The Effect of Low Staple Strength on Farm Wool Profitability

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Abstract

Australia produces 98% of the world's fine wool. Fine wool attracts price premiums at auction. Fine wool can be much more susceptible to breakage as a result of low staple strength or 'tender' wool. Tender wool receives discounts that can range from 3% to up to 30%. This can greatly impact on farm wool income.

To evaluate the management strategies for overcoming poor staple strength, producers need to determine whether staple strength is a problem in their wool clip, and the cost to their business in forgone income as a result of strength discounts.

This study explored whether wool of poor staple strength is a problem in South West Victoria. Based on a Case Study and on industry data it was found that wool with poor staple strength can comprise almost a third of wool sold.

The severity of price discounts for tender wool changes from year to year. In years of high wool prices, and high discounts and premiums, staple strength was a key contributor to profit. In these years, profit from wool of sound strength almost doubled the profit from tender wool. In years where the wool price and discounts were low, the difference in operating profit was very marginal, with staple strength having little effect on final profits.

Managing to avoid or reduce tender wool in reproducing ewes cost $3.29 per ewe to improve staple strength by 5 N/ktex. There were increases in income of $8.98 per ewe in 2001-02 and $7.09 in 2002-03 but management costs outweighed the income benefits in years of lower wool prices.

Introduction

Wool has always been an important part of the agriculture in Australia. It is one of Australia's most important agricultural exports. Approximately one-third of commercial farms produce wool as part of their operation. The price for wool is volatile. The best priced wool is generally of a low micron and of good quality. Quality characteristics include staple length, style, vegetable matter, colour, position of break and the focus of this study, staple strength.

Staple strength is a good indicator of the processing quality of wool. Buyers discount wool that is below the strength of 35 N/ktex and pay premium prices for wool above 38 N/ktex. This makes staple strength an important contributor to the final price of the wool clip.

Staple strength of wool is difficult to predict and manage. Poor staple strength, or 'tender' wool, occurs when there is a break in the wool fibre. The break is usually at the point of minimum fibre diameter, or when there is a rapid change in the diameter (thickness) of the fibre. In highly seasonal environments, sheep have a diet of dry summer feed, then with the autumn break they can be exposed to (sometimes) large quantities of highly digestible green feed. This pattern of nutritional variability including intermittent nutritional stress is a factor in poor staple strength.

To manage for staple strength, producers need to first determine whether staple strength is a significant problem in their wool clip, and the cost to their business in forgone income as a result of discounts for low staple strength of the wool they produce. When armed with this information, producers are in a position to respond to wool prices, discounts, premiums and seasonal variation in order to maximise profit.

In this study the question of whether tender wool is a significant problem for wool growers is explored, the potential cost from producing wool of a poor staple strength is estimated, and finally, opportunities to manage to reduce the extent of poor staple strength in the wool clip are investigated.

Literature

The Wool Industry

Wool is an important agricultural industry in Australia. In 2004-05 Australia produced around 525 kilo tonnes of wool, 42 per cent of the world's greasy wool, most of which was exported. In that same period, wool accounted for 6.7 per cent of the gross value of farm production and was the second most common enterprise on Australia farms. Exports of wool were valued at $2.8 billion, making it Australia's fourth most important agricultural export behind beef, wheat and wine (ABARE, 2006).

Australia's major wool export markets include China, Italy, India, Taiwan, Czech Republic, Slovak Republic, France and Germany. Australia produces 98% of the world's fine wool (<19 micron). Italy and China are the main buyers of this type of wool (Woolmark, 2003).

In self-replacing Merino activities, income from wool usually makes up 80-95 per cent of total activity gross income. The remaining 5-20 per cent is derived from the sale of cast-for-age adult sheep and hoggets.

Wool producers have responded to the relative prices of different micron wools by increasing the production of higher value, finer micron wool. Despite a contraction in total wool production of 41 per cent between 1994-95 and 2004-05, production of wool 19 microns and less rose by 61 per cent. This has resulted in a marked decline in the premium paid for finer wools relative to medium grade wools (ABARE, 2006).

Challenges facing Australian wool producers over the years have included severe drought, volatile wool prices, animal welfare concerns, strong demand for sheep meat and competition for land resources from beef cattle, cropping (ABARE, 2006) and managed investment company schemes such as bluegum plantations. Faced with these circumstances producers of wool have little choice but to improve their wool clip and management practices in order to stay profitable and competitive in the industry.

The key short term causes of changes in the micron profile from year-to-year are typically seasonal. Over the medium term, changes in management decisions such as breeding decisions (genetics) and changes in flock demographics (proportion of ewes versus wethers) are important in driving underlying trends (AWI, 2006).

The price received for a wool clip depends on a combination of wool quality characteristics and market forces. On farm the wool is classed into lines of wool of a similar quality. Once the wool has reached market lines of wool are objectively tested by core sampling for fibre diameter, yield and other quality characteristics such as staple length, staple strength, colour, vegetable matter and position of break. Buyers have access to this information when evaluating the wool. The focus in this study is on wool production in South West Victoria. The best way to maximise price for a South West Victorian producer is to produce a heavy fleece of low fibre diameter (micron). Significant price premiums are generally achieved for wool of lower diameter (or finer) wool, as seen in Figure 1.

Fibre diameter is measured in micrometres (μm) and is frequently abbreviated to micron or μ. Low fibre diameter wool is known as fine, higher micron wool is referred to as medium or broad. Fine wool is used in a larger range of clothing products and is much softer on the skin than broad wool, allowing it to be used in higher-value apparel products. For many producers, breeding strategies are geared towards producing lower micron wool. The relationship between price and fibre diameter is shown in Figure 1.

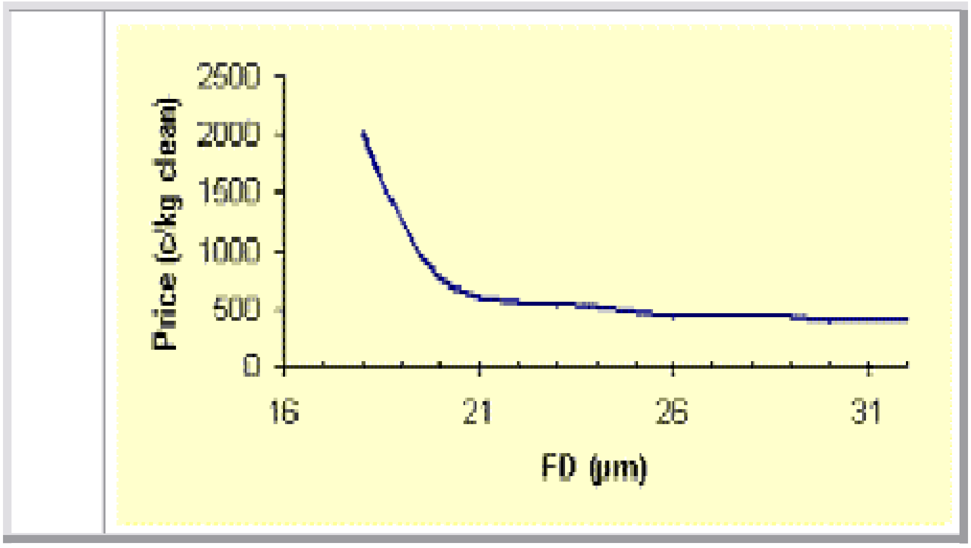

Figure 1 The category indicator prices for wool sold at auction in Australia, mid-December 2000 (Source: Australian Wool Exchange Market Reporting Service)Wool Growth and Components of Staple Strength

Staple strength

Objective measurement of staple strength was introduced in 1985/86 because too many wool fibres were breaking during early stages of processing. A measure of staple strength enabled exporters and topmakers to objectively evaluate the quality of the wool for their particular production purposes.

Staple strength indicates the fibre's ability to withstand tension and is a measure of how well the fibre will process, particularly for scourers and combers. Poor staple strength reduces processing efficiency, resulting in an increased amount of fibre breakage and wastage (Peterson, 1999).

Staple strength is measured in Newtons per kilotex (N/ktex), which is estimated from the amount of pull/force (Newtons) required to break a wool staple of a given thickness (kilotex) (Brown and Crook, 2005). The point at which the fibre breaks (POB) has implications for processing. If breaks occur in the centre or mid-point of the fibre, this can reduce hauteur (the mean fibre length in a top) and further discounts may be applied. In any one sample a large number of staples are tested, the position of break (POB) is reported as the percentage of fibres breaking in the tip, middle or base part of the staple. A clip of poor staple strength is commonly referred to as 'tender', the opposite of this is 'sound'.

Wool growth

The strength of the staple is a consequence of the wool growth properties of the sheep and the environment in which the animal lives. Growth of wool is influenced by both physiological and nutritional factors. The availability of nutrients to the wool follicle has a big impact on wool growth. This availability is influenced by changes in nutrient partitioning and body composition (Brown and Crook, 2005). Post-ruminal protein supply is an important factor in wool growth and is often related to the amount of sulfur in the animal's food intake (Friend and Robards, 2003).

Wool growth is closely related to fibre diameter, so variation in growth will be translated into variation in diameter (or width) along fibres. Wool growth is not constant throughout the year and is influenced by both the quality and quantity of available feed on offer (Schlink *et al.* 1999). There is minimal fibre growth (and consequently diameter) in the summer/autumn. Whereas most wool growth occurs in the spring when there is an excess of feed (Peterson, 1999).

Key influences on staple strength

The quality and value of fine wool is more sensitive to faults than broader wool as it is harder to process and there is a higher expectation of quality at the processing and final product level. This has significant ramifications for fine and superfine-wool producers, as large discounts are applied where tests show unacceptable levels of quality defects such as vegetable matter or poor staple strength. These discounts can dramatically decrease wool income.

Much work has been done on the science of what causes a wool fibre - or the arrangement of many fibres into a staple - to break under a low force threshold. One of the main components is variation in diameter along the fibre (Schlink *et al.* 2000). This can occur when sheep have access to different levels of nutrition throughout the year. A small diameter would occur when the sheep is fed at minimal or below energy requirements. If a sheep has access to a large supply of highly nutritious food the fibre diameter may blow out. Robertson *et al.* (2000) found that variation in fibre diameter along the staple explained 42 per cent, and minimum diameter 45 per cent of the variation in staple strength.

The weakness from this variability is often attributed not only to irregular nutrition levels, but also the rate at which the along fibre diameter changes (Doyle *et al.*1995). In a practical sense, a sheep may experience a tough summer and then suddenly have access to lots of lush green feed as a result of a good autumn break. This rapid change in nutrition levels is translated as an abrupt change in the wool fibre diameter. Research by Adams and Kelly (2000) came to these conclusions, their findings showing that changes in the rate of wool growth along the staple has a major impact on staple strength, making it important to consider the whole profile of the fibre diameter of the staple. They also found that staple strength is determined by both the amount of wool grown at the weak point and the amount of wool grown throughout the rest of the year.

Minimum fibre diameter is also an important component of staple strength. The minimum diameter is usually the site at which the fibre is weakest, indicating a point of stress for the sheep, be the stress nutritional, pathological or environmental. Thomas and Hynd (1998) found that minimum fibre diameter was most closely associated with staple strength, accounting for 66 per cent of the total variance in staple strength generated by selective breeding and nutrition. Their research found that an increase in the minimum diameter of 1μm was associated with an increase in staple strength of about 5 N/ktex.

A commonly used indicator of staple strength is the covariance of fibre diameter (CVFD). This measures the similarity of fibre diameter between fibres within the staple. CVFD is cheaper to measure then N/ktex and also has a high heritability, making it one of the few ways to breed for improved staple strength (Schlink *et al.* 1999). Thomas and Hynd (1998) produced more data on this, finding that nutrition influences staple strength by affecting along-fibre changes, whereas genetic differences in staple strength are largely attributable to between-fibre variations in diameter.

While there are many influences on staple strength, no one factor is usually the sole cause of tender wool. Peterson *et al.* (1998) conducted a study of fine wool and broad wool sheep. The fine wool sheep grew fibres with a lower minimum diameter than the broad sheep but were higher in staple strength due to other factors such as CVFD along fibres. This may have been due in part to the broad wool sheep 'blowing out' when grazing green pasture, resulting in greater variation in diameter along single fibres. This highlights the complexities that can arise when trying to manage sheep for high staple strength.

Other contributors to poor staple strength include the intrinsic strengths of proteins making up fibres, see Huson and Turner (2001). Hynd *et al.* (1997) also looked at follicle shutdown before and after the break of season, finding that on average 10 per cent of follicles became inactive around the break of season.

Staple strength is a complex measurement, summarising the effects of a few quite different biological components. How these components will influence staple strength is likely to vary depending on the interaction between sheep genotype and a number of nutritional, physiological and environmental factors (Thomas and Hynd, 1998)

Seasonal Variation in the Wool Industry

Geographic distributions

Fine wool Merino sheep are mostly located in the tablelands of NSW, in southwest Victoria and in northeast Tasmania. Fine wool Merino sheep in South West Victoria are the focus of this study.

Figure 2 shows the importance of South West Victoria in terms of production levels.

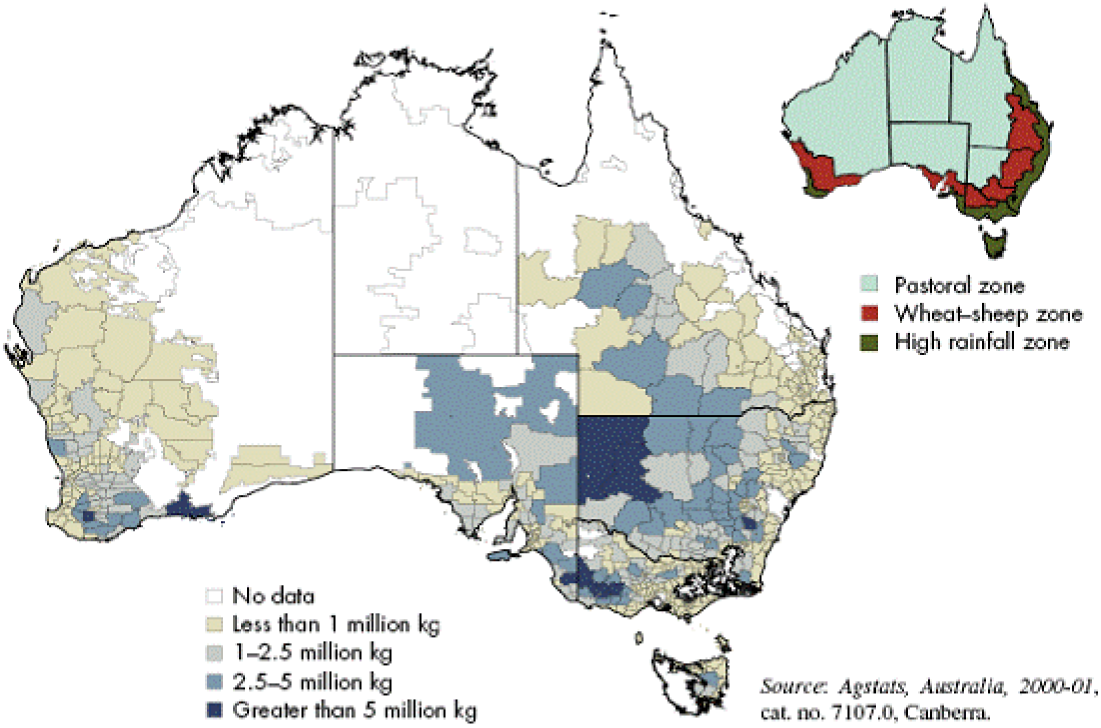

Figure 2 Wool Production 2000-01

Mediterranean climate

Much of southern Australia experiences the climate characterised as 'Mediterranean', with mild wet winters and hot dry summers. The changes in feed quality and quantity result in large seasonal changes in both wool growth and liveweight (Adams *et al.* 1998; Mata *et al.* 1999; Schlink *et al.* 1999). These conditions are found in South Western Australia, South Australia and parts of Victoria and New South Wales. Approximately half of the Merino sheep in Australia graze annual pastures, in which the feed undergoes substantial changes throughout the year. Although wool of low staple strength is produced in all states in Australia, the problem is most significant in the southern states, where 25-35% of the wool sold at auction has a staple strength of <30 N/ktex (Masters *et al.* 1998).

Hynd *et al.* (1997) found results to suggest that the follicles of Merino sheep in Mediterranean environments undergo significant morphological changes throughout the year. These changes differ from the normal sequence of events associated with the hair cycle and appear to be associated with the break of season in autumn. The results suggest a nutritional influence on the follicle.

There is a marked decline in pasture quality between spring and autumn with a rapid transition from dry herbage of low digestibility, to green, highly digestible herbage produced after the break of season in autumn. This can result in an 8 micron difference in the mean fibre diameter between spring and autumn leading to a large variation in diameter along wool fibres (Schlink *et al.*, 1999; Masters *et al.* 1998).

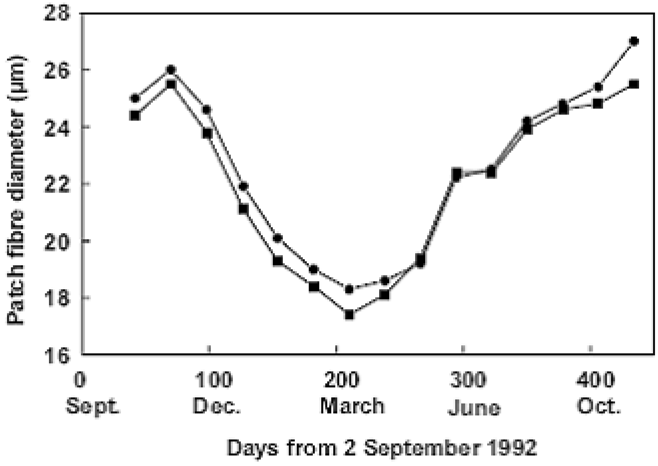

Figure 3 Fibre diameter variation throughout the year (Source: Schlink *et al.* 1999)

Management Strategies

Research has been done on strategies for managing staple strength and the point of break. There is no one answer and some strategies would be more suited to certain regions and farm business systems than others. Strategies to improve staple strength are usually focussed around meeting the nutritional needs of the sheep to produce wool fibres that are more uniform in diameter along their length. In the following section some of the options available to producers are explored.

Liveweight changes

There is a well documented positive relationship between wool growth, liveweight and liveweight changes (Masters *et al.* 1998; Peterson *et al.* 2000). Based on this, liveweight changes could be used as a guide to changes in fibre diameter profile. The management options to control liveweight variability would be to increase initial liveweight (going into summer), or to minimise the decline in liveweight over summer-autumn possibly through supplementary feeding.

Doyle *et al.* (1995) found maintenance of body tissues through adequate nutrient supply during summer-autumn is only one of a complex group of interacting factors which determine staple strength. He concluded though, that it is a prerequisite for achieving staple strength of >30N/ktex. Adams *et al.* (1998) found differing results. His study did not find significant correlations between liveweight changes and wool growth, suggesting that larger sheep cannot buffer wool growth during autumn by the mobilisation of body reserves.

Supplementary feeding and stocking rate

The underlying principle of supplementary feeding during summer-autumn to increase staple strength has been to minimise liveweight loss and increase the minimum diameter along fibres. This should reduce the variation in diameter along fibres. The likelihood of achieving gains in staple strength from summer-autumn feeding is highest when sheep are heavy going into summer, and there is a long period before the break of season. Supplementary feeding may also increase the mean fibre diameter of the wool grown. This has the potential to offset improvements in wool value derived from staple strength when fleece value of a broader micron is calculated (Peterson *et al.* 2000).

Maintenance of liveweight through supplementary feeding will increase wool growth and staple strength but is not sufficient to overcome the problem completely and is not usually a cost-effective strategy (Master *et al.* 1998). Not all studies have found the same results, Peterson *et al.* (1998) found that increased feeding during autumn could have almost no effect on the mean fibre diameter and fleece weight of wool grown over a season. This may be due to the situation where sheep fed a restricted diet during summer-autumn have been shown to compensate in liveweight and wool growth later in the green pasture phase of winter and spring. Different research designs and conditions mean conclusive results are not always found, what most studies agree on though is that through supplementary feeding at key times during the year, feed deficiencies of sheep can be met. By meeting the animal's nutritional requirements staple strength should be improved.

Another strategy is to reduce the potential fibre diameter 'blow-out' by controlling intake of green feed. Fibre diameter 'blow-out' occurs when the fibre diameter rapidly increases after the break of season, adding to the variation along wool fibres. This strategy is best for young sheep and wethers where limiting feed intake will not have an effect on breeding performance. Staple strength has been improved by 5-6 N/ktex when feed intake was restricted after the break of season (Peterson *et al.* 2000). Furthermore, the increase in staple strength was complemented by a decrease in mean fibre diameter of up to 1μm.

In South West Victoria a fibre diameter 'blow-out' generally occurs during the spring, not at the time of the autumn break. The same stocking rate management theory could be applied for the spring in this study though.

An increased stocking rate to manage the 'blow-out' may decrease the clean fleece weight per head, but this should be offset by an increase in clean wool grown per grazed hectare. This strategy is also related to managing the rate of change of fibre diameter rather than the minimum diameter. By preventing rapid changes in growth rate and fibre diameter as green feed availability increases, reduced variability should be achieved. Doyle *et al.* (1995) completed a study finding that staple strength was not increased by restricting access to green feed after the break of season. This suggests that there are many influences on staple strength.

Breeding for staple strength

Coefficient of variation in fibre diameter (CVFD) is significantly related to staple strength and is also very heritable, making it a suitable low cost selection criterion for improving fleece staple strength as a management strategy (Schlink *et al.* 1999; Adams *et al.* 1998).

Further studies have found that wool produced by sheep bred for high staple strength had significantly less variation in diameter between individual fibres than wool bred for low staple strength (Thomas and Hynd, 1998; Adams *et al.* 1997). Between-fibre differences in diameter are responsible for most of the differences between sheep selected for and against staple strength.

Breeding for staple strength is a longer term strategy than the other management strategies explored, due to the nature of genetic improvements occurring over generations.

Lambing and shearing schedule

April/May is a time when the quantity and quality of pasture can be at its lowest, despite this many producers lamb their ewes at this time. A strategy to lamb later in winter or in spring would mean nutrient requirements are more closely matched to the availability of pasture. This would also reduce the additional nutrition management required of the producer.

There is a management trade-off to be considered with later lambing however, as weaner lambs entering summer may be of lower liveweight and need careful management, especially when weaned onto dry pastures (Peterson *et al.* 2000).

Robertson *et al.* (2000) and (1996) found that the effect of a nutritional stress on staple strength may vary depending on the ewe's stage of reproduction. Identification of the particular stages of reproduction when staple strength is most sensitive to changes in nutrition should enable implementation of management strategies to avoid or reduce such short-term stresses. Robertson *et al.* (2000) also found that the later the time of restriction during pregnancy, the greater the reduction in staple strength. Staple strength was also more of a problem in twin-bearing compared to single-bearing ewes (Behrendt, 2006). Results indicate that a mechanism is operative during reproduction that has a major influence on nutritional interactions with staple strength. Behrendt (2006) found that there were opportunities to substantially improve twin ewe and progeny performance through improved ewe nutrition during pregnancy and lactation.

Shearing is an annual event that can be managed to influence staple strength (Peterson *et al.* 2000). Gordon *et al.* (1999) found that altering shearing intervals to manipulate staple length can affect other important quality traits such as fibre diameter, staple strength and position of break. While changing shearing time does not actually increase the strength of single fibres, measured staple strength may be higher if the weakest point is at the very end of the staple and is therefore clamped during testing. By moving from a spring to an autumn shearing the weakest point along the fibre would be at the time of shearing. This may result in the weak point being clamped, thereby minimising the percentage of mid-point breaks (Gordon *et al.* 1999). This would improve the wool processing ability and decrease discounts.

The logistics of arranging traditional annual events within the wool producing enterprise such as joining, lambing, lamb marking and weaning around continually changing shearing dates may prove difficult.

Flock makeup

Studies have found that the production of low staple strength wool, although not restricted to a specific class of sheep, was highest in young sheep. Barton *et al.* (1994) found that 58-70% of the wool from weaners and hoggets had a staple strength <30N/ktex. This has implications for flock makeup as a higher proportion of younger sheep in the flock will change the staple strength distribution of the flock.

Changes in wool growth response to nutrition are linked to changes in whole body metabolism, so that feed intake and body composition differs in young and adult animals. In the Mediterranean climatic zone, weaner and hogget sheep are confronted by the stress of weaning and the transition from abundant green feed to a limited supply of dry feed that is low in digestibility and protein at a time when they have a high demand for nutrients for growth (Masters *et al.* 1998). This increases their susceptibility to tender wool.

Young sheep in particular are most prone to fibre diameter 'blowout' during the year and it is these animals which will gain most in wool quality (higher strength, lower fibre diameter) from restricting feed intake on green feed (Doyle *et al.* 1995). As mentioned in the previous section reproducing ewes are also more vulnerable to poor staple strength partly due to their greatly increased energy requirements.

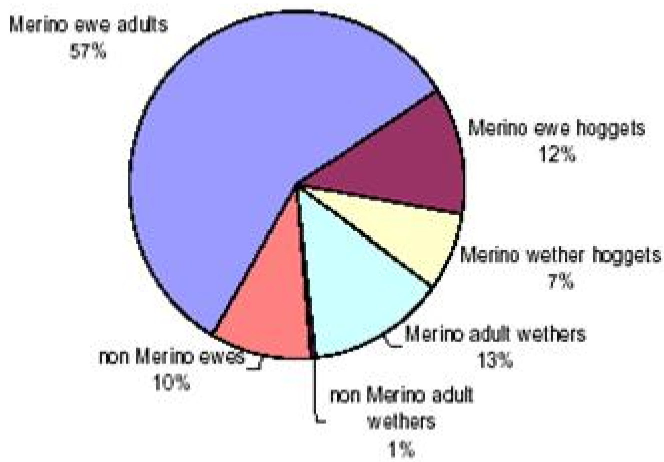

Figure 4 Composition of the adult sheep flock Australia-wide (Source: Curtis & Croker, 2005)

Lifetime wool project results

The Lifetime Wool Project is a national project developing ewe management guidelines for woolgrowers. It looks at the effects of ewe nutrition at different times of year on the productivity and profitability of the ewe and her progeny. Recent results from this project have found that for a late winter/spring lambing ewe shorn in spring/summer, a loss of one condition score in early and mid-pregnancy can decrease staple strength by 5 N/ktex (Behrendt, 2006).

Research Aims

Need for producers to understand how affected by discount prices

Producers are exposed to a lot of uncertainty when selling their wool at auction. An online resource 'Woolcheque' allows farmers to compare how wool with similar attributes has sold in the market (AWI, 2006). Woolcheque can display price tends over the previous twelve months for individual lots or entire clips, allowing growers to get an overview of market movements in relation to their own wool.

Staple strength though, is a quality attribute that is hard to pin down and consequently hard to fix. The discounts and the relative importance of staple strength varies from year to year, making it an even more ambiguous opportunity cost. To determine the effect of tender wool on their income, producers first need to have some sense of the possible causes and the potential cost. With premiums available for the wools of greater strength, there are also potential gains to be had if improvements are made and sustained.

Decision making process

There is no guaranteed management strategy that will always improve staple strength identified in the literature. There are many components of tender wool and because it is a biological process, many components of staple strength may even influence individual sheep in different ways. Despite this, there are management strategies that have been researched that have found improvements in staple strength. For producers to consider pursuing these strategies they need to have an economic incentive. The price they receive for improved strength must outweigh the management costs. By determining how much tender wool can cost producers, this approximate figure can be used to assess potential management strategies. It is information to aid producers in farm business decisions and in setting priorities.

Research questions and aim

The aim of this study is to do an economic analysis on the possible impact of low staple strength wool on farm profitability. This is based on Superfine (17-18.5 micron) Merino wool grown in the high rainfall zone of South West Victoria.

1. Is the phenomenon of tender wool a significant problem for wool growers?
2. What is the potential cost, or forgone income from producing poor staple strength wool?
3. Are there genuine opportunities to manage to reduce the extent of poor staple strength in a wool clip?

Method and Data

To determine the cost of staple strength to farm wool profitability, data from a range of sources was incorporated into a farm budget analysis. The data was a combination of industry data and farm case study figures.

Introduction of the Case Study

In this study the effects of tender wool on a representative wool growing farm was investigated. The case study method is a method of research that typically deals with a few cases and draws on a wide range of disciplinary knowledge to analyse complex systems in depth. Crosthwaite *et al.* (1997) recommended case study methods for the purposes of researching farming systems that are complex, influenced by many purposive and ad hoc management decisions, and occur with a context of ill-defined feed-back loops and uncertainty.

Farming systems are multi-faceted and there are numerous interacting factors affecting profitability and productivity. Many factors including farm management and the environment influence staple strength. To gain an understanding of how these factors can affect profitability, the case study method is useful. Insights can be gained during data collection to inform the theory. It allows a level of explanation building to occur throughout the study.

The case study farm carried a flock of 10,000 self-replacing fine wool merinos. It was located in the high-rainfall zone of South West Victoria. In Table 1 the approximate ages of the flock are shown. There are a number of culling events at certain ages for sheep, and the selling of cast for age sheep.

Age (Years)	Ewes	Wethers
1	1143	1337
2	1081	1283
3	1037	1354
4	996	
5	956	
6	918	
Total	6131	3869

Table 1 Case study flock structure

Four years of the farm's wool sale data was used to define the quantities and characteristics of wool produced. The data was acquired from sale records of the wool agent. This data also allowed any changes between years to be explored. The sale data provided figures on the following wool attributes in Table 2.

Characteristic	*Description*
Sale	The date and place of sale eg. 03/M06G
Lot	The lot number
Description	The kind of wool, eg. Fleece wool AAAM
Bls	How many bales in the sale lot
Mic	The micron (µ)
VMB	Percentage of vegetable matter in the wool
S/DRY	The yield of greasy to clean wool
mm	The length in millimetres of the staple
S/S	Staple strength (N/Ktex)
POB	Point of break in the wool: top, middle or bottom
¢/Kg	Cents per kilogram
Proceeds ($)	Total amounts paid for wool lot
Buyer	The buyer of the lot

Table 2 Wool characteristics defined

These are standard attributes that are tested in most fleece wool sold at auction, allowing buyers to use objective measures to determine the value of the wool.

Averages were taken from the case study farm for five of these characteristics in Table 3. The cents/kg column refers to the average price received for the case study farm. This value already incorporates discounts and premiums for quality characteristics specific to the farm. For the purposes of this study, average market prices for the relevant time period will be used instead of the actual prices received by the case study. This will increase the reliability of the results when applying them to other similar properties.

Assumptions

The case study farm runs 10,000 ewes. The sheep cut on average 5kg greasy wool per head. Over the four years provided an average yield of 0.75 per cent. The yield indicates the amount of clean wool derived from the greasy wool. All data and graphs that follow refer to clean wool.

Fleece is the best quality wool and attracts the best price. Skirtings consist of bellies and pieces. Cardings are of lower quality again, consisting mostly of locks. Skirtings and Cardings made up 22% of total bales, but receive less than the fleece price. These lesser value wool components are accounted for by valuing the fleece with all wool is included at 90 per cent of the value of fleece wool.

A grading system was created for staple strength distribution to help to categorize the type of wool strength being produced in the simulations in the study.

Strength grades	Corresponding measured strength level
Premium	46-50N/ktex, average = 47 N/ktex
Sound	31-45N/ktex, average = 38 N/ktex
Part tender (W1)	25-30N/ktex, average = 28 N/ktex
Tender (W2)	18-24N/ktex, average = 22 N/ktex
Very Tender (W3)	1-17N/ktex, average = 16 N/ktex

Table 3 Strength grade distribution data

These staple strength grades (Table 3) are based on Australian Wool Innovation (AWI) definitions. AWI considers 31+ N/ktex to be sound with an average of 38N/ktex. For the purpose of this study another premium grade ≥46 N/ktex was created to capture the premiums gained from having very high tensile (sound) strength wool. This category represents the optimum strength that can be achieved and the simulations were geared towards the achievement of this strength.

The 31-45 N/ktex strength grade encompasses a large proportion of the strengths. It is an acceptable category to aim for as producers aren't exposed to discounts for strength. Above a staple strength of 38N/ktex wool is generally rewarded with a premium that increases with N/ktex. 38N/ktex is assumed to be the average for the category of 31-45 N/ktex.

The data provided from wool sales of the Case Study farm was used to break up the yearly data into staple strength grades. The percentage of wool in each strength grade was calculated from the amount of bales sold of each staple strength level to determine an approximate distribution of wool for each year and then an average over the wool sale period (see Table 5). The distribution was based on 562 bales sold in the four-year period.

Case Study Relevance to South West Victorian Merino Wool Producers

Assumptions

The situation of the case study farm is applicable to South West Victorian Merino wool producers. The Farm Monitor project figures used are the averages of farm data collected. In the summary of results of the Wool Industry Farm Monitor Project for South West Victoria the following Farm Physical Parameters were found (Table 4).

	South West Average
Average Wool Clip Fibre Diameter (μm)	18.4
Average Wool Clip Yield (%)	69%
Adult Clean Wool Cut (kg)	3.1

Table 4 Wool industry farm monitor project physical parameters

These figures were not too dissimilar from the assumptions for the case study farm. The yield and wool cut were less in the monitor project and the micron was much the same. The case study farm performed higher than the district average for certain parameters.

While fleece income was based on production levels for the case study and market wool prices and discounts, the other inputs for Operating Profit were extracted from the Farm Monitor Project (FMP). The FMP should reflect the average of a number of different farms operating under similar market and climatic conditions.

The management strategy component of this study was based on some quite specific assumptions about the feed on offer. This study also had the key assumption that by keeping the ewe condition score at three, an improvement of 5 N/ktex in staple strength could achieved. This assumption was based on research findings. Further research needs to be done to see if this assumption could realistically be applied in the field.

Ability to apply the results to other properties

To determine how applicable the results are to other producers the question needs to be posed: what is a typical strength distribution? The case study, based on real data, suggests that on average approximately one third of wool produced is tender or <30N/ktex.

This data supports the distribution of case study staple strength used in the analysis. Assuming that <30N/ktex is tender, the pattern seems to be that the lower the micron the greater the proportion of tender wool sold. Tender wool makes up just less than one third of wool in the 17 and 18 micron groups (the micron grades focussed on in this study). The high proportion of >35N/ktex wool does not show up for the case study due to different strength categories used.

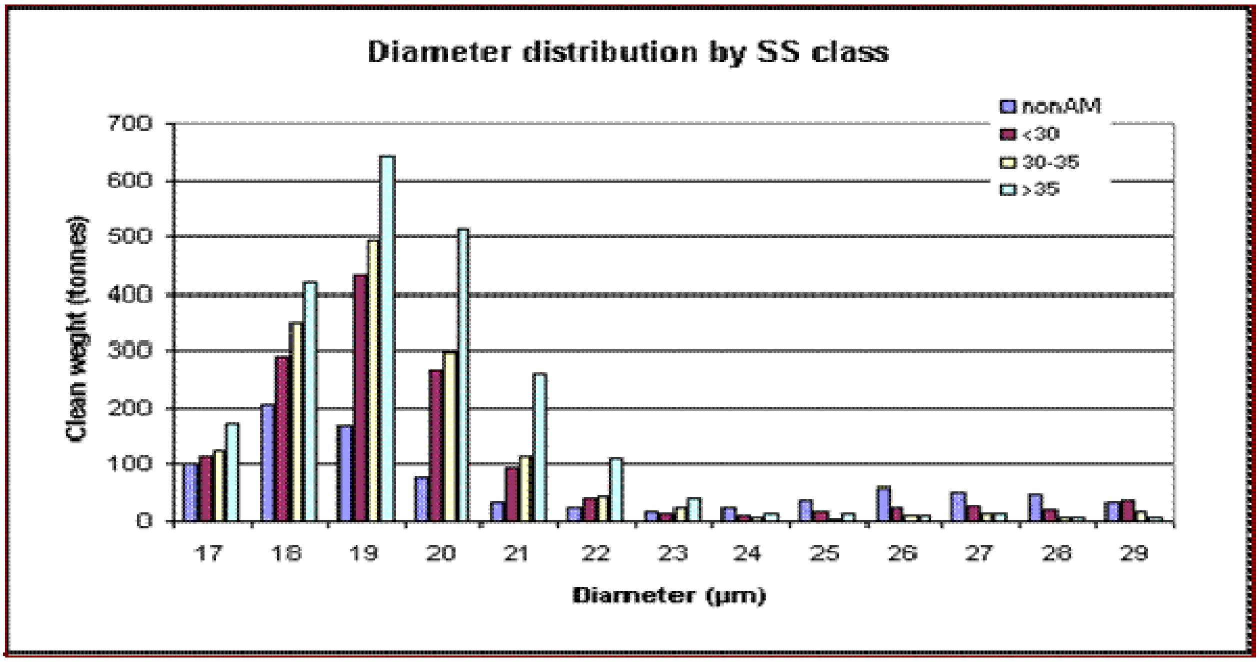

Figure 5 (Hamilton) Region, 2002-03 (Source: Behrendt, 2006)

In Figure 5 a relationship is shown between micron and staple strength. The lower the micron, the higher the proportion of tender wool. This highlights that staple strength is more of an issue for fine and superfine wool producers.

Price Data

This study used price information from 2001-02 to 2005-06. The prices used for this five-year period were for Merino superfine (17-18.5 micron) fleece wool of 38N/ktex. The data on prices and discounts was acquired from Woolmark Business Intelligence. The assumption was made that at a staple strength of 38N/ktex the price should not be influenced by premiums or discounts.

While it is straightforward to determine price when there are no quality defects, the effects of discounts or premiums for staple strength need to be incorporated to determine the actual prices received in different wool production scenarios. In Figure 6 the percentage premium or discount applied in a certain year for each N/ktex can be determined.

The percentages of discounts/premium above or below the standard of 38N/ktex were applied to the average price in each of the five years to create a chart of prices received in each staple strength category. These prices are for fleece wool only. Appendix I shows how the price chart was constructed for 2001-02.

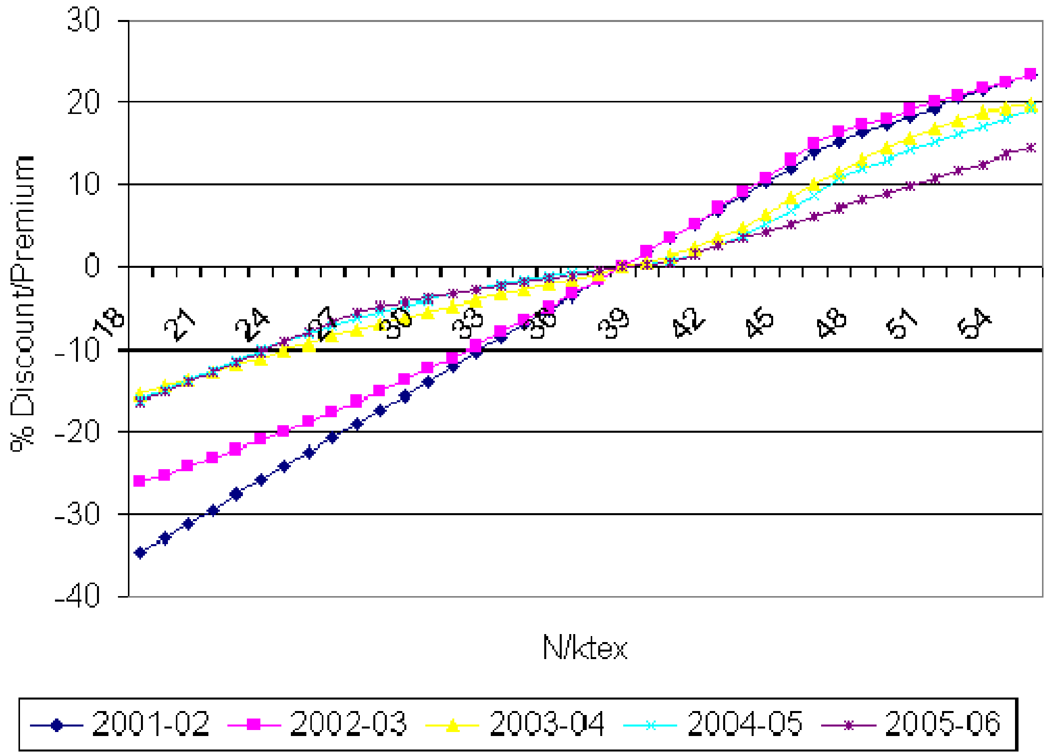

Figure 6 Superfine discounts and premium schedule

Simulations for distribution of staple strength

To determine how tender wool affects the income of a producer, it is necessary to know how much tender wool they produce. The average distribution of staple strength for the wool depot at the case study farm over the four-year period can be seen in Table 5. This is based on wool sale data.

Grades (N/ktex)	Premium ≥46	Sound 31-45	Part-tender 25-30	Tender 18-24	Very tender ≤17
Average	7%	59%	18%	15%	1%

Table 5 Case Study Farm Staple Strength Distribution

To see how the distribution of staple strength affects farm income, five other distributions of staple strength were constructed to compare to the case study farm. The simulations of the five other distributions were designed to display the full range of impacts that staple strength can have on income by representing situations of very tender wool, very sound wool and some more realistic possibilities in between.

Aside from changes in staple strength distribution, assumptions for the case study farm remained the same for all simulations. It was assumed that the staple strength distributions for each simulation were the same in each of the five years.

The six simulations produced different levels of wool in each strength grade. The production levels were based on the same assumptions for amount of wool cut, yield and head of sheep (these assumptions were held constant for the study).

Wool Profitability

Operating profit is the measure that was used to determine the impact of staple strength on the business of wool producers. Operating profit is farm gross income, less variable costs and overhead costs including an allowance for owner/operator labour and management. Operating profit excludes interest and lease costs. It can be used to compare the operational efficiency of the whole farm business. All inputs into operating profit except fleece income were obtained from five years of the Victorian Department of Primary Industries 'Farm Monitor Project'. This project collects data from many wool properties in Victoria's South West about productivity gains and profitability. Rather than use an average for five years of inputs, the costs relating to each year were put into the table separately. The aim was to capture some of the natural variations in farm costs before wool income is considered.

Using the Farm Monitor Project data is a valuable source of information as the data relates to the region of the study and the costs are likely to be accurate reflections of operation costs for the South West.

A table was produced reflecting the average wool incomes per kilogram clean wool. The income is likely to be different for each simulation, for each year. To calculate these values the price for a simulation and year was multiplied by the wool production for that year, multiplied by the percentage of fleece wool price achieved (90%). This gave a gross income figure. To get the gross wool income per kilogram, income was divided by the total amount of clean wool produced.

Farm operating profit was calculated for each simulation for the five years of the study. The individual simulation tables of operating profit can be seen in the Appendix II.

Management Strategy

Results from the Lifetime wool project are emerging that draw links between the condition score of ewes during pregnancy and staple strength changes. The Lifetime wool project has found that for late winter/spring lambing ewes shorn in spring/summer, a loss of condition score during early and mid-pregnancy can reduce staple strength by 5 N/ktex. This research may help to determine whether there are genuine opportunities to manage to reduce the extent of poor staple strength in a wool clip. In this study feed budgeting tools were used to work out whether pregnant ewes undergo a loss of one condition score under typical South West Victorian pasture conditions; what the deficiency or surplus is in ME (MJ/day); how much supplementary feed would be required to meet this deficiency; and the cost of this feed. In this study the benefits of the improved staple strength, compared with the added costs of keeping the ewes at a condition score of 3 during early and mid-pregnancy is analysed. To do this, first the amount of green and dry feed likely to be on offer (tonnes per hectare) had to be established. The pasture was assumed to be of high quality, with improved perennials and a legume content of 50 per cent. Ewes were assumed to be joined in April, lambing in September. They were assumed to be at a condition score of three at the time of joining. The ME (MJ/day) able to be consumed on this pasture were adjusted accordingly, see Table 6.

	Green FOO	Dry FOO	ME consumed
April	200	1500	4.5
May	500	800	4.9
June	700	0	7.5
July	900	0	9.9
August	1200	0	12.4
September	1500	0	20

Table 6 Energy available from pasture

Barley was used as supplementary feed, assuming an ME of 12.3 (MJ/kg) DM basis or 11.1 ME on an as fed basis. The barley was assumed to cost $160/tonne. To work out the amount of barley supplement needed, the seasonal energy deficiency was divided by the as fed ME value of barley (11.1 MJ/kg). The cost of the barley was worked out according to how much feed was needed to meet the ewe's energy deficiency. The cost of supplementary feed additional to pasture was calculated on a per month and per ewe basis, see Table 9.

To determine the financial gain if an extra 5 N/ktex was added in staple strength per ewe the price chart was used. It was assumed that the 5 N/ktex would move the ewe wool clip from the Part-tender (25-30 N/ktex) grade to the Sound (31-45 N/ktex) grade. By using the Price Chart and adjusting it for non-fleece wool, the increased income received per kilogram can be seen in 0. To determine income per ewe the increased return per kg was multiplied by 3.75kg for a per ewe value. This was based on the assumption that the ewe would cut 5kg greasy with a yield to clean wool of 75%.

Results and Discussion

In this section results depicting pricing and production of poor staple strength from the Case Study and its simulations are examined. This provides an overview of how tender wool can adversely affect income. The results of a proposed management strategy are discussed and costed against predicted improvements in staple strength. The impacts of these findings on producers from a profit and from a decision making and management point of view is explored.

The staple strength of the wool clip in 2003 and 2004-05 had similar distributions of staple strength. It is interesting to note the decreases in the sound and part-tender categories and the large increases in the premium category in 2006. There was also a relative increase in the tender category.

Pricing Results

Wool price movements

In Figure 7 the lack of volatility from 2004 to 2006 can be seen. The highest prices occurred in 2000-2001. The price around $10 per kg clean, are low for superfine wool. Decline in raw wool prices can be attributed to the dual effects of the rising Australian dollar and subdued textile demand. The fall in the premium for finer wool was also due to the surge in fine wool production and weak global demand for the higher priced fine wool garments (Woolmark, 2003).

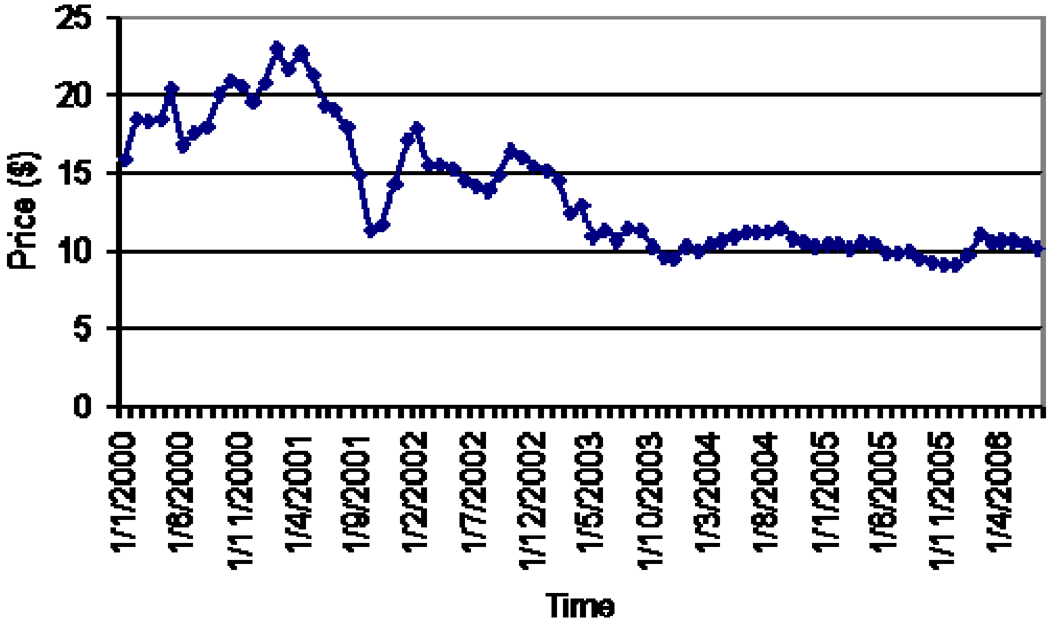

Figure 7 Superfine 38N/ktex Price History

Prices received at different staple strengths

The price chart (Figure 7) incorporates prices, discounts and in the case of ≥46 N/ktex, premiums. It can be seen that both staple strength discounts/premiums, and also the year in which the wool was sold, influence price. In comparing 2001/2002 to 2005/2006 it can be seen that staple strength discounts had less impact when the wool price was already low. The Sound and Premium categories (≥46 and 31-45 N/ktex) experienced the most fluctuation in price between years.

In Table 7 the price for very sound wool is adjusted for non-fleece wool and multiplied by the number of kilograms of clean wool cut. This is the maximum gross wool income that could be achieved on the case study farm if all the wool was ≥46 N/ktex. It is different every year due to the change in wool price and size of premium and indicates the maximum income that would be possible, holding wool cut, flock size, yield and the discount factor constant.

Year	≥46
2001/2002	$603,914.20
2002/2003	$552,467.97
2003/2004	$399,841.71
2004/2005	$398,341.30
2005/2006	$363,803.66

Table 7 Maximum prices in each year

Wool Production and Income

The amount of wool produced in each staple strength category varies according to the distribution of the staple strength. Simulations five and six are particularly vulnerable to discounts with a lot of low staple strength wool, whereas in simulations two and three wool produced is all sound and very sound.

Total wool income incorporates the production and price charts and is adjusted for non-fleece wool. Simulations two and three (best case and all sound) resulted in highest wool income. Simulations five and six are the less desirable options, but they are still more profitable in years of high prices (2001-02, 2002-03) than the cases of simulations two and three when the wool price was low in 2005-06. This means that in a year when prices are high, it can be just as profitable to have tender wool as it is to have sound wool in a year of poor wool prices.

Gross income can be seen on a per kg clean basis. These are the values used in the net operating profit calculations.

The extremes in operating profit between years and between simulations can be seen. The fact that there are extremes is interesting to note. This indicates that staple strength matters in profit terms. In 2001/2002 all simulations resulted in profits ranging from $6.25 to $11.80 per kilogram clean. The 'best case' simulation resulted in nearly double the profit of the 'all tender' simulation. In the case of 2005/2006 however, four of the six simulations made a net loss. The profit for simulations two and three was very little with incomes of just 41 and 5 cents respectively. The five year averages told another story, with a range of $2.59-$5.77 separating the simulations. This does not portray the huge fluctuations between simulations from year to year.

The ‘Poor Strength Distribution’ and ‘All Tender’ simulations resulted in profit on average over the five years. This indicates that, based on the assumptions of this study, it is usual to produce a profit even with tender wool. When comparing the large variation between simulations and years, it must be noted that all simulations are based on the same number sheep, cutting and yielding the same amount of wool, and of identical micron. The only variable is the amount of tender wool produced and the yearly price variation.

Management Strategy Results

In this section the questions of whether there are opportunities to manage staple strength in the wool clip is explored. A supplementary feeding strategy was based on meeting the nutritional needs of a ewe in early to mid reproduction. The costs of this strategy were then compared to the increased returns of an increase of 5 N/ktex in wool staple strength.

Metabolizable energy (ME, MJ/kg) is the amount of energy the animal can derive from the food source. Condition Score is a subjective measurement of the body reserves (muscle and fat) of a sheep. It is measured on a scale of 1-5. The ewe’s energy requirements throughout pregnancy were compared with the energy consumed from the available pasture and from this resultant weight gain/losses were predicted. Using feed budgeting tools the change in condition score was determined (0). The change in CS per month was related to the energy deficiency and consequential weight change of the ewe. The most dramatic changes were early on in pregnancy during autumn.

	ME Required	Energy Surplus/deficiency (ME)	Weight change (g) per day	Weight change (kg) per month	CS change per month
April	7.8	-3.3	-95	-2.9	-0.41
May	8	-3.1	-88	-2.7	-0.39
June	8.6	-1.1	-32	-1.0	-0.14
July	9.3	0.6	11	0.3	0.05
August	11.1	1.3	22	0.7	0.10
September	19.2	0.8	15	0.5	0.06

Table 8 Weight and resultant CS change during pregnancy

To keep the CS from dropping to a CS of two (from the assumed starting CS of three), supplementary feed was used to meet the energy deficiency. As the ewes were only energy deficient in April, May and June these were the only months in which supplementary feeding was needed.

	Energy Surplus/deficiency (ME)	Supplement needed kg/hd/day	Supplement Costs $/hd/day	Supplement Costs $/hd/month
April	-3.3	0.30	$0.05	$1.43
May	-3.1	0.28	$0.04	$1.39
June	-1.1	0.10	$0.02	$0.48
July	0.6	-0.05	$-0.01	
August	1.3	-0.12	$-0.02	
September	0.8	-0.07	$-0.01	
Total Cost per Ewe				**$3.29**

Table 9 Cost of supplement to keep CS constant

In Table 9 it can be seen that a supplement cost of $3.29 per ewe is predicted to keep a joined ewe at a condition score of three. To determine whether this is of good value, the projected improvement in income from an increase of 5 N/ktex was compared later in this section.

In Figure 8 is an example of how a spring lambing ewe's condition score may change in a typical season when her ME requirements are met by just South West Victorian pasture. The most dramatic CS loss occurs in autumn just after the ewe has been joined. This is a well know period of liveweight loss in this region.

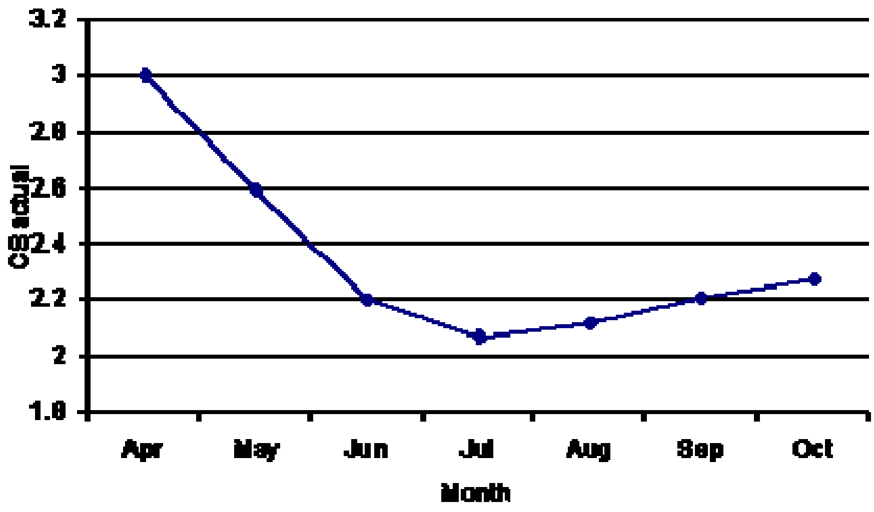

Figure 8 Condition Score Profile

The extra income provided can be seen in Table 10 and Table 11. In 2001-02 and 2002-03 there was increased income of $8.98 and $7.09 per ewe respectively from producing wool that was sound rather than part-tender. This is a large improvement from a relatively moderate improvement in staple strength. There was still increased income in 2003-04, 2004-05 and 2005-06 of $2.50, $1.96 and $1.59 respectively but these returns were not enough to cover the supplement cost of $3.29.

Year	2001/02	2002/03	2003/04	2004/05	2005/06
$/kg/clean	2.39	1.89	0.67	0.52	0.42
Increased return per ewe ($)	8.98	7.09	2.50	1.96	1.59

Table 10 Increased income per ewe from improvement of 5 N/ktex

These increased returns were based on managing the flow to move the wool clip from part-tender wool to sound wool. These same calculations were done assuming the ewes would have had tender or sound wool without supplementary feeding. This comparison is of interest as it indicates when the best return on the supplementary feeding is achieved. In Table 11 the impact of wool prices is again highlighted. In 2001/2002 and 2002/2003 it was always profitable to supplementary feed regardless of the ewe's projected staple strength, as the $3.29 cost was always exceeded by increased return. In the other years, 2003/2004 and 2004/2005 it would have only been profitable to supplementary feed to achieve premium strength wool and in 2005/2006 it wouldn't have been profitable to feed as the increased returns were less than $3.29.

It is interesting to note (Table 11) that in general the greatest increase in ewe income occurred when the sheep were supplementary fed to improve from a sound staple strength to a very sound or premium wool clip. This indicates that the benefits of premiums may outweigh the downside of discounts.

Year	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006
Sound to Premium	$8.40	$8.13	$4.59	$4.19	$2.70
Tender to Sound	$8.98	$7.09	$2.50	$1.96	$1.59
Tender to Part-Tender	$5.43	$3.38	$1.72	$2.06	$2.33

Table 11 Variation in increased income per ewe from an improvement of 5 N/ktex

Achieving premium staple strength wool is a good idea in theory, but in a practical sense, the average staple strength of the Case Study farm was 32.2 N/ktex and achieving ≥46 N/ktex would require an average of 14 N/ktex improvement in staple strength. This is probably beyond the management scope of most wool production systems in South West Victoria.

Wool producers will find that whether it is worthwhile improving wool strength from tender to part-tender or tender to sound wool, will depend on the season. In a good season, ewes may naturally produce part-tender of sound wool. In Table 11 the improvement depending on the change can be seen, the seasonal aspect of tender wool has impacts for producers when deciding how beneficial a management strategy will be.

The increased return from improving staple strength from tender to sound was found to be profitable in two years, but this management strategy may also be of benefit in the years that it does not appear to add to profit. Maintaining ewes in condition score three during pregnancy has a number of benefits in addition to staple strength. These include decreased ewe mortality and increased ewe wool production. There are also potential benefits to the lamb such as increased lamb survival rates and improved wool follicle development in the growing foetus (Behrendt, 2006). These added benefits combined with increased income from improved staple strength might make the supplementary feeding a feasible management strategy. This will depend on the producer's farm management goals and resources.

Overall though, it seems most successful management strategies are aimed at better matching feed supply to the demand of the animals, creating a constant plane of nutrition. Gloag *et al.* (2002) found similar results, concluding that farms that produced wool of higher tensile strength generally spent more on supplementary feed per animal, applied more fertiliser per hectare and had a higher wool cut per head.

Influences on farm wool profitability

Farm Profitability

Between the six simulations and the five years explored there was a huge range in net operating profit per kilograms clean wool produced. The range of profits from -$1.13 per kg clean in 'All Tender' in 2005-06 to a positive profit of $11.80 in 'Best Case' in 2001-02 indicates the impact variability in wool price and staple strength can have on income. When these operating profits are applied to the quantity of clean kilograms produced on farm the result is a loss of $42,375 or an operating profit of $442,500. These are at the extreme ends of the simulations. These results highlight the potential for gains or losses that farmers can be exposed to when managing staple strength. In Table 12 is highlighted the variation between years and simulations. The Best Case and All Sound simulations experienced profit varying by around $400,000, depending on the year. This is a huge figure based solely on variation in wool, discount and premium prices. The variation between simulations was also interesting. In 2001-02 Best Case made a profit of $400,664 whereas All Tender made $234,687 profit. This is a large variation when the only variable is the proportion of staple strength. In 2005-06 there was less difference in profit between all simulations. The range was $-42,264 for All Tender and $15,429 for Best Case. In this year staple strength had much less influence on profit compared to 2001-02. The five year average fails to indicate the huge variations between years.

Simulation	2001-02	2002-03	2003-04	2004-05	2005-06	5 Year Average
1: Case Study	$324,575	$160,646	$144,738	$109,190	$-19,035	$144,023
2: Best Case	$442,664	$265,968	$198,842	$158,341	$15,429	$216,249
3: All Sound	$400,567	$265,968	$175,873	$137,415	$1,923	$196,349
4: Mixed Flock	$334,199	$169,670	$149,125	$112,910	$-16,573	$149,866
5: Poor Strength	$266,687	$115,950	$126,610	$92,854	$-32,834	$113,854
6: All Tender	$234,257	$93,139	$116,913	$83,051	$-42,264	$97,019
Profit from increase of 5 N/ktex, Part-Tender to Sound	$34,885	$23,298	$-4,844	$-9,810	$-10,423	$6,621

Table 12 Case study farm profit figures

A strong pattern that emerged from the results is that of relatively greater gains for improved staple strength when the price and the discount is high versus years when the price and discount are both smaller.

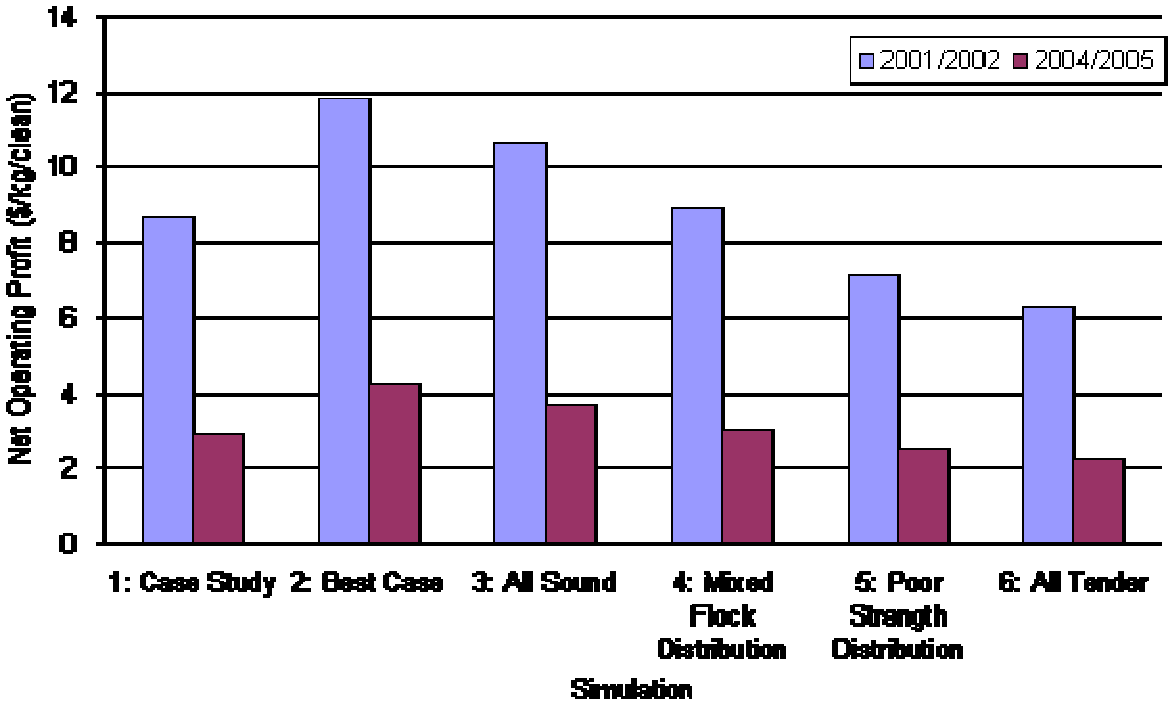

Figure 9 Comparisons of profit in years of high and low wool prices

From this it could predicted that in years of poor wool prices, having a better strength distribution within the flock will not be of great financial gain. This suggests that in years of low prices strength in not a big influence on profit.

Variability of farm income

It has been established that the wool market is volatile and difficult to predict. Forward selling wool is a useful tool to reduce the risks and uncertainty in the wool market. A crucial part of these contracts though is the specifications of the product. If a contract states 3000kg clean, 18 micron, 35N/ktex wool then the producer must be able to have this amount of wool available. If environmental and management conditions have been such that the producer has 18 micron wool of 29N/ktex then they cannot meet the contract and are at risk of large penalties or forgoing the sale. Environmental changes are also an important management factor. Rainfall, time of rainfall and temperature influence the quality and quantity of pasture available. These climate fluctuations are difficult to plan for or predict with any certainty. Producers need to react to events as they occur. In this case, producers need in-depth knowledge of the effect of seasonal conditions and on-farm management practices on wool quality, so that wool quality parameters can still be predicted as circumstances change (Gloag *et al.* 2002).

The simulations devised in this study were designed to incorporate the range of good and bad staple strengths that the Case Study farm may produce. This allowed the full range of incomes influenced by wool prices, discounts and premiums to be compared. The 'Best Case' (no tender wool) and 'All Tender' simulations show the large variability of farm income due to staple strength, even though in practice wool production systems will not produce the 'Best Case' or 'All Tender' cases.

For wool producers the components of farm income can change. In a year such as 2005-06 when the Case Study would have made a loss on wool but mutton prices were high, sheep trading income increased incomes. Years of high profits, such as 2001-02 in this study, help offset years such as 2005-06 when prices and incomes are low. This is also why producers should manage staple strength to maximise profits in years where there is the opportunity, as it will help to cover for the less profitable years.

Farm decision making

In the literature there are a number of management strategies identified to meet the fluctuating needs of the animal. For farmers to assess how relevant these strategies are to their farm they need to have an understanding of the extent of the problem and an understanding of what it costs them.

This study has ascertained that staple strength is definitely a key source of profit in some years. The problem with this simplification is that it is difficult to know when the wool price and discounts will be relatively high, until after the event when you can look back on past data. The market will have a large impact on the price received, but the environment will dictate how much of a problem tender wool is from year to year (Peterson *et al.* 2000). Producers need to follow the market to observe levels of discounts and premiums as they make management decisions. Internet tools such as Woolcheque (AWI, 2006) can assist producers in observing how wool of a similar type is selling There are prediction problems with this though, in that the producers must decide how to manage their sheep months before the wool is sold. In years when input costs and wool prices are such that the income from the wool clip will break-even with costs, this may be the time for producers to make a decision about managing the staple strength of the flock.

Other key factors that must be considered are the flock makeup and the timing of events such as shearing and lambing (Gordon *et al.* 1999). Farmers may make strategic decisions to carefully manage the nutrition of the sheep in the flock most prone to tender wool, such as hoggets and pregnant ewes.

Relationship with other fleece characteristics

There will always be some sort of relationship between micron and staple strength. In Figure 5 the relationship between lower micron and a higher proportion of staple strength can be seen. Fine micron wool is a wool fibre of low diameter. This suggests a greater vulnerability to poor strength. Fine wool is also often a result of high stocking rates and running sheep quite hard. If these management activities are not carefully managed, tender wool can be brought about by these nutritionally challenging conditions.

A consequence of feeding sheep well and at a constant plane of nutrition should result in wool of a higher staple strength, but other common results are an increased micron and increased fleece weight. This can create a paradox for the producer: by trying to control tender wool, the micron of the sheep may increase, reducing the premium received for a broader micron. This increase in micron may offset the gains of improved staple strength. An increase in wool cut may improve the returns per sheep though. The positive relationship and consequential trade off between fleece weight and micron will be covered later.

Market Forces

Superfine wool

Although wool at all micron levels can be exposed to staple strength discounts, industry data shows it becomes more of a problem as the wool becomes finer (Figure 10).

This is partly due to increased quality expectations. As the micron decreases the wool can be used for higher value end products, but the fibre’s strength must also be present for the processing to be economic and of value to processors. Conversely there are also premiums available if you can achieve good strength wool in the superfine category.

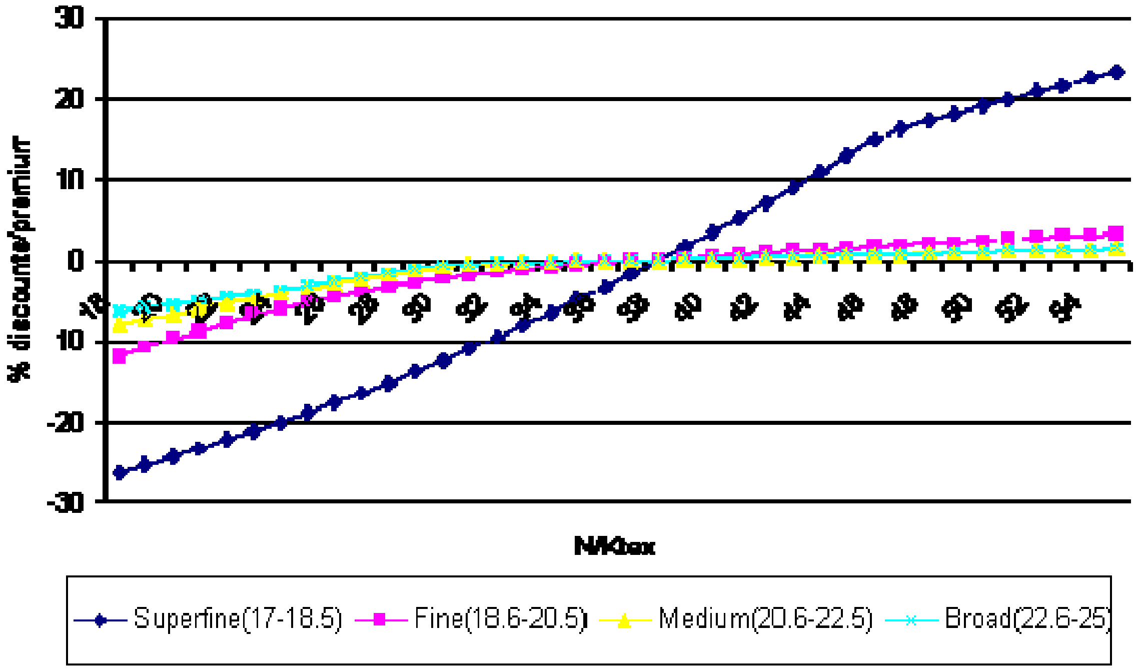

Figure 10 Staple strength schedule 2002-03

Decreasing micron of the national fleece

It is widely accepted that finer wool sheep generally have lower fleece weights. Given that wool is bought by the kilogram, producing slightly less wool but at a lower micron requires a price premium for finer wool which outweighs the losses in wool cut. If producers are having problems with poor staple strength, these discounts may erode the price premium received for fine wool. This is an important consideration as some producers may be best to grow wool at a higher micron and fleece weight, and avoid potentially larger staple strength discounts. Market signals in recent years have provided little incentive for fine wool growers to decrease fibre diameter, especially when it can mean a decline in fleece weight per animal (AWI, 2006).

Distribution of staple strength

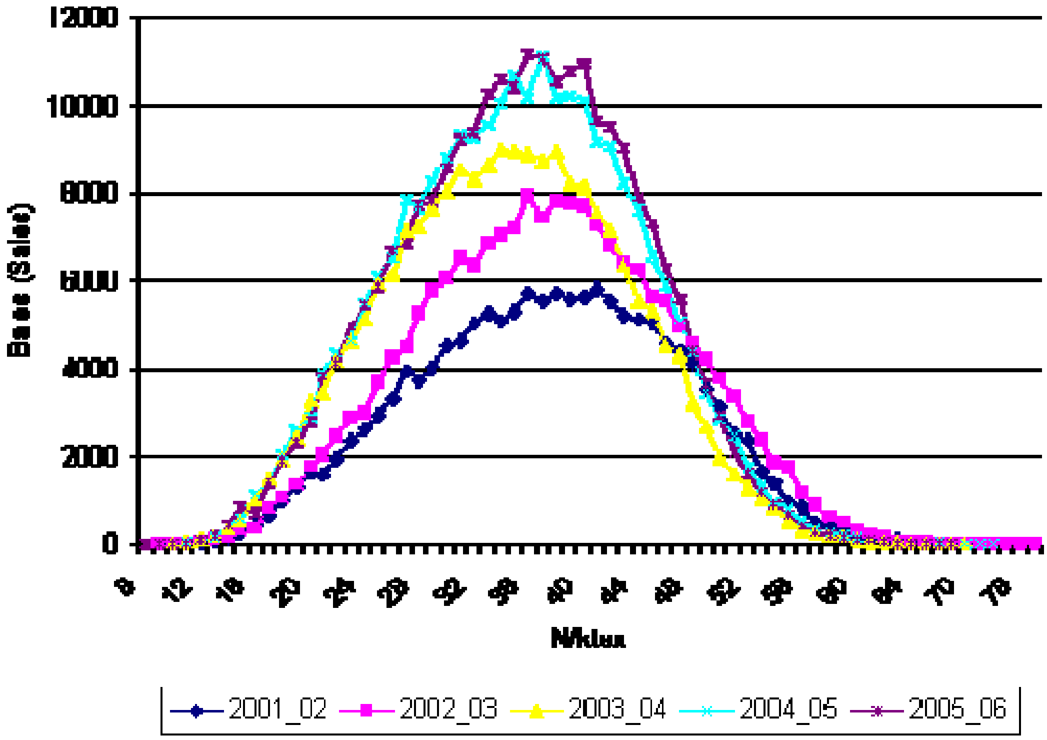

Figure 11 Staple strength distribution (bales) 17-18.5µm (Source: Woolmark, 2006)

In Figure 11 it can be seen that the distribution of wool sales hovers between 33 and 46 N/ktex. There has been a slight decrease in the average N/ktex over time. There has also been an increase in the amount of bales sold. This is probably a result of widespread breeding for low micron, increasing the amount of wool sold at a lower micron. It might also explain the slight shift in average N/ktex; as more wool of a lower micron is produced, the likelihood of tender wool increases. Difficult seasons and drought condition also decrease micron and staple strength.

Conclusions

The question of whether tender wool is a significant problem for wool growers in South West Victoria was explored. The potential cost from producing wool of poor staple strength was estimated using simulations based on a case study. Whether or not there are opportunities to manage to reduce the extent of poor staple strength in the wool clip was investigated.

Poor staple strength is an issue for superfine Merino wool producers in South West Victoria, with almost a third of all wool sold at the superfine level classed as ‘tender’. The extent of the impact of staple strength on farm profitability of wool production depends on wool prices and the discounts and premiums for staple strength.

Over the five year span of this study, there were large variations in farm operating profit between years and between simulations. Only in the 'Best Case' and 'All Sound' simulations was an operating profit made consistently. The magnitude of these profits over the five years was influenced strongly by wool price and premium levels. In 2001-02, producing very sound wool produced a profit $442,664, almost double the profit of producing tender wool, $234,257. In 2005-06 the difference between simulations was marginal, with very sound wool making a profit of only $15,429, and tender wool making a loss of $-42,264. These results suggest that in years of high wool prices, farmers should manage for improved staple strength to significantly increase profit, whereas in years of low wool prices, staple strength is less of a factor determining profit.

This study also found that there are strategies to manage nutrition to reduce the incidence of tender wool. The results of a cost analysis found that the benefits of managing to improve staple strength by feeding resulted in extra profits of $34,885 and $23,298 in 2001-02 and 2002-03. In the other three years the extra income from improved staple strength did not offset the extreme cost of supplementary feeding. This highlights the influence of wool price, discounts and premiums on the viability of managing for increased staple strength.

Management strategies available to producers warrant further research. This may merit identifying vulnerable parts of the flock and managing them specifically. Strategies that have additional benefits as well as increased staple strength, such as in reproduction performance, will be more valuable. Profitably managing staple strength is a combination of responding to the market and to the season. Producers need information and the knowledge to be able to respond tactically to fluctuating conditions.

This study has implications for producers. It highlights that for superfine South West Victorian wool producers, poor staple strength wool makes up a large proportion of wool sold. It is shown in the results that in certain years producers forgo large profits due to poor staple strength wool. In other years, staple strength has limited influence on wool profitability. Producers have the means to manage for poor staple strength wool and in certain years can increase profit through feeding management to reduce tender wool.

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APPENDIXES

1.1

Appendix I Effect of Staple Strength Discount/Premiums on 2001-02 Prices

N/ktex	Discount/Premium	2001-02 Price ($)	Change with Discount/Premium ($)	New Price ($)
18	-35%	15.40	-5.34	10.06
19	-33%	15.40	-5.07	10.33
20	-31%	15.40	-4.80	10.59
21	-30%	15.40	-4.54	10.86
22	-28%	15.40	-4.27	11.13
23	-26%	15.40	-4.00	11.40
24	-24%	15.40	-3.74	11.66
25	-23%	15.40	-3.46	11.93
26	-21%	15.40	-3.20	12.20
27	-19%	15.40	-2.94	12.46
28	-17%	15.40	-2.66	12.74
29	-16%	15.40	-2.40	13.00
30	-14%	15.40	-2.14	13.26
31	-12%	15.40	-1.86	13.54
32	-10%	15.40	-1.60	13.80
33	-9%	15.40	-1.34	14.06
34	-7%	15.40	-1.06	14.34
35	-5%	15.40	-0.80	14.60
36	-4%	15.40	-0.54	14.86
37	-2%	15.40	-0.26	15.14
38	0%	15.40	0.00	15.40
39	2%	15.40	0.26	15.66
40	4%	15.40	0.54	15.94
41	5%	15.40	0.80	16.20
42	7%	15.40	1.06	16.46
43	9%	15.40	1.34	16.74
44	10%	15.40	1.60	17.00
45	12%	15.40	1.86	17.26
46	14%	15.40	2.14	17.54
47	15%	15.40	2.34	17.74
48	16%	15.40	2.51	17.91

49	17%	15.40	2.66	18.06
50	18%	15.40	2.82	18.22
51	19%	15.40	2.99	18.39
52	20%	15.40	3.14	18.54
53	22%	15.40	3.31	18.71
54	23%	15.40	3.46	18.86
55	24%	15.40	3.62	19.02

1.2 Appendix II Net Wool Operating Profit Tables

Net Wool Operating Profit (1: Case study)					
	2001/2002	**2002/2003**	**2003/2004**	**2004/2005**	**2005/2006**
Fleece income ($/kg/clean)	12.96	11.92	9.22	9.31	8.78
Sheep Trading profit ($/kg/clean)	2.81	2.23	3.13	3.56	2.39
Gross Income	15.77	14.15	12.35	12.87	11.17
less Enterprise Costs ($/kg clean)	3.42	5.92	5.06	6.08	6.93
less Overhead Costs ($/kg/clean)	2.57	2.64	2.04	2.47	2.65
less Owner/Operator labour ($/kg/clean)	1.12	1.31	1.39	1.41	2.10
Operating Profit ($/kg/clean)	8.66	4.28	3.86	2.91	-0.51

Net Wool Operating Profit (2: Best Case)					
	2001/2002	**2002/2003**	**2003/2004**	**2004/2005**	**2005/2006**
Fleece income ($/kg/clean)	16.10	14.73	10.66	10.62	9.70
Sheep Trading profit ($/kg/clean)	2.81	2.23	3.13	3.56	2.39
Gross Income	18.91	16.96	13.79	14.18	12.09
less Enterprise Costs ($/kg clean)	3.42	5.92	5.06	6.08	6.93
less Overhead Costs ($/kg/clean)	2.57	2.64	2.04	2.47	2.65
less Owner/Operator labour ($/kg/clean)	1.12	1.31	1.39	1.41	2.10
Operating Profit ($/kg/clean)	11.80	7.09	5.30	4.22	0.41

Net Wool Operating Profit (3: All Sound)					
	2001/2002	**2002/2003**	**2003/2004**	**2004/2005**	**2005/2006**
Fleece income ($/kg/clean)	14.98	13.65	10.05	10.06	9.34
Sheep Trading profit ($/kg/clean)	2.81	2.23	3.13	3.56	2.39
Gross Income	17.79	15.88	13.18	13.62	11.73
less Enterprise Costs ($/kg clean)	3.42	5.92	5.06	6.08	6.93
less Overhead Costs ($/kg/clean)	2.57	2.64	2.04	2.47	2.65
less Owner/Operator labour ($/kg/clean)	1.12	1.31	1.39	1.41	2.10
Operating Profit ($/kg/clean)	10.68	6.01	4.69	3.66	0.05

Net Wool Operating Profit (4: Mixed Strength)					
	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006
Fleece income ($/kg/clean)	13.21	12.16	9.34	9.41	8.85
Sheep Trading profit ($/kg/clean)	2.81	2.23	3.13	3.56	2.39
Gross Income	16.02	14.39	12.47	12.97	11.24
less Enterprise Costs ($/kg clean)	3.42	5.92	5.06	6.08	6.93
less Overhead Costs ($/kg/clean)	2.57	2.64	2.04	2.47	2.65
less Owner/Operator labour ($/kg/clean)	1.12	1.31	1.39	1.41	2.10
Operating Profit ($/kg/clean)	8.91	4.52	3.98	3.01	-0.44

Net Wool Operating Profit (5: Poor Strength)					
	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006
Fleece income ($/kg/clean)	11.41	10.73	8.74	8.88	8.41
Sheep Trading profit ($/kg/clean)	2.81	2.23	3.13	3.56	2.39
Gross Income	14.22	12.96	11.87	12.44	10.80
less Enterprise Costs ($/kg clean)	3.42	5.92	5.06	6.08	6.93
less Overhead Costs ($/kg/clean)	2.57	2.64	2.04	2.47	2.65
less Owner/Operator labour ($/kg/clean)	1.12	1.31	1.39	1.41	2.10
Operating Profit ($/kg/clean)	7.11	3.09	3.38	2.48	-0.88

Net Wool Operating Profit (6: All Tender)					
	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006
Fleece income ($/kg/clean)	10.55	10.12	8.48	8.61	8.16
Sheep Trading profit ($/kg/clean)	2.81	2.23	3.13	3.56	2.39
Gross Income	13.36	12.35	11.61	12.17	10.55
less Enterprise Costs ($/kg clean)	3.42	5.92	5.06	6.08	6.93
less Overhead Costs ($/kg/clean)	2.57	2.64	2.04	2.47	2.65
less Owner/Operator labour ($/kg/clean)	1.12	1.31	1.39	1.41	2.10
Operating Profit ($/kg/clean)	6.25	2.48	3.12	2.21	-1.13

1.3 Appendix III Simulation Wool Gross Incomes

Gross Income ($) (1: Case Study)							
	Staple Strength Categories (N/ktex)						
Year	**≥46**	**31-45**	**25-30**	**18-24**	**≤17**	**Total Fleece Wool Income ($)**	**Income per kg clean ($)**
2001-02	42,612						