lifetimewool

# Implications of Lifetimewool for On-farm Management on the southern slopes (southern NSW & central Vic)

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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 survival and weaning percentages
b. Increased progeny fleece weight (CFW) and decreased fibre diameter (FD).
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 condition score (CS) targets for producers in five regions in Australia.

Altering the target CS profile of ewe's 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 CS 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 southern New South Wales.

A version of MIDAS was created for this analysis using pasture growth and digestibility estimates provided by Phil Graham (NSW DPI). 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, 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 ewes. The optimum profile identified when including the progeny effects is $1515 more profitable than the profile that was thought to be optimal without Lifetimewool, if survival of progeny is based on the response observed in the paddock scale experiments. The optimum profile is robust and altering prices or management didn't affect the optimum condition score targets.

The benefits from the improved ewe nutrition profiles identified in this analysis are less than the benefits that producers can achieve from increasing pasture utilization. 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 CS profile for the southern slopes of NSW is:

a. To allow moderate loss of condition after joining and regain the condition prior to lambing.
b. Aim for CS2.6 or above at joining.

To achieve these targets it will be necessary for producers to increase the rate of supplementary feeding and to alter the timing of feeding to defer pasture at the break of season. Also, the benefits from the improved ewe nutrition profiles identified in this analysis are small compared to the level of wholefarm profit. This along with the extra work associated with altering the grain feeding will be a disincentive to adoption of the Lifetimewool findings.

The most important target is regaining any condition that was lost after joining, prior to lambing. If it will be difficult to gain condition in late pregnancy because of a shortage of feed the most profitable solution is to transfer some feed from early pregnancy to late pregnancy. Losing extra condition in early pregnancy and regaining some in late pregnancy is better than losing less and gaining less.

# 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 survival of lambs and weaning percentages.
b. Increased progeny CFW and decreased FD.
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 ewe's 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 CS profile of ewe's 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 CS 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 southern slopes of NSW.

# 2. Methods

## 2.1 MIDAS

A version of MIDAS was created using pasture growth and digestibility estimates provided by Phil Graham (NSW DPI).to represent the southern slopes of NSW. This model was used to calculate the profitability for a range of nutrition profiles for reproducing ewes. 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 Little River catchment region in southern NSW. The total area of the farm is 900ha and is comprised of 5 land management units (LMUs) (Table 2.1). The pasture production profile and crop production varies on each LMU (Appendix 1)

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

| Land Management Unit | Area (ha) |
|---|---|
| L2 Red Chromosols-better | 513 |
| L3 Red Chromosols-poorer | 60 |
| L5 Red Chromosols-shallow | 64 |
| L6 Siliceous sands & shallow S. sands | 21 |
| L8 Yellow podosols & yellow chromosols | 243 |

### *2.2.2 Animal production system*

The analysis is based on a self replacing merino flock producing a medium micron wool and lambing in July/August and shearing in January. Surplus young ewes and all wethers are sold as hoggets off shears in January.

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

| | |
|---|---|
| Standard reference liveweight (kg) | 50 |
| Fleece weight (clean kg/hd) | 3.4 |
| Mean fibre diameter (µm) | 20.0 |
| Weaning rate (%) | 88 |

### *2.2.3 Pasture production*

The pasture production is based on a combination of annual pastures, phalaris and sub-clover pastures and lucerne pastures typical for farms in the region. Each pasture can be grown on all land management units and the model selects the most profitable pasture and rotation for each soil .More 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).**

| | |
|---|---|
| Profit ($/ha) | 135 |
| Crop Area (%) | 30 |
| | |
| Number of ewes | 3650 |
| Stocking rate[1] (DSE/Winter Grazed ha) | 12.6 |
| Supplementary feeding (kg/DSE) | 34.5 |
| (t) | 273 |

| | |
|---|---|
| Flock structure | |
| % ewes | 66 |
| Sale age of CFA ewes | 5.5 |
| Sale age of surplus young ewes | hoggets |
| Sale age of wethers (yrs) | hoggets |
| Lambing (%) | 87 |
| | |
| Pasture growth (t/ha) | |
| Annual | 6.3 |
| Phalaris | 7.1 |
| Lucerne | 4.1 |
| Pasture utilization (%) | |
| Annual | 67 |
| Phalaris | 50 |
| Lucerne | 90 |
| | |
| Wool income ($/ha) | 336 |
| Sale sheep income ($/ha) | 140 |

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

## 2.3 Lifetimewool assumptions about progeny production

For this analysis the production of the progeny was adjusted based on the CS profile of the ewes (nutritional strategy; Table 2.5). The adjustment was calculated using the coefficients derived from the statistical analysis of the Austral Park 2001 and 2002 progeny (Gavin Kearney *pers. comm.*), see Table 2.4. The coefficients were derived from the maternal live weight and changes in maternal live weight during pregnancy in the plot scale experiments. However, because of the complications associated with correcting for wool and conceptus grow these have been converted to condition score and condition score changes throughout the presentation of this analysis. The conversion has used 10 kg of live weight per condition score.

The adjustment in production was applied to all age groups of progeny because the weight of evidence supports the progeny effects being permanent (Andrew 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 nutrition strategy for the ewes 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 CS profile of that class of stock (see Table 2.5 for the differences in ewe production for each CS 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.

**Table 2.4 : Coefficients fitted in the statistical model that explains progeny production from Ewe condition score (CS) at joining (kg) and CS change (kg) during pregnancy and lactation using the Austral Park 2001 and 2002 progeny where one CS equal 10 kg of maternal live weight (Gavin Kearney *pers. comm.)*.**

| | CFW (kg) | FD (μ) | Birth Weight (kg) | Survival (%) |
|---|---|---|---|---|
| Constant[1] | 2.87 | 17.34 | 3.67 | -9.64 |
| Ewe CS at Joining | 0.010 | | 0.027 | |
| *Ewe CS change* | | | | |
| Day 0-90 | 0.019 | -0.031 | 0.033 | |
| Day 90-lambing | 0.019 | -0.036 | 0.045 | |
| Birth class Twin | -0.143 | 0.128 | -1.12 | -0.473 |
| Rearing class Twin born reared Single | -0.274 | 0.482 | | |
| Rearing class Twin | | 0.286 | | |
| Progeny Female | | | -0.192 | 0.586 |
| Birth weight | | | | 4.32 |
| Birth weight squared | | | | -0.395 |

The change in progeny CFW and FD measured in the paddock scale experiments was similar to that measured in the plot scale experiments (Ralph 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 (Andrew Thompson *pers. comm.*) because the response in survival in the small plot trials was increased by the frequent management interventions.

## 2.4 The condition score profiles

Fifteen different CS profiles have been evaluated in this analysis. The profiles examined vary in the average condition of the ewes at joining and the average amount of condition lost to the minimum and then the amount of condition regained from the minimum to lambing (Figure 2.1). There are 3 alternative CS at joining (2.6, 3.0 and 3.4), 3 rates of loss of condition to the minimum (no loss, lose 0.3CS and lose 0.6CS) and 2 rates of gain of condition from the minimum to lambing (no gain and gain 0.3CS).

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.

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

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

of gain in condition prior to lambing. Each nutrition strategy examined has a similar pattern that varies in only 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.

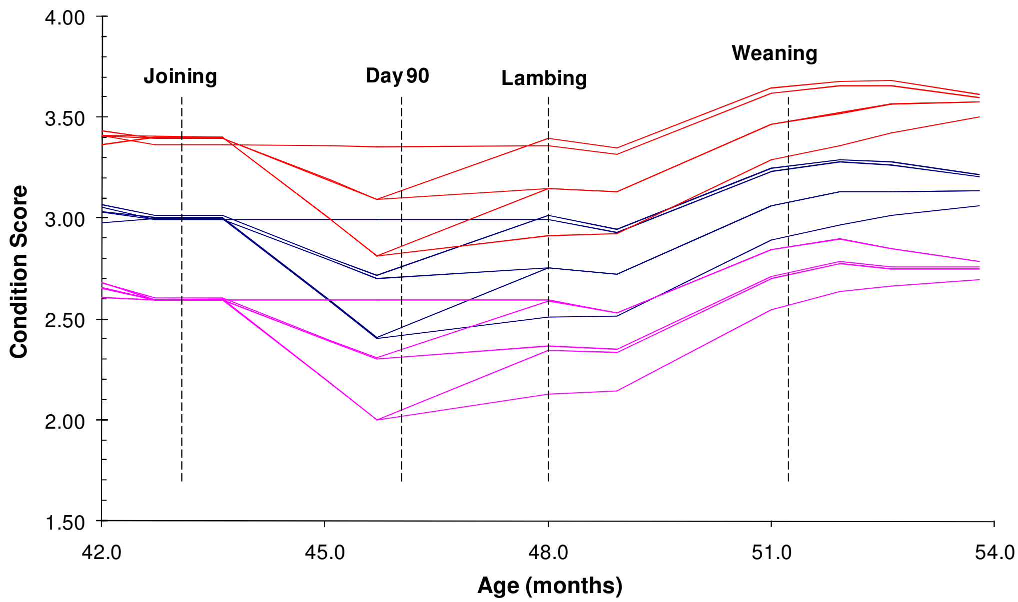


**Figure 2.1: The 15 nutrition profiles examined in MIDAS.**

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 2.5 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 0.54MJ/d, 0.59MJ/d, 0.39MJ/d and 0.52MJ/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 186MJ 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 0.3CS and regaining it before lambing requires approximately 48MJ 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 0.3 CS and not regaining it until after lambing requires approximately 29MJ 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 30MJ, losing 0.6CS and regaining 0.3 by lambing only requires 16MJ more energy than maintenance, and losing 0.6CS and not regaining until after lambing saves a total of 45MJ.

Starting and finishing at a lower (or higher) CS 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 CFW, 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 FD is only related to change in ewe condition from joining to lambing, with loss of condition during this period increasing the FD. 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 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 minimum | | 0 | 0.3 | | 0.6 | | 0 | 0.3 | | 0.6 | | 0 | 0.3 | | 0.6 | |
| Gain to Lambing | | 0 | 0.3 | 0 | 0.3 | 0 | 0 | 0.3 | 0 | 0.3 | 0 | 0 | 0.3 | 0 | 0.3 | 0 |
| ***ME intake*** | | | | | | | | | | | | | | | | |
| Joining to D90 | MJ/d | 8.99 | 8.44 | 8.18 | 7.62 | 7.36 | 9.53 | 8.96 | 8.69 | 8.13 | 7.87 | 9.98 | 9.45 | 9.19 | 8.65 | 8.4 |
| Day 90 to Lamb | MJ/d | 11.18 | 12.81 | 11.25 | 12.83 | 11.31 | 11.77 | 13.32 | 11.77 | 13.22 | 11.77 | 12.21 | 13.74 | 12.21 | 13.61 | 12.21 |
| Lamb to Wean | MJ/d | 17.14 | 17.14 | 17.26 | 17.27 | 17.34 | 17.53 | 17.53 | 17.53 | 17.53 | 17.53 | 18.04 | 18.04 | 18.04 | 18.04 | 18.04 |
| Wean to Join | MJ/d | 9.55 | 9.55 | 9.77 | 9.77 | 10.12 | 10.07 | 10.07 | 10.24 | 10.24 | 10.63 | 10.57 | 10.57 | 10.9 | 10.9 | 11.33 |
| ***Ewe Production*** | | | | | | | | | | | | | | | | |
| CFW | kg | -0.2 | -0.16 | -0.23 | -0.2 | -0.25 | 0.00 | 0.02 | -0.06 | -0.04 | -0.08 | 0.18 | 0.21 | 0.15 | 0.17 | 0.14 |
| FD | µ | -0.28 | -0.22 | -0.33 | -0.25 | -0.34 | 0.00 | 0.05 | -0.08 | -0.02 | -0.1 | 0.25 | 0.31 | 0.22 | 0.27 | 0.21 |
| SS | N/kT | -0.56 | -2.69 | -1.43 | -7.31 | -6.77 | 0.00 | -1.85 | -0.64 | -5.51 | -5.09 | 0.77 | -0.99 | 0.07 | -4.23 | -3.82 |
| Mortality | % | 0.6 | 0.5 | 1.4 | 1.4 | 2.6 | 0.0 | -0.1 | 0.3 | 0.3 | 0.9 | 0.0 | -0.1 | 0.1 | 0.0 | 0.3 |
| Rep. Rate | % | -8.0 | -7.8 | -8.0 | -7.9 | -8.0 | 0.0 | 0.4 | 0.0 | 0.2 | 0.1 | 7.6 | 8.2 | 8.2 | 8.4 | 8.4 |
| ***Progeny Prod'n*** | | | | | | | | | | | | | | | | |
| CFW | kg | -0.04 | -0.03 | -0.08 | -0.08 | -0.12 | 0.00 | 0.01 | -0.04 | -0.04 | -0.08 | 0.03 | 0.05 | 0.00 | 0.00 | -0.05 |
| FD | µ | 0.00 | -0.03 | 0.07 | 0.05 | 0.13 | 0.00 | -0.03 | 0.06 | 0.04 | 0.13 | -0.01 | -0.04 | 0.06 | 0.04 | 0.12 |
| ***Survival*** | | | | | | | | | | | | | | | | |
| *Aust. Pad scale* | | | | | | | | | | | | | | | | |
| Singles | % | -3.6 | -2.6 | -6.1 | -5.2 | -9.3 | 0.0 | 1.0 | -2.2 | -1.3 | -4.9 | 2.5 | 3.3 | 0.8 | 1.6 | -1.2 |
| Twins | % | -7.2 | -0.6 | -10.6 | -5.9 | -14.2 | 0.0 | 6.3 | -3.2 | 1.4 | -6.6 | 5.9 | 11.6 | 3.3 | 7.4 | 0.3 |
| *Plot Scale* | | | | | | | | | | | | | | | | |
| Singles | % | -0.4 | -0.3 | -0.7 | -0.6 | -1.1 | 0.0 | 0.1 | -0.3 | -0.2 | -0.6 | 0.3 | 0.4 | 0.1 | 0.2 | -0.1 |
| Twins | % | -3.6 | -0.3 | -5.3 | -3.0 | -7.1 | 0.0 | 3.2 | -1.6 | 0.7 | -3.3 | 3.0 | 5.8 | 1.6 | 3.7 | 0.2 |

## 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 CS targets (Table 2.6). Future prices are uncertain and therefore decisions made about CS 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 CS profile is not affected by market changes. A sensitivity to flock structure was also carried out to examine whether the optimum ewe CS targets are altered by flock structure.

**Table 2.6: 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 cln sweep the board)* | | |
| 18µ | 1422c/kg | +25%, -25% |
| 19µ | 1170c/kg | |
| 20µ | 962c/kg | |
| 21µ | 845c/kg | |
| *FD premium* | As above | +25%, -25% |
| *Meat Price* | | |
| *($/hd net)* | | |
| Ewe Hgt | $34/hd | +25%, -25% |
| CFA Ewe | $32/hd | |
| Wether | $46/hd | |
| *Grain Price* | | |
| *($/t fed out)* | | |
| Oats | $200/t | +100%, +25%, -25% |
| Lupins | $250/t | |
| ***Flock Structure*** | | |
| Sale Age of Wethers | 17 months | 5mo, 29mo, 41mo |
| % ewes | 66% | 79%, 56%, 49% |

Note: Sale sheep price is an average price including sheep of no commercial value.

## 3. Results and Discussion

### 3.1 The implications of Lifetimewool and 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 CS profile for the ewe flock if Lifetimewool effects are ignored is to join ewes in CS2.6, allow ewes to lose 0.6CS and regain 0.3CS prior to lambing and the remainder after lambing. This CS profile has a low energy requirement after the break of the season and this reduction in energy requirements outweighs the reduction in fleece value of ewes and the reduction in ewe reproductive rate and survival. On paper, following this CS profile was $6375 more profitable than regaining the lost condition prior to lambing (Table 3.1).

The advantage of losing more condition in early pregnancy and reducing the energy requirement of the ewes near the break of season is greater at high stocking rates (Figure 3.1).

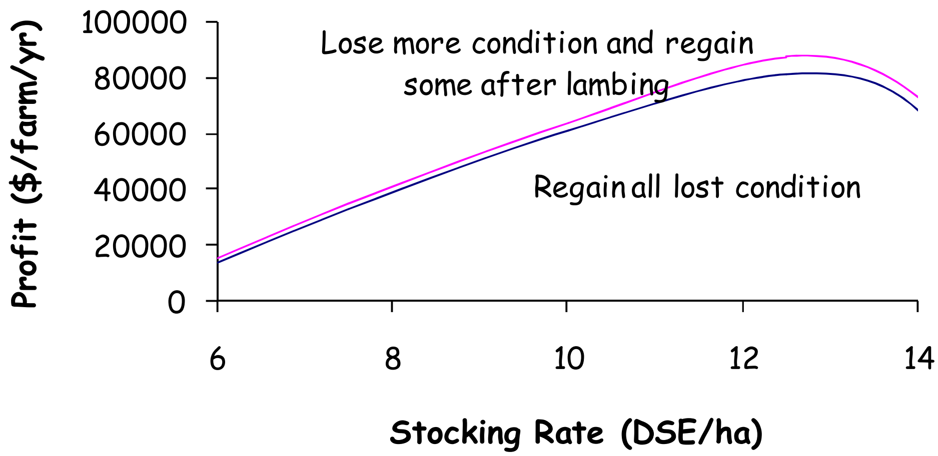


**Figure 3.1: The effect of altering stocking rate on farm profit for a farm that has higher or lower targets for ewe condition score, when the Lifetimewool effects of ewe condition on progeny fleece production and survival are ignored.**

When the Lifetimewool relationships are included, the optimum ewe nutrition profile changes. It is more profitable to lose less condition and regain all the lost condition before lambing. The calculations including the Lifetimewool impacts indicate that following the lower profile is actually less profitable by $1515/farm (2% of profit or $0.40/ewe) if the Australian paddock scale survival effects are used (Table 3.1). If the plot scale survival effects are used then the difference between the 2 profiles is less than $100/farm. Further details on other patterns are presented in Appendix 2.

**Table 3.1: Differences in profitability ($/yr) for the 900ha MIDAS farm when Lifetimewool effects are excluded or included with higher 'paddock' or lower 'plot' scale effects on lamb survival.**

| Pattern | Excluding | Including | |
|---|---|---|---|
| | | Australian Paddock | Plot |
| Join CS2.6, Lose 0.6CS to day 90 & regain 0.3CS before lambing. | +6375 | 0 | 80 |
| Join CS2.6, Lose 0.3CS to day 90 & regain 0.3CS. | 0 | +1515 | +0 |
| Response (% of profit) | 7% | 2% | 0% |
| ($/ewe) | $1.75 | $0.40 | $0.02 |

Regaining the lost condition prior to lambing requires more energy just after the break of the season but results in higher progeny fleece values and higher progeny survival. In this case the reduction in progeny production for the ewes that lose more condition in early pregnancy outweighs the saving in energy requirement and results in a benefit from meeting the target condition scores at all stocking rates (Figure 3.2) and there is little difference in the optimum stocking rate regardless of the timing of regaining the condition.

Figure 3.2 also puts the magnitude of the benefits from Lifetimewool into context. For producers in southern NSW and central Victoria altering the nutrition targets of their ewes only has a small impact on farm profit although increasing stocking rate (in a sustainable manner) has a large impact on profitability. This indicates that producers in this region will maximize their profit potential if they concentrate on optimizing stocking rate.

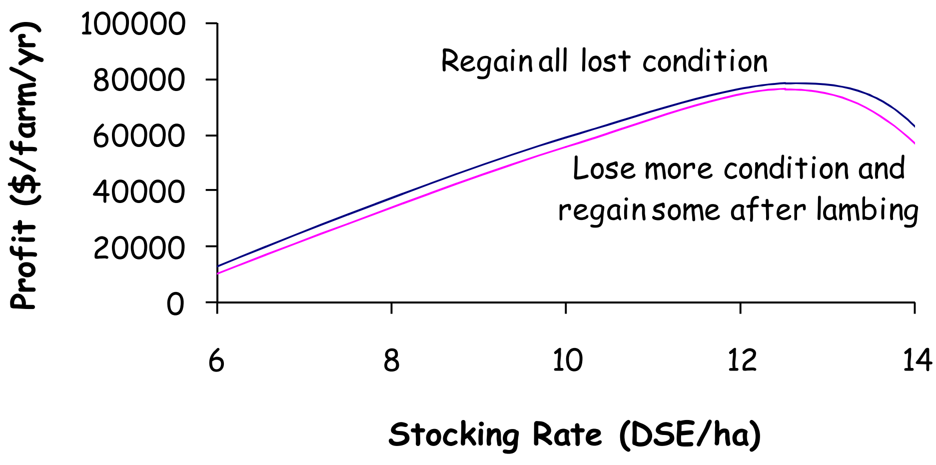


**Figure 3.2: The effect of altering stocking rate on farm profit for a farm that has higher or lower targets for ewe condition score, when the Lifetimewool effects of ewe condition on progeny fleece production and survival are included.**

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. If the influence of ewe nutrition on progeny survival is as measured in the paddock sites then changes in the fleece value contribute 1½ times the amount of changes in survival (Table 3.2).

**Table 3.2: The proportion of the difference in profitability from including Lifetimewool relationships due to changes in progeny fleece values and changes in progeny survival. The values are based on the relationship for progeny survival as observed in the paddock scale experiments.**

| | |
|---|---|
| Fleece Value | 62 |
| Survival | 38 |

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 is five times as important as 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 achieve deferment of pasture at the break of season to allow a feed wedge to build that then allows the gain in condition of the ewe on green feed prior to lambing.

The increase in the amount of supplement that is required will depends 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 approximately 10% from 206t/year or 25kg/DSE up to 221t/year or 27kg/DSE.

## 3.2 Cost of missing condition score targets

The optimum CS profile, with standard prices and production, is joining in CS2.6 followed by a managed loss of 0.3CS to reach a minimum of CS2.3 around day 80 of pregnancy and then using green pasture to regain the lost condition prior 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 CS 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, lamb survival or ewe survival varies this affects the calculation of the 'per ewe' value.

These values provide some insight into the importance of achieving the different targets. Regaining the lost condition leading up to lambing is equal in importance to losing condition between joining and day 90. If it will be difficult to gain condition in late pregnancy because of a shortage of feed the most profitable solution is to transfer more feed from early pregnancy to late pregnancy. Losing extra condition in early pregnancy and regaining some in late pregnancy is better than losing less and gaining less.

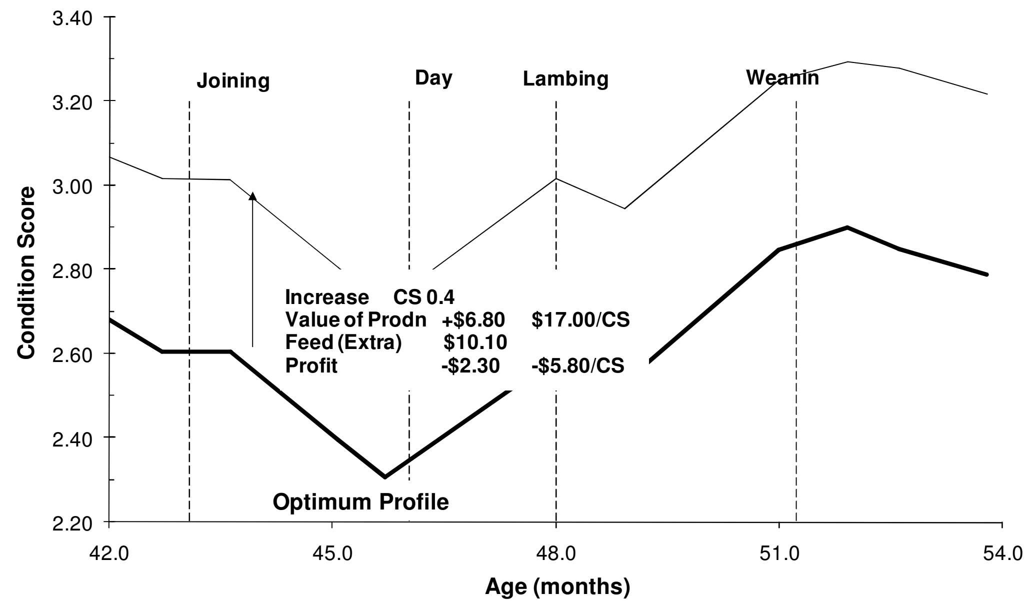


**Figure 3.3: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that maintains ewes in higher condition all year.**

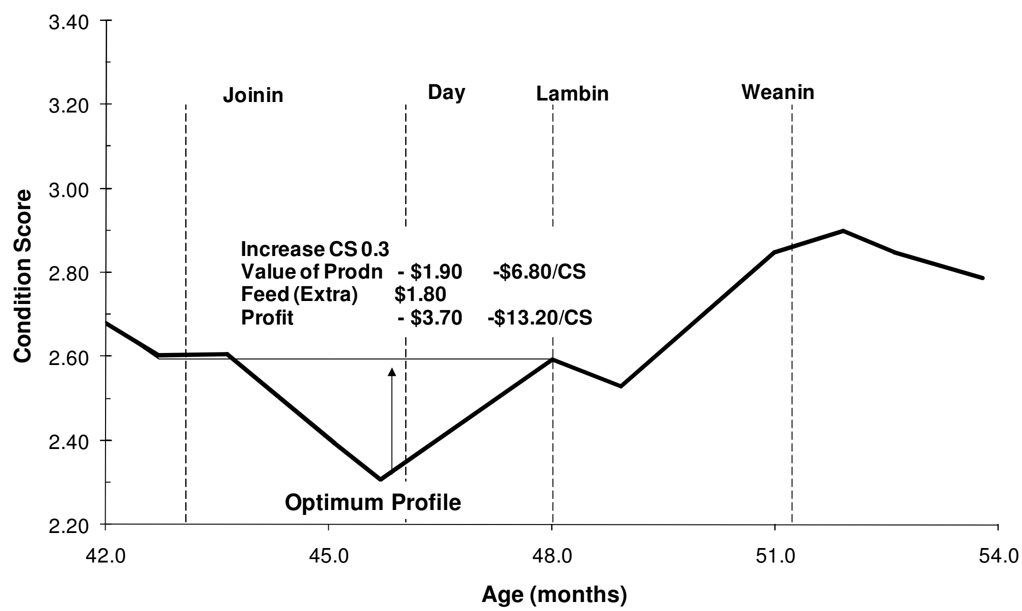


**Figure 3.4: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that maintains the ewes in the same condition from joining to lambing.**

The value of production is the amount that could be spent to increase ewe condition (or reduce loss of condition) at the different times. The profit values include the cost of providing the feed to meet the CS targets in an average year. If the season is not average then the change in value of production and an estimate of the 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.

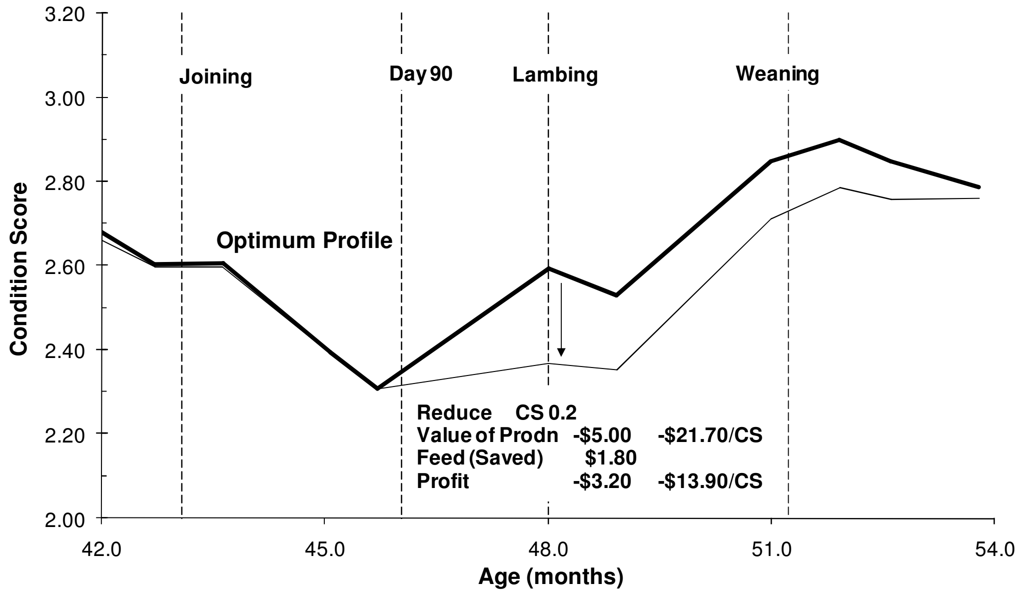


**Figure 3.5: Change in value of production, profit and cost of feeding if a sub-optimal profile is followed that produces ewes leaner than optimum at lambing.**

## 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 +/- 25%, meat price +/- 25%, grain price +100%/-25% and changing flock structure. The difference in profit per hectare compared to the optimum CS profile (2.6 at joining, 2.3 around day 80 and returning to 2.6 by lambing) for the 15 different CS profiles for the range of prices productivity and management examined is presented in Table 3.4. In the table the most profitable CS profile is highlighted in bold for each scenario.

Changing prices has little effect on the optimum nutrition profile (Table 3.4). For all the price and management scenarios examined only doubling the grain price changed the optimum nutrition profile. If grain price was doubled then the optimum profile was to lose 0.6CS to CS 2.1 by day 80 and then regain 0.3CS to lambing. In all other scenarios the optimum profile remains as join in condition score 2.6, lose 0.3CS to day 80 and then regain condition to CS 2.6 by lambing.

Therefore, the optimum CS profile for ewes is robust and the profile that gives the maximum profit for each scenario is not affected by changing prices or management. Details of farm profit and production and the impact of the different scenarios examined are presented in Appendix 3.

**Table 3.4: Difference in profit per hectare compared to the optimum CS profile (2.6 at joining, lose 0.3 to a minimum around day 80 and regain 0.3 by lambing) for the 15 different CS profiles for the range of prices productivity and management examined. The most profitable CS profile is highlighted in bold for each scenario.**

| Joining Condition Score | 2.6 | | | | | 3.0 | | | | | 3.4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Loss to minimum | 0 | 0.3 | | 0.6 | | 0 | 0.3 | | 0.6 | | 0 | 0.3 | | 0.6 | |
| Gain to Lambing | 0 | 0.3 | 0 | 0.3 | 0 | 0 | 0.3 | 0 | 0.3 | 0 | 0 | 0.3 | 0 | 0.3 | 0 |
| ***Standard scenario*** | -17 | **0** | -15 | -2 | -18 | -29 | -9 | -25 | -10 | -29 | -38 | -16 | -31 | -17 | -35 |
| ***Prices*** | | | | | | | | | | | | | | | |
| Wool +25% | -16 | **0** | -15 | -4 | -21 | -30 | -10 | -27 | -13 | -32 | -42 | -18 | -33 | -20 | -39 |
| -25% | -14 | **0** | -12 | 0 | -13 | -21 | -8 | -19 | -8 | -21 | -25 | -12 | -21 | -12 | -24 |
| FD premium +25% | -17 | **0** | -15 | -3 | -20 | -31 | -11 | -28 | -13 | -33 | -42 | -18 | -34 | -20 | -40 |
| -25% | -16 | **0** | -14 | **0** | -16 | -27 | -8 | -23 | -8 | -25 | -34 | -14 | -27 | -13 | -30 |
| Meat +25% | -17 | **0** | -15 | -3 | -20 | -29 | -9 | -25 | -10 | -30 | -39 | -15 | -30 | -16 | -35 |
| -25% | -16 | **0** | -14 | -1 | -16 | -28 | -10 | -24 | -10 | -27 | -36 | -16 | -30 | -17 | -33 |
| Grain +100% | -18 | 0 | -14 | **2** | -15 | -28 | -12 | -25 | -11 | -26 | -33 | -18 | -29 | -18 | -31 |
| +25% | -19 | **0** | -16 | **0** | -17 | -32 | -12 | -28 | -11 | -31 | -39 | -19 | -34 | -19 | -37 |
| -25% | -12 | **0** | -13 | -4 | -19 | -22 | -6 | -20 | -9 | -25 | -31 | -11 | -24 | -13 | -29 |
| ***Flock Structure*** | | | | | | | | | | | | | | | |
| Sell Wethers 5mo | -21 | **0** | -17 | -1 | -19 | -45 | -26 | -31 | -21 | -34 | -55 | -48 | -40 | -44 | -44 |
| 29mo | -13 | **0** | -14 | -5 | -18 | -21 | -6 | -20 | -9 | -25 | -27 | -9 | -23 | -13 | -28 |
| 41mo | -10 | **0** | -13 | -8 | -19 | -16 | -3 | -16 | -9 | -21 | -20 | -5 | -18 | -10 | -23 |

## 4. Conclusions

Including the biology that has been quantified as part of the Lifetimewool project alters the outcome about the most profitable nutrition strategy for ewes if survival of progeny is based on the relationship observed in the paddock scale trials. The optimum profile identified when including the progeny effects is $1515 more profitable than the profile that was thought to be optimal without Lifetimewool. The optimum profile is robust and there was very little effect of altering prices or management.

The optimum profile for the southern slopes of NSW and central Victoria is:

a. To allow moderate loss of condition from joining to day 90 and regain the condition prior to lambing.
b. Aim for CS2.6 or above at joining.

To achieve these targets it will be necessary for producers to alter the timing and slightly increase their rate of supplementary feeding which could be a disincentive to adoption of the findings of Lifetimewool.

Regaining condition prior to lambing is an important target but only has a similar value to the loss of condition to day 90. If condition cannot be regained prior to lambing it is most profitable to still allow moderate loss of condition to day 90 (0.3CS).

Joining in better condition allows greater loss of condition to day 90 while still managing the ewe mortality risk at lambing associated with poor condition.

## 5. References

Standing Committee on Agriculture (1990). Feed standards for Australian Livestock – Ruminants. CSIRO Publishing.

J.M. Young, A.N.Thompson, and C.M.Oldham (2004). Lifetime Wool 15. Whole-farm Benefits from Optimising Lifetime Wool Production. *Aust Soc. Anim. Prod.*

Young, J.M. (2007). Implications of Lifetimewool for on-farm management in the Great Southern of WA. Report to AWI. May 2007.

## *Appendix 1: Standard Farm Production*

**Table A1.1: Sheep management program.**

| | 'Wool' |
|---|---|
| Lambing time | July/Aug |
| Weaning age | 12 weeks |
| Shearing time | Jan |
| Stock turn off | |
| - wether lambs | |
| - ewe lambs | |
| - ewe hoggets | Jan |
| - CFA ewes | Jan |
| - adult wethers | Jan |

Other management comments:

- Animal husbandry
  - Drenching (1 or possibly 2 summer drenches)
  - Jetting (normally spring born lambs jetted at marking or weaning)
- Crutching (contract)
- Shearing (contract)

## Pasture productivity assumptions

**Table A1.2: Digestibility of total pasture available in each of the feed periods (Phil Graham *pers. comm.*)**

| Period start | Period end | Annual Pasture | | Phalaris | | Lucerne | |
|---|---|---|---|---|---|---|---|
| | | PGR (kg/ha/d) | DMD (%) | PGR (kg/ha/d) | DMD (%) | PGR (kg/ha/d) | DMD (%) |
| 8-Apr | 12-May | 8 | 73 | 11 | 73 | 15 | 75 |
| 13-May | 28-Jul | 20 | 73 | 16 | 73 | 14 | 72 |
| 29-Jul | 25-Aug | 30 | 75 | 28 | 75 | 25 | 72 |
| 26-Aug | 27-Oct | 60 | 70 | 55 | 73 | 50 | 77 |
| 28-Oct | 24-Nov | 20 | 63 | 42 | 67 | 50 | 75 |
| 25-Nov | 15-Dec | | 58 | 15 | 62 | 20 | 73 |
| 16-Dec | 20-Jan | | 50 | | 58 | 12 | 73 |
| 21-Jan | 17-Feb | | 45 | | 50 | 5 | 73 |
| 18-Feb | 17-Mar | | 42 | | 45 | 5 | 73 |
| 18-Mar | 7-Apr | | 40 | | 42 | 8 | 75 |

**Table A1.3: Maximum crop yields (kg/ha) on each soil (this is the yield of the crop in the highest yielding rotation). Note: the actual rotation selected may yield less than this.**

| | S2 | S3 | S5 | S6 | S8 |
|---|---|---|---|---|---|
| Wheat | 4000 | 3600 | 4000 | 2000 | 2400 |
| Barley | 3600 | 3240 | 3600 | 1800 | 2160 |
| Lupins | 1600 | 1440 | 1600 | 800 | 960 |
| Canola | 2200 | 1980 | 2200 | 1100 | 1320 |

## *Appendix 2: Profit & production summary for the 15 patterns*

**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 minimum | | 0 | 0.3 | | 0.6 | | 0 | 0.3 | | 0.6 | | 0 | 0.3 | | 0.6 | |
| Gain to Lambing | | 0 | 0.3 | 0 | 0.3 | 0 | 0 | 0.3 | 0 | 0.3 | 0 | 0 | 0.3 | 0 | 0.3 | 0 |
| ***Survival:*** | | | | | | | | | | | | | | | | |
| ***Aust. Pad. Scale*** | | | | | | | | | | | | | | | | |
| Profit | $/ha | 147 | **163** | 148 | 161 | 145 | 135 | 154 | 138 | 153 | 135 | 126 | 147 | 132 | 147 | 128 |
| | Δ$/ewe[2] | -3.7 | **0.0** | -3.2 | -0.4 | -3.9 | -6.8 | -2.3 | -6.0 | -2.5 | -6.6 | -9.7 | -4.3 | -7.8 | -4.3 | -8.9 |
| Value of Prodn* | $/ewe | 75.8 | **77.7** | 72.7 | 73.7 | 69.0 | 82.2 | 84.5 | 79.0 | 80.5 | 75.5 | 87.2 | 89.8 | 84.6 | 86.1 | 81.4 |
| Stocking Rate[1] | DSE/ha | 13.0 | **12.9** | 13.1 | 12.7 | 12.8 | 12.6 | 12.6 | 12.6 | 12.6 | 12.6 | 12.2 | 11.9 | 12.4 | 12.2 | 12.3 |
| Supplement | kg/DSE | 30.1 | **27.2** | 28.2 | 25.5 | 26.8 | 34.5 | 30.6 | 32.1 | 29.0 | 30.8 | 37.9 | 32.9 | 35.1 | 31.4 | 34.3 |
| | t | 246 | **221** | 232 | 205 | 216 | 273 | 242 | 255 | 230 | 244 | 292 | 247 | 275 | 241 | 266 |
| ***Plot Scale*** | | | | | | | | | | | | | | | | |
| Profit | $/ha | 149 | **163** | 152 | 163 | 151 | 135 | 152 | 139 | 152 | 138 | 122 | 141 | 130 | 144 | 128 |
| | Δ$/ewe[2] | -3.3 | **0.0** | -2.7 | 0.0 | -3.0 | -6.8 | -3.0 | -6.0 | -2.8 | -6.2 | -10.8 | -5.9 | -8.4 | -5.2 | -9.0 |
| Value of Prodn* | $/ewe | 77.7 | **78.7** | 75.8 | 76.2 | 73.5 | 82.2 | 83.4 | 80.2 | 80.8 | 78.0 | 85.7 | 86.9 | 84.0 | 84.7 | 82.0 |
| Stocking Rate[1] | DSE/ha | 13.2 | **12.9** | 13.1 | 12.8 | 13.0 | 12.6 | 12.5 | 12.6 | 12.6 | 12.7 | 12.1 | 11.8 | 12.4 | 12.1 | 12.4 |
| Supplement | kg/DSE | 29.8 | **27.1** | 27.8 | 25.2 | 26.3 | 34.5 | 30.7 | 31.8 | 29.0 | 30.3 | 38.3 | 33.4 | 35.2 | 31.6 | 34.2 |
| | t | 247 | **221** | 230 | 203 | 214 | 273 | 242 | 254 | 230 | 242 | 292 | 249 | 275 | 241 | 267 |

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

[2] Change in profit divided by number of ewes.

## *Appendix 3 – Detailed Sensitivity Analysis results*

**Table A3.1: Profit and production summary for the optimum CS profile for each of the scenarios examined in the sensitivity analysis.**

| | | Profit | SR | Supplement | |
|---|---|---|---|---|---|
| | | $/ha | DSE/ha | kg/DSE | Tonnes |
| ***Standard*** | | 163 | 12.9 | 27.2 | 221 |
| ***Prices*** | | | | | |
| Wool +25% | | 221 | 13.0 | 28.3 | 232 |
| -25% | | 94 | 12.4 | 26.5 | 206 |
| FD premium +25% | | 183 | 13.0 | 28.3 | 232 |
| -25% | | 135 | 13.0 | 28.3 | 231 |
| Meat +25% | | 185 | 13.0 | 28.3 | 232 |
| -25% | | 131 | 13.0 | 28.3 | 231 |
| Feed Grain +100% | | 117 | 11.5 | 26.4 | 192 |
| +25% | | 144 | 12.7 | 26.6 | 212 |
| -25% | | 171 | 13.0 | 28.3 | 231 |
| ***Flock Structure*** | | | | | |
| Sell Wethers 5mo | | 165 | 13.1 | 28.9 | 239 |
| 29mo | | 164 | 12.6 | 25.7 | 203 |
| 41mo | | 164 | 12.4 | 23.4 | 182 |