in CS2.6, allow ewes to lose 0.8CS up to day 90 and regain 0.4CS prior to lambing and the remainder after lambing. This profile has the lowest energy requirement from joining to day 90 but a slight increase from day 90 to lambing (on green feed). This reduction in energy requirements during the dry phase outweighs the increase in energy requirement after day 90 and the reduction in fleece value of ewes and the reduction in ewe reproductive rate. However, this pattern is only more profitable at higher stocking rates (Figure 3.1); at lower stocking rates the advantage of lower energy requirements per ewe only equals the reduction in ewe production. However, in practice the differences are minimal and normal on-farm variation would mask these small differences.

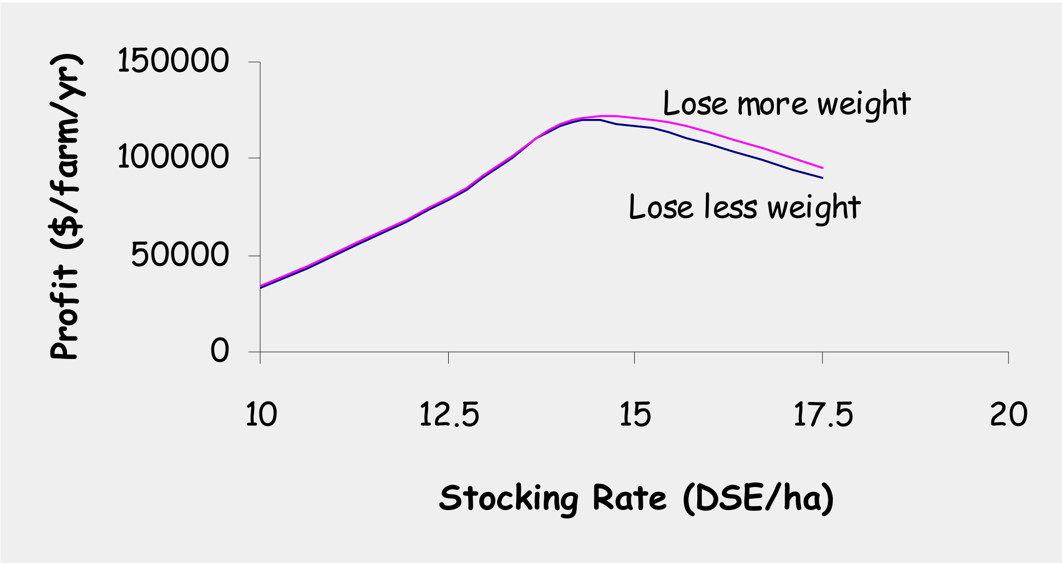

Figure 3.1: The effect of altering stocking rate on farm profit for a farm that has high condition targets for ewes and a farm that has low condition score targets for ewes when ignoring the Lifetimewool effects of ewe condition on progeny fleece production and survival.

When the Lifetimewool relationships are included, the optimum ewe nutrition profile changes. It is more profitable to allow less loss of condition to day 90 (only 0.4CS) and then regain this condition before lambing. The improved calculations including the Lifetimewool impacts indicate that following the lower profile is actually less profitable by between $3 275/farm (2% of profit or $0.50/ewe) and $15 000/farm (10% of profit or $2.30/ewe) depending on the magnitude of the impact of ewe nutrition on progeny survival (Table 3.1). Further details on other patterns are presented in Appendix 2.

Table 3.1: Differences in profitability ($/yr) for the 1000ha MIDAS farm excluding and including the Lifetimewool effects with the range of progeny survival levels-July/Aug lambing flock.

Pattern	Excluding	Including	
		Paddock	Plot
Join CS2.6, Lose 0.8CS to D90 & regain 0.4CS.	+3 275	0	0
Join CS2.6, Lose 0.4CS to D90 & regain 0.4CS.	0	+15 000	+9 500
Response (% of profit)	2%	10%	6%

Meeting these condition targets requires more energy, but results in higher progeny fleece values and higher progeny survival. In this case the reduction in progeny production for the thinner ewes results in a benefit from meeting the target condition scores regardless of the stocking rate (Figure 3.2). There is also little difference in the optimum stocking rate for thinner or fatter ewes.

Figure 3.2 also puts the magnitude of the benefits from Lifetimewool into context. If a farmer is growing productive pastures and is achieving high utilization rates there is little scope to increase profit by further increasing stocking rate. Concentrating on ewe condition targets is an avenue for them to increase profit. However, for the farmer that is currently only utilizing a low proportion of their pasture the benefits from monitoring ewes to achieve the condition targets is similar to the benefit achieved from running an extra 1DSE/ha.

Figure 3.2: The effect of altering stocking rate on farm profit for a farm that has high condition targets for ewes and a farm that has low condition score targets for ewes when including the Lifetimewool effects of ewe condition on progeny fleece production and survival.

The effect of including or excluding the Lifetimewool impacts on farm profit are a combination of the impact of ewe nutrition on progeny fleece value and the impact on progeny survival. The proportion of the effect due to the 2 factors varies with the assumptions about level of progeny survival (Table 3.2). If there is a stronger influence of ewe nutrition on progeny survival (as measured at the paddock sites) then survival has a similar contribution to fleece value, whereas if the impact on survival is based on the small plot trials then the impact on profit is driven by the fleece value.

Table 3.2: The proportion of the difference in profitability from including Lifetimewool due to changes in progeny fleece values and changes in progeny survival for the range of progeny survival levels.

	Paddock	Plot
Fleece Value	55	80
Survival	45	20

When the ewe nutrition targets are changed the optimum stocking rate and the optimum level of grain feeding both change. However, the change in grain feeding has five times the importance of the change in stocking rate. So, a simple rule of thumb for producers to achieve the Lifetimewool nutrition targets is to maintain their current stocking rates and feed more grain. The grain should be targeted at the period after joining to reduce the rate of loss of condition and also to achieve deferment of pasture at the break of season to allow gain in condition on green feed.

The increase in the amount of supplement that is required will depend on the current management of the ewes. If producers are currently following the nutrition profile that is identified as the optimum when Lifetimewool is ignored, then it is estimated they will need to increase their supplementary feeding by about 10% from 25kg/DSE to 27kg/DSE. This increase in supplement reflects a return on the money expended greater than 100% based on the 'Paddock' survival levels.

3.2 Cost of missing targets

The optimum ewe condition targets with standard prices and production is joining in CS 2.6 and then slow loss of condition from joining to day 90 with the condition regained from day 90 to lambing. If this target is not achieved then profit is reduced (see Appendix 2 for details of profitability of each pattern). Figures 3.3, 3.4 & 3.5 show the reduction in profit and the change in the value of production if the ewe condition targets are not achieved either because too much or too little condition is lost or gained at different times. These values are calculated for flocks of the same size (fixed number of DSE) so that changes in value of production are not the result of changing flock size, however, there are some unavoidable errors associated with the calculations because the flock composition changes when lambing percentage varies.

These values provide some insight into the importance of achieving the different targets. Achieving the gain from day 90 to lambing is the most important target. The reduction in profit from not gaining condition after day 90 ($11 per CS) is much greater than the cost of not losing condition from joining to day 90 ($6.40/CS). This indicates that if the condition can't be regained between day 90 and lambing then it is better to maintain animals.

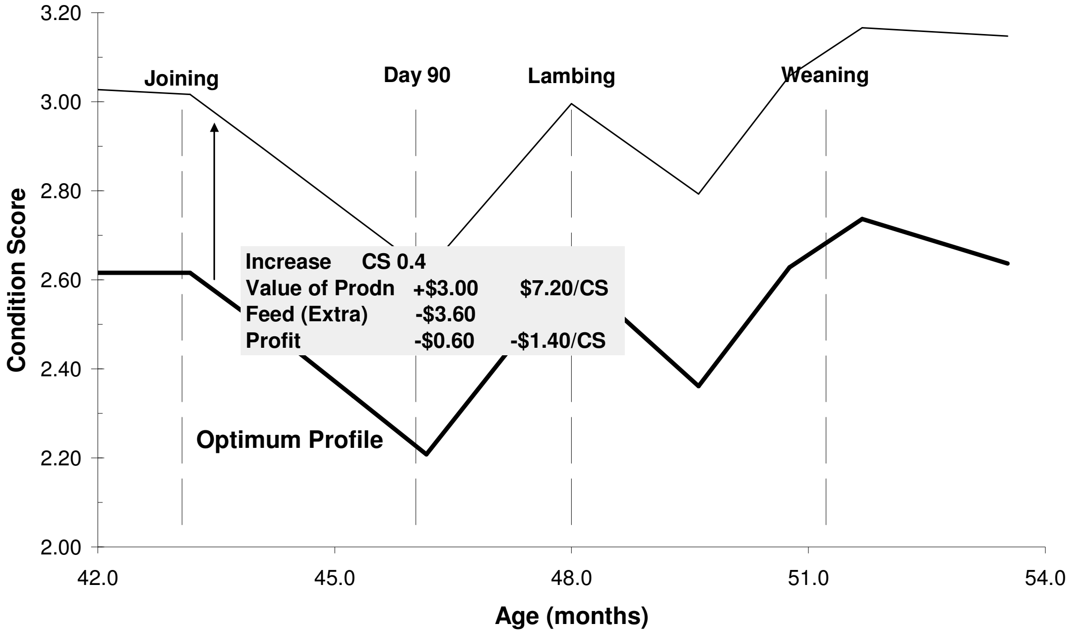

Figure 3.3: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that is higher condition all year – July/Aug lambing.

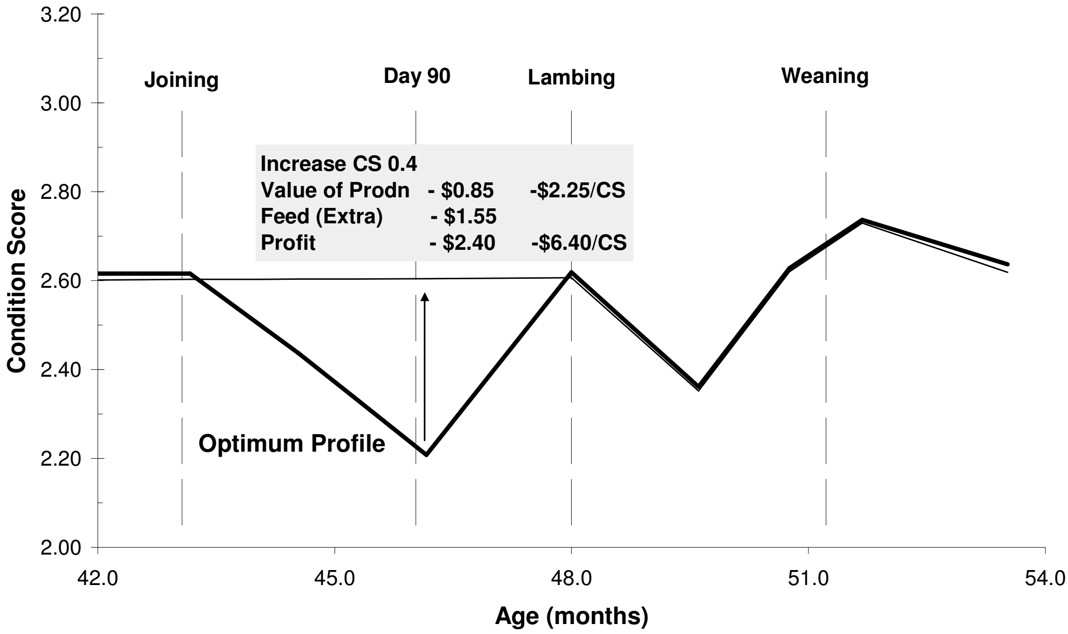

Figure 3.4: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that is higher condition at Day90 – July/Aug lambing.

The value of production is the amount that could be spent to increase ewe condition at the different times. The profit values include the cost of providing feed to meet the condition targets in an average year. If the season is not average then the change in value of production and an estimate of cost of feeding could be used to decide if it will be profitable to alter the feeding of the ewes. As a rule of thumb, gaining condition using grain will not be profitable, whereas it can be profitable to reduce or stop loss of condition using grain.

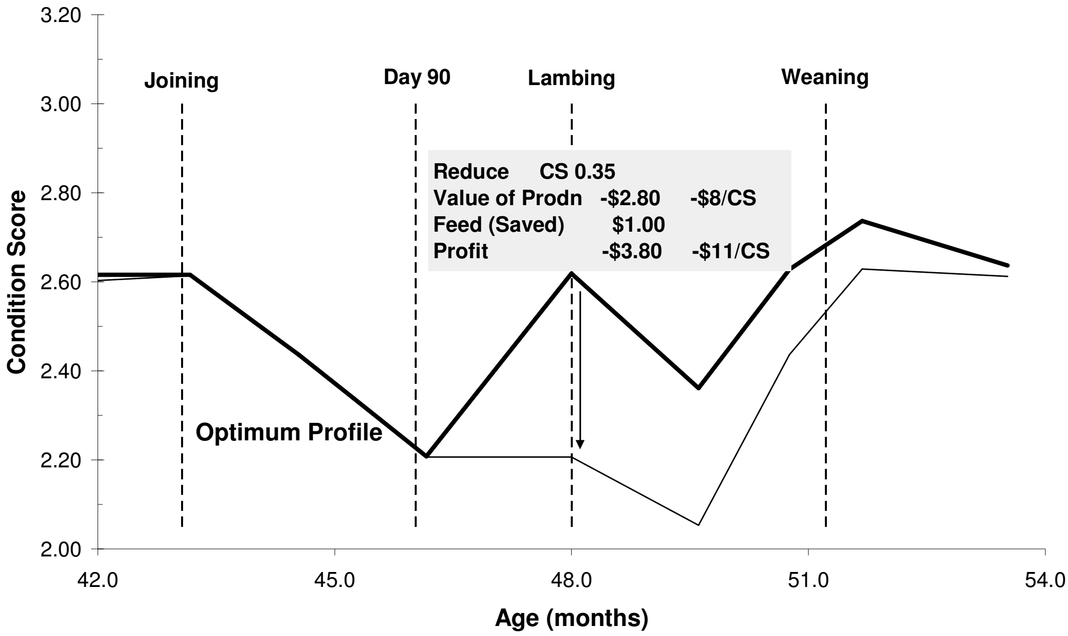

Figure 3.5: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that is thinner at lambing – July/Aug lambing.

3.3 Sensitivity Analysis

The profitability of the 15 different patterns was examined for the range of scenarios outlined in Table 2.6. The scenarios included changing wool prices in a range +/- 33%, meat price +/- 25%, grain price +100%/-25%, changing flock structure and changing pasture species.

Altering prices, flock structure and pasture species change the penalty associated with losing condition during gestation and the benefit of regaining the condition prior to lambing. However, for the range of price and production scenarios examined the finding that the most profitable nutrition strategy includes losing 0.4CS from joining to day 90 and then regaining the condition prior to lambing did not change (Table3.4).

Increasing wool prices, increasing meat prices, reducing grain prices or adding Lucerne to the pasture mix does increase the optimum target for the ewes at joining (Table 3.4).

It appears that the optimum condition targets for ewes are robust and the profile that gave the maximum profit for each scenario was affected little by changing prices, productivity or management. Details of farm profit and production and the impacts of the different scenarios examined are presented in Appendix 4.

Table 3.4: Difference in profit per hectare compared to the optimum pattern for the standard scenario for the 15 different target condition scores for the range of prices productivity and management examined. The most profitable target is highlighted in bold for each scenario.

Joining Condition Score	2.6					3.0					3.4				
Loss to Day 90	0	0.4		0.8		0	0.4		0.8		0	0.4		0.8	
Gain to Lambing	0	0.4	0	0.4	0	0	0.4	0	0.4	0	0	0.4	0	0.4	0
Standard	-17	**0**	-40	-15	-47	-22	-6	-34	-19	-52	-18	-2	-30	-15	-49
Prices															
Wool +25%	-18	0	-44	-18	-54	-19	-3	-33	-18	-54	-13	**3**	-28	-13	-49
-25%	-12	**0**	-25	-8	-28	-18	-6	-23	-14	-34	-17	-5	-23	-13	-34
FD premium +25%	-18	**0**	-44	-18	-54	-23	-7	-37	-23	-60	-20	-3	-34	-19	-57
-25%	-17	**0**	-35	-13	-41	-20	-5	-28	-16	-44	-17	-1	-26	-13	-42
Meat +25%	-18	0	-43	-17	-52	-20	-4	-33	-18	-54	-15	**2**	-28	-12	-49
-25%	-14	**0**	-31	-11	-36	-19	-6	-27	-17	-42	-18	-4	-26	-16	-42
Grain +100%	-12	**0**	-21	-3	-21	-21	-11	-24	-15	-33	-23	-14	-27	-18	-37
+25%	-14	**0**	-31	-10	-35	-21	-8	-29	-17	-43	-21	-7	-29	-17	-44
-25%	-15	0	-37	-16	-45	-14	0	-26	-14	-43	-8	**6**	-20	-7	-38
Flock Structure															
Sell Wethers 5mo	-14	**0**	-34	-14	-41	-17	-4	-28	-16	-43	-13	0	-24	-13	-41
29mo	-12	0	-30	-12	-36	-14	-3	-23	-14	-37	-10	**1**	-20	-10	-35
41mo	-21	**0**	-48	-16	-56	-28	-8	-41	-23	-63	-25	-4	-38	-19	-61
Pasture System															
Lucerne	-16	0	-28	-11	-35	-14	0	-19	-7	-30	-8	**6**	-14	-1	-22

4. Results & Discussion May Lambing

4.1 Optimum targets

The most profitable condition score targets for May lambing ewes if Lifetimewool effects are ignored is to join ewes in CS2.6, allow ewes to lose 0.4CS up to day 90 and regain the condition after lambing. The other profiles that lose condition at different rates through to lambing have a similar profitability. Each of these profiles has a low energy requirement during the dry feed phase from joining to lambing and this reduction in energy requirements outweighs the reduction in fleece value of the ewes.

This nutrition strategy is also the most profitable condition score targets for ewes if Lifetimewool effects are included. Including the Lifetimewool effects does reduce the cost associated with feeding the ewes more (Table 4.1), but there is still a substantial cost to maintain ewe condition during gestation. This conclusion is different than the conclusion for the spring lambing flock because there is no green feed during the joining to lambing period.

Table 4.1: Differences in profitability ($/yr) for the 1000ha MIDAS farm excluding and including the Lifetimewool effects with the range of progeny survival levels- May lambing flock.

Pattern	Excluding	Including	
		Paddock	Plot
Join CS2.6, lose 0.4CS to D90 & no regain to lambing	+25 700	+9 100	+15 500
Join CS2.6, maintain to D90 & maintain to lambing.	0	0	0

3.2 Cost of missing targets

If the optimum target is not achieved then profit is reduced (see Appendix 3 for details of profitability of each pattern). Figures 4.1, 4.2 & 4.3 show the reduction in profit and the reduction in the value of production if the ewe condition targets are not achieved either because too much or too little condition is lost or gained at different times. These values are calculated for flocks of the same size (fixed number of DSE) so that changes in value of production are not the result of changing flock size, however, there are some unavoidable errors associated with the calculations because the flock composition changes when lambing percentage varies.

These values provide some insight into the importance of achieving the different targets. Managing the loss during the period joining to day 90 is the most important period. Losing insufficient condition during this period reduces profit by $5.10/ewe/CS.

The value of production is the amount that could be spent to increase ewe condition at the specified times. The values (as expected) are very similar to the values for a July/Aug lambing flock. None of the values are sufficient to make it profitable to gain condition using grain feeding. Getting heavier sheep by stopping or reducing loss of condition may pay in some circumstances.

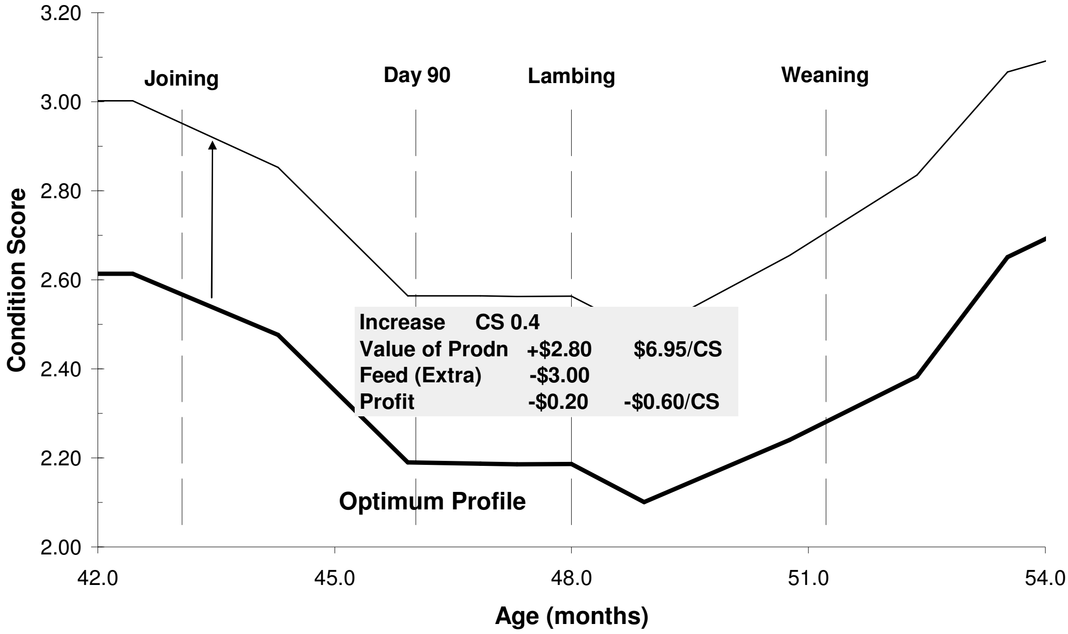

Figure 4.1: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that is higher condition all year – May lambing.

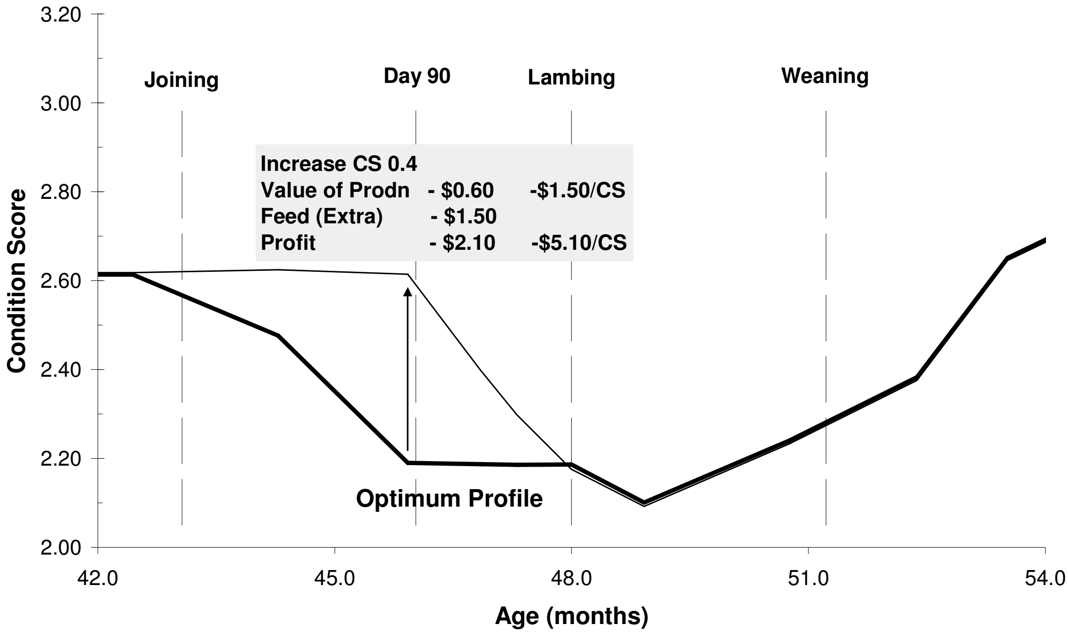

Figure 4.2: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that is higher condition at Day90 – May lambing.

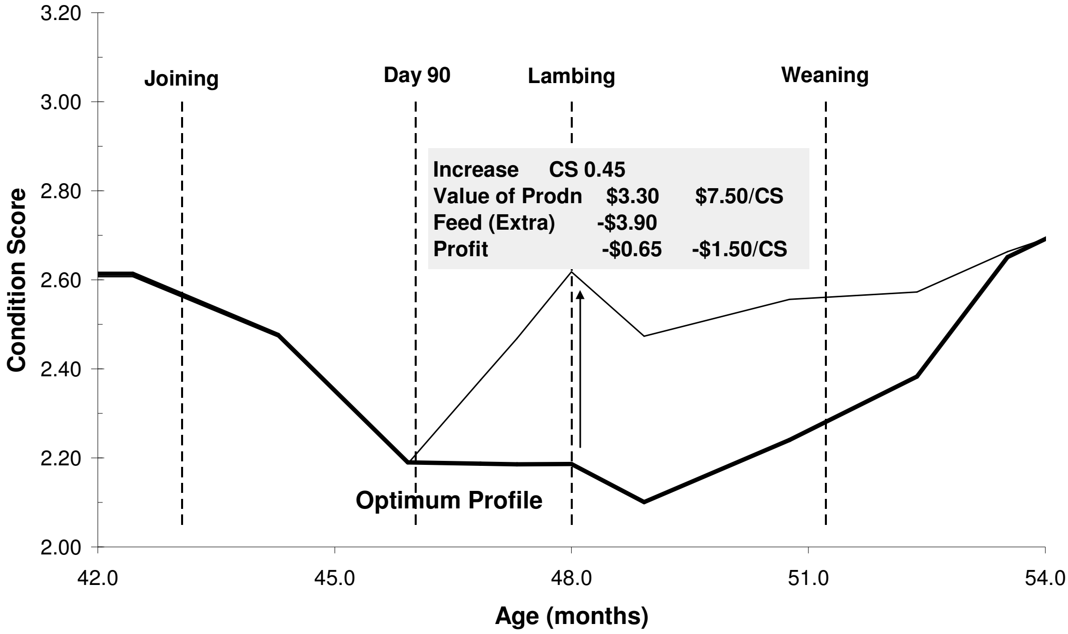

Figure 4.3: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that is thinner at lambing – May lambing.

5. Conclusions

Including the biology that has been quantified as part of the Lifetimewool project in economic analyses alters the outcome about the most profitable nutrition strategy for spring lambing ewes but not for autumn lambing ewes. For spring lambing flocks the optimum profile identified when including the progeny effects is between $10 000 and $15 000 more profitable than the profile that was thought to be optimal without Lifetimewool. The range in value of the Lifetimewool information is related to the increase in survival of progeny that will be achieved from ewes that follow an improved nutrition profile. The optimum profile is robust and the impact of altering prices or production was very minor.

The optimum profile for autumn lambing flocks is unchanged by including the Lifetimewool effects. This is because there are only limited opportunities to adjust the ewe profiles other than by using grain feeding and grain feeding is more costly than the benefits received from improved survival and production from the progeny.

For the spring lambing flocks the benefits from the improved ewe nutrition profiles identified in this analysis are similar to the benefits that producers can achieve from increasing stocking rates by 1 DSE/ha. This indicates that producers adopting the Lifetimewool findings should do it as part of a package aimed at achieving high rates of pasture utilisation.

The optimum profile for the spring lambing flocks in the Great Southern region in WA is:

a. to allow moderate loss of condition from joining to day 90, provided the condition can be regained prior to lambing
b. aim for CS2.6 or above at joining

To achieve these targets it will be necessary for producers to increase their rate of supplementary feeding by about 10%. The grain should be targeted at the period after joining to reduce the rate of loss of condition and also to achieve deferment of pasture at the break of season to allow gain in condition on green feed.

The most important target is regaining the condition between day 90 and lambing. Meeting this target increases the value of production of the flock by $11/ewe/CS. This is not high enough to make it profitable to achieve the target by gaining condition using supplementary feed, so it is more profitable to maintain condition between joining and day 90 if the condition can’t be regained on green feed.

The optimum profile for the autumn lambing flocks is:

a. to allow moderate loss of condition from joining to day 90 and then maintenance through to lambing and then regain the condition after lambing.
b. aim for CS2.6 or above at joining

It is not profitable for producers to aim to regain condition prior to lambing because the only feed available to achieve this is grain and this is too expensive.

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Appendix 1: Standard Farm Production

Table A1.1: Sheep management program.

	July/Aug lambing	May lambing
Start of lambing	21 July	28 April
Weaning age (youngest)	8 weeks	8 weeks
Shearing time	Jan/Feb	Sept/Oct
Crutching time	Oct	June
Stock turn off		
- wether lambs	Feb	Oct
- ewe hoggets	Feb	Oct
- CFA ewes	Feb	Oct
- shippers	Feb	Oct

Other management comments:

- Animal husbandry
    - Drenching (1 summer drench)
    - Jetting (spring born lambs jetted at marking or weaning)
- Crutching (contract)
- Shearing (contract)

Pasture productivity assumptions

Table A1.3: Growth & Digestibility of pasture on sandy gravel soils in each of the feed periods.

			Sub Clover		Lucerne	
Period of Year	Start of period	End of period	Growth (kg/d)	DMD (%)	Available (kg/d)	DMD (%)
1	24-Apr	14-May	37	81	4	76
2	15-May	11-Jun	19	81	5	81
3	12-Jun	6-Aug	40	81	4	81
4	7-Aug	24-Sep	55	78	10	81
5	25-Sep	29-Oct	60	75	26	81
6	30-Oct	26-Nov		68	50	77
7	27-Nov	21-Jan		60	26	74
8	22-Jan	12-Mar		54	8	68
9	13-Mar	9-Apr		52	4	67
10	10-Apr	23-Apr		50	4	67

Appendix 2: Profit & production summary for the 15 patterns-July/Aug lambing

Table A2.1: Stocking rate, value of production, stocking rate and supplementary feeding for flocks with ewes with different target condition scores. The most profitable target is highlighted for each scenario.

Joining Condition Score		2.6					3.0					3.4				
Loss to Day 90		0	0.4		0.8		0	0.4		0.8		0	0.4		0.8	
Gain to Lambing		0	0.4	0	0.4	0	0	0.4	0	0.4	0	0	0.4	0	0.4	0
Survival:																
Paddock Scale																
Profit	$/ha	160	**177**	137	162	130	156	172	144	158	126	159	176	147	162	128
	Δ$/ewe†	-2.5	**0.0**	-6.6	-2.1	-7.5	-3.4	-0.9	-5.0	-2.9	-8.7	-2.9	-0.3	-4.8	-2.5	-8.8
Value of Prodn*	Δ$/ewe†	-3.5	**-1.9**	-13.3	-4.8	-19.9	0.0	1.4	-1.7	-1.1	-16.6	2.7	4.0	0.6	1.4	-13.8
Stocking Rate	DSE/ha	14.3	**14.3**	14.3	14.4	14.4	14.3	14.1	14.3	14.3	14.4	14.2	14.1	14.2	14.2	14.3
Supplement	kg/DSE	29.0	**26.0**	31.4	25.0	30.6	37.5	34.0	37.5	34.2	40.3	41.3	37.2	41.4	38.0	44.9
	t	414	**371**	384	358	378	535	481	537	489	498	587	522	589	540	551
Plot Scale																
Profit	$/ha	173	**202**	141	182	133	157	184	141	164	103	158	186	140	165	100
	Δ$/ewe†	1.3	**3.5**	-1.1	2.0	-1.6	0.0	2.2	-1.2	0.6	-3.8	0.0	2.3	-1.4	0.6	-4.3
Value of Prodn*	Δ$/ewe†	-2.7	**-1.7**	-13.5	-3.9	-19.0	0.0	1.0	-1.3	-0.9	-16.4	2.2	3.1	0.6	1.0	-11.3
Stocking Rate	DSE/ha	14.3	**14.3**	14.6	14.4	14.7	14.3	14.1	14.3	14.3	14.4	14.2	14.1	14.2	14.2	14.3
Supplement	kg/DSE	28.6	**25.9**	30.4	24.6	29.4	37.5	34.3	37.1	34.1	39.2	41.8	37.8	41.4	38.3	44.3
	t	410	**370**	443	353	432	535	485	531	487	485	594	531	589	544	544

Appendix 3: Profit & production summary for the 15 patterns-May lambing

Table A2.1: Stocking rate, value of production, stocking rate and supplementary feeding for flocks with ewes with different target condition scores. The most profitable target is highlighted for each scenario.

Joining Condition Score		2.6					3.0					3.4				
Loss to Day 90		0		0.2	0.4		0		0.2	04		0		0.2	0.4	
Change to Lambing		0	-0.4	-0.2	0	+0.4	0	-0.4	-0.2	0	+0.4	0	-0.4	-0.2	0	+0.4
Survival:																
Paddock Scale																
Profit	$/ha	62	61	67	**71**	60	61	59	64	68	58	59	59	63	66	57
	Δ$/ewe†	-2.3	-2.2	-0.9	**0.0**	-3.0	-2.9	-2.9	-1.7	-0.8	-3.8	-3.6	-3.3	-2.2	-1.3	-4.5
Value of Prodn*	Δ$/ewe†	0.0	-1.3	-1.3	**-1.4**	-2.9	0.0	0.3	0.3	0.3	-1.3	0.3	2.1	2.5	2.8	1.4
Stocking Rate	DSE/ha	11.5	11.7	11.8	**11.8**	11.2	11.4	11.5	11.6	11.6	11.1	11.3	11.3	11.5	11.6	11.1
Supplement	kg/DSE	59.8	51.0	48.1	**46.8**	63.2	67.1	59.7	57.8	56.1	71.1	74.5	67.8	65.7	64.0	78.0
	t	505	457	434	**425**	511	540	509	498	485	552	574	559	553	542	584
Plot Scale																
Profit	$/ha	70	89	97	**102**	60	59	74	81	86	49	49	63	69	74	40
	Δ$/ewe†	1.3	3.1	4.1	**4.7**	0.0	0.0	1.7	2.5	3.2	-1.5	-1.4	0.4	1.2	1.9	-2.8
Value of Prodn*	Δ$/ewe†	2.1	5.4	5.7	**6.0**	-0.7	0.0	4.0	4.3	4.4	-2.3	-1.6	3.1	3.7	4.3	-3.6
Stocking Rate	DSE/ha	11.6	12.0	12.1	**12.1**	11.3	11.4	11.7	11.7	11.8	11.1	11.2	11.4	11.5	11.6	11.0
Supplement	kg/DSE	58.9	48.2	45.9	**44.9**	63.0	67.1	58.0	56.2	54.8	72.0	75.7	66.7	65.1	63.6	79.9
	t	503	450	430	**421**	511	540	509	495	482	554	577	558	548	540	589

Appendix 4 – Detailed Sensitivity Analysis results

Table A3.1: Profit and production summary for the standard pattern for each of the scenarios examined in the sensitivity analysis for July/Aug lambing.

		Profit	SR	Supplement	
		$/ha	DSE/ha	kg/DSE	Tonnes
Standard		162	14.4	25.0	358
Prices					
Wool +25%		267	14.4	25.0	358
-25%		55	13.4	25.0	250
FD premium +25%		191	14.4	25.0	358
-25%		139	14.4	25.0	358
Meat +25%		209	14.4	25.0	358
-25%		107	14.1	25.0	302
Grain +100%		198	9.6	25.0	134
+25%		142	13.7	25.0	250
-25%		179	14.4	25.0	358
Flock Structure					
Sell Wethers 5mo		153	13.6	24.3	329
29mo		149	13.1	23.9	310
41mo		177	15.0	26.3	396
Pasture System					
Lucerne		177	15.0	15.3	195