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## Realities of clip preparation for strong wool from adult sheep

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### ABSTRACT

There has been debate about the usefulness and profitability of varying standards of clip preparation, and the timing and frequency of shearing. This paper takes a modelling approach to gauge the relative economic value of adjusting these factors to modify the style of wool. Although adult fleeces were used as the basis for the analyses presented, the model can be used to handle all types of wool. The model shows that shearing in spring, when wool colour is best, increases wool revenue. There may however, be conflict with the overall management of the ewe flock. Similarly, shearing twice a year will yield higher wool revenue, but provides a lower net margin from wool because of higher shearing costs, but with possible management benefits. Skirting levels can have a greater impact on wool revenue of twice-yearly shorn fleece wool as second shorn oddments are primarily downgraded on length with little change in yellowness. If the grower is supplying to a specified contract, the price differential associated with clip preparation may be substantively greater than those apparent in the auction.

**Keywords:** economics; sheep farming; wool production; wool preparation.

### INTRODUCTION

While the price of raw materials traded on a commodity market is dictated by supply and demand, the relative price between different consignments in the market will differ depending on their suitability for a particular end-use. Approximately 75% of the New Zealand clip is classified as strong wool ( $>32 \mu\text{m}$ ) suited for producing interior textiles, specifically carpets. Past research has shown that the processing performance of strong wool is related to fibre diameter, fibre length, brightness, intensity of yellowing, wool bulk and vegetable matter contamination (Carnaby *et al.*, 1985). There have been various anecdotal views expressed by woolgrowers, wool buyers and industry observers as to the importance of wool preparation standards on the value of wool at the farm gate. These have tended to focus on the value of single lines, usually fleece lines, rather than considering total returns from the clip as a whole.

The purpose of wool preparation is to reduce the variation within lines, principally fleece lines, for combining into processing lots. A composite assessment of the 'degree of fault' within a line is commonly referred to as 'style'. Style can involve a consideration of the extent of staple crimp clarity, staple tippyness, freedom from unscourable discolouration and extent of vegetable matter contamination. This paper builds upon Sumner *et al.* (2008) which described the relative economic value (REV) of various objective fibre characteristics based on wool auction prices for strong wool between July 2003 and June 2007. The fibre characteristics that a woolgrower can most readily

influence through changes in management are wool length and unscourable discolouration. Apart from breed, the options available to growers to modify the style, and hence, the objective specifications of the lines within their clip are shearing date, shearing frequency and standard of fleece preparation undertaken at shearing.

The extent and position of faults within individual fleeces, and the number and competence of wool handlers can affect fleece preparation standards, which are best described as the difference in length, yellowness, stains and the presence of vegetable matter contamination between fleece and oddment lines. The financial implications of changing the number and competence of wool handlers can be gauged in terms of the change in the fault levels they are able to achieve between lines of wool. Adult ewes in New Zealand are typically shorn once in early summer, or twice a year in late autumn and again in summer. This second regime is termed "second shear". Other shearing regimes such as shearing three times every two years also exist.

This paper provides up-to-date economic guidelines as to the potential value of changing aspects of wool production and levels of preparation on wool auction prices. Wool characteristics are the expression of a biological system and as such are interdependent on each other. Thus, changes in aspects of management can change several characteristics, each affecting the wool price in different ways. For example, while shearing more than once-yearly yields a shorter fibre, with an associated discount for the reduction in length, the fibre is potentially brighter and less yellow with a premium for 'better' colour.

**TABLE 1:** Example printout of the interactive sections of a spreadsheet calculator used to calculate the potential effect on wool returns following changes in on-farm management, which affect wool characteristics. Plain text = Derived (fixed) price parameters; Italicised text = Variable parameters changed to fit each scenario; Bold text = Computed outputs.

(a) Derived price parameters

Auction price parameters	Adult fleece		Adult oddments	
	Characteristic mean	REV (cents/kg clean/unit)	Characteristic mean	REV (cents/kg clean/unit)
Mean indicator price		376		376
Mean auction price (c/kg clean)	366		322	
Assessed barbe length (mm)	94	0.1	70	0.6
Mean fibre diameter ( $\mu\text{m}$ )	36.5	-3.2	36.2	-1.4
Brightness (CIE Y)	63.4	2.2	57.4	3.4
Yellowness (CIE Y-Z)	2.3	-6.1	6.4	-3.1
Vegetable matter content(%)	0.14	-4.7	0.20	-14.2

(b) Example printout for a once-yearly shorn fleece.

Fibre attribute	Total	Fleece	Bellies	Pieces	Locks
Indicator price (c/kg clean)		376			
Washing yield (%)	71.3	75.0	58.0	62.0	50.0
Assessed barbe length (mm)	106	115	85	70	20
Mean fibre diameter ( $\mu\text{m}$ )	36.4	36.5	36.0	36.0	36.0
Brightness (CIE Y)	63.0	64.4	57.3	57.3	59.1
Yellowness (CIE Y-Z)	2.8	2.0	6.0	6.0	5.0
Vegetable matter content (%)	0.01	0.00	0.10	0.05	0.05
Proportion of total greasy fleece (%)	100.0	76.0	8.0	14.0	2.0
Weight (kg greasy/sheep)	<b>3.70</b>	<b>2.81</b>	<b>0.30</b>	<b>0.52</b>	<b>0.07</b>
Weight (kg clean/sheep)	<b>2.64</b>	<b>2.11</b>	<b>0.17</b>	<b>0.32</b>	<b>0.04</b>
Price (c/kg clean)		<b>373</b>	<b>333</b>	<b>325</b>	<b>304</b>
Total revenue/sheep	<b>\$9.59</b>	<b>\$7.86</b>	<b>\$0.57</b>	<b>\$1.04</b>	<b>\$0.11</b>

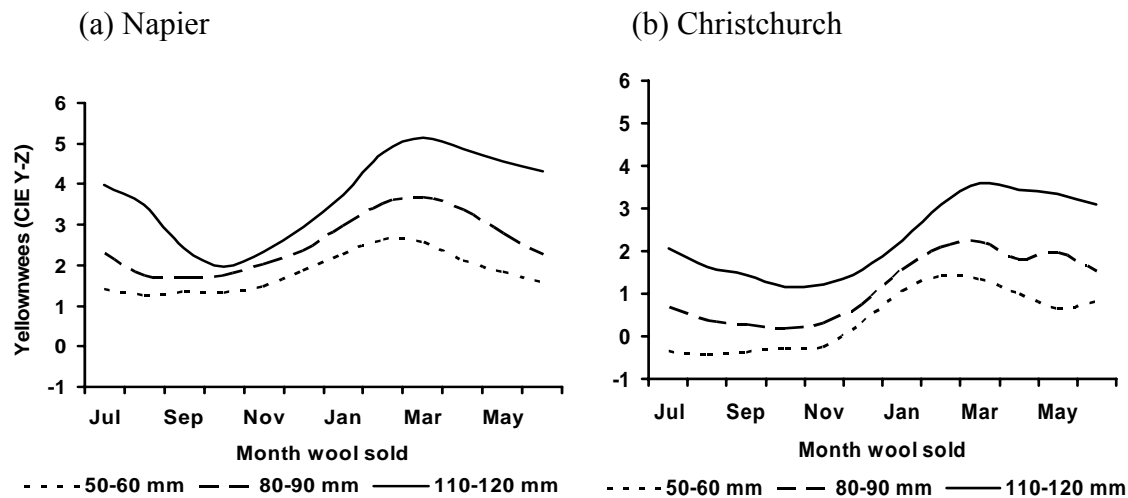
**TABLE 2:** Potential effect on wool returns per sheep at the wool indicator price of \$3.76/kg clean following shearing adult sheep once-yearly at different times during the year. The fleece had greasy weight of 3.7 kg; washing yield 75%; barbe length 115 mm; mean fibre diameter 36.5  $\mu\text{m}$  and skirted fleece 76%. Italicised text = Variable parameters; Bold text = Computed outputs.

Component	Characteristic	Shearing time			
		Early spring	Early summer	Late summer	Early autumn
Characteristics that change					
Fleece	Brightness (CIE Y)	64.4	62.5	60.8	59.1
	Yellowness (CIE Y-Z)	2.0	3.0	4.0	5.0
	VM contamination (%)	0.0	0.1	0.2	0.3
Wool revenue per sheep		<b>\$9.64</b>	<b>\$9.31</b>	<b>\$8.99</b>	<b>\$8.67</b>
Net margin per sheep		<b>\$5.44</b>	<b>\$5.11</b>	<b>\$4.79</b>	<b>\$4.47</b>

**TABLE 3:** Summary of the potential effect on wool revenue and net margin per sheep at the \$3.76 indicator price following shearing adult sheep with “good” colour grade (low CIE Y-Z value) or “poor” colour grade (high CIE Y-Z value), once-yearly in November or twice-yearly in May and November. Revenue from crutching the group shorn once a year in November is included. Bold text = Computed outputs.

Parameter	Colour Grade	Shearing frequency		
		Once-yearly	Twice-yearly	
		November	May	November
Wool revenue per sheep	“Good”	<b>\$10.14</b>		<b>\$11.31</b>
	“Poor”	<b>\$9.31</b>		<b>\$10.54</b>
Net margin per sheep	“Good”	<b>\$5.94</b>		<b>\$5.31</b>
	“Poor”	<b>\$5.11</b>		<b>\$4.54</b>

**FIGURE 1:** Seasonal variation in mean yellowness (CIE Y-Z) of strong adult fleece sold at auction in Napier and Christchurch from 1 July 2003 to 30 June 2007. Fleece wool of 50-60 mm is from shearing twice-yearly, 80-90 mm from shearing three times in two years and 110-120 mm from shearing once-yearly.



**MATERIALS AND METHODS**

The New Zealand Wool Board and Wool Services International auction price databases for strong adult fleece wool sold at Napier and Christchurch between 1 July 2003 and 30 June 2007 were used to establish estimates of the likely change in wool characteristics achievable through changes in farm management. For the purposes of the analyses presented, only full wool and second shear fleeces were considered. Fleece wool lengths of 110 to 120mm were used to represent “full wool” and 50 to 60mm to represent “second shear” wool. The estimates of the REV for different wool characteristics used in this study were those estimated by Sumner *et al.* (2008). A spreadsheet calculator was developed to estimate the change in value of a whole fleece of defined specifications through changes in the fibre characteristics of the individual components of the fleece (Table 1).

While the calculator was based on a single fleece, it was an average fleece representative of a line within a clip and hence could be extrapolated to a whole clip. The spreadsheet used estimates of the wool indicator price, fleece weight, proportional breakdown of components within the fleece and washing yield. Length, mean fibre diameter, brightness, yellowness, mean vegetable matter content and potential auction price of each component were also used to estimate the net wool returns per sheep. To adjust for changes in overall wool prices when estimating net wool returns at a point in time, provision was made to include values for the indicator wool price at the time under review and the mean indicator wool price at the time the REV was calculated. This was \$3.76/kg clean (Sumner *et al.* 2008). During this analysis, the strong wool indicator ranged between \$3.03 and \$4.53/kg clean. Equivalent changes in each of the oddment components were included in the

calculations. The projected effect was calculated at the mean indicator price. Average contract rates for shearing of \$3.00/sheep and crutching of \$1.20/sheep were assumed (Lincoln University, 2008).

The illustrative analyses reported were based on a range of lines of wool that varied by yellowness as may be expected in wool from different regions of New Zealand. The key regional difference is East versus West coast, and Northern versus Southern regions as high rainfall in combination with relatively humid summer conditions induces wool to develop yellow discolouration (Sumner, 2002).

For each “example fleece” the value for the total wool derived from the fleece was determined after apportioning it into components derived from skirting using a weighted average to ensure the average characteristics of the “example fleece” were unchanged.

**RESULTS**

**Seasonal variation in wool yellowness**

The seasonal variation in CIE Y-Z for fleece wool sold at auction in Napier and Christchurch between 1 July 2003 and 30 June 2007 within three different length groupings of strong fleece wool to represent twice-yearly shearing, shearing three times in two years and shearing once-yearly is shown in Figure 1. The intensity of wool yellowing increased with wool length regardless of the sale location or month of sale.

**Effect of shearing date**

The earlier in the wool growing season beginning in July, that sheep are shorn, the less the extent of yellowing (Figure 1). The seasonal trend in brightness was similar to that for yellowness (R.M.W. Sumner, Unpublished data) as brightness is measured by CIE Y, a factor in the measurement

**TABLE 4:** Potential effect on wool revenue per sheep at \$3.76/kg clean indicator price for once-yearly shorn adult fleeces with “good” colour grade (low CIE Y-Z) and “poor” colour grade (high CIE Y-Z) at three levels of skirting. The fleece was 3.7kg greasy with mean fibre diameter of 36.5 µm and zero vegetable matter contamination. Italicised text = Variable parameters; Bold text = Computed outputs.

Characteristic	Skirting level					
	Light	Medium	Heavy	Light	Medium	Heavy
	(CIE Y-Z changed considerably by skirting)			(CIE Y-Z changed little by skirting)		
“Good” colour grade fleece characteristics that change						
Washing yield (%)	<i>74.5</i>	<i>75.0</i>	<i>75.5</i>	<i>74.5</i>	<i>75.0</i>	<i>75.5</i>
Assessed barbe length (mm)	<i>113</i>	<i>115</i>	<i>116</i>	<i>113</i>	<i>115</i>	<i>116</i>
Brightness (CIE Y)	<i>62.8</i>	<i>63.5</i>	<i>65.3</i>	<i>63.3</i>	<i>63.5</i>	<i>64.1</i>
Yellowness (CIE Y-Z)	<i>2.9</i>	<i>2.5</i>	<i>1.5</i>	<i>2.6</i>	<i>2.5</i>	<i>2.2</i>
Skirted fleece (%)	<i>80</i>	<i>76</i>	<i>70</i>	<i>80</i>	<i>76</i>	<i>70</i>
Wool revenue per sheep	<b>\$9.45</b>	<b>\$9.49</b>	<b>\$9.52</b>	<b>\$9.48</b>	<b>\$9.49</b>	<b>\$9.49</b>
“Poor” colour grade fleece characteristics that change						
As above except for						
Brightness (CIE Y)	<i>57.3</i>	<i>58.2</i>	<i>59.9</i>	<i>58.0</i>	<i>58.2</i>	<i>58.7</i>
Yellowness (CIE Y-Z)	<i>6.0</i>	<i>5.5</i>	<i>4.5</i>	<i>5.6</i>	<i>5.5</i>	<i>5.2</i>
Wool revenue per sheep	<b>\$8.62</b>	<b>\$8.65</b>	<b>\$8.69</b>	<b>\$8.65</b>	<b>\$8.65</b>	<b>\$8.66</b>

**TABLE 5:** Potential effect on wool revenue per sheep at \$3.76/kg clean indicator price for second shear adult fleeces with “good” colour grade (low CIE Y-Z) and “poor” colour grade (high CIE Y-Z) at three levels of skirting. The fleece was 3.7 kg greasy with mean fibre diameter of 36.5 µm and zero vegetable matter contamination. Italicised text = Variable parameters; Bold text = Computed outputs.

Characteristic	Skirting level					
	Light	Medium	Heavy	Light	Medium	Heavy
	(CIE Y-Z changed considerably by skirting)			(CIE Y-Z changed little by skirting)		
“Good” colour grade fleece characteristics that change						
Yield (%)	<i>79.0</i>	<i>80.0</i>	<i>81.0</i>	<i>79.0</i>	<i>80.0</i>	<i>81.0</i>
Barbe length (mm)	<i>70</i>	<i>70</i>	<i>70.5</i>	<i>70</i>	<i>70</i>	<i>70.5</i>
Brightness (CIE Y)	<i>63.9</i>	<i>64.4</i>	<i>65.0</i>	<i>64.2</i>	<i>64.4</i>	<i>64.8</i>
Yellowness (CIE Y-Z)	<i>2.3</i>	<i>2.0</i>	<i>1.5</i>	<i>2.1</i>	<i>2.0</i>	<i>1.8</i>
Skirted fleece (%)	<i>80</i>	<i>76</i>	<i>70</i>	<i>80</i>	<i>76</i>	<i>70</i>
Wool revenue per sheep	<b>\$5.62</b>	<b>\$5.58</b>	<b>\$5.48</b>	<b>\$5.63</b>	<b>\$5.58</b>	<b>\$5.52</b>
“Poor” colour grade fleece characteristics that change						
As above except for						
Brightness (CIE Y)	<i>58.5</i>	<i>59.1</i>	<i>59.6</i>	<i>58.9</i>	<i>59.1</i>	<i>59.2</i>
Yellowness (CIE Y-Z)	<i>5.3</i>	<i>5.0</i>	<i>4.7</i>	<i>5.1</i>	<i>5.0</i>	<i>4.9</i>
Wool revenue per sheep	<b>\$5.16</b>	<b>\$5.13</b>	<b>\$5.04</b>	<b>\$5.17</b>	<b>\$5.13</b>	<b>\$5.07</b>

of yellowness. Wool shorn early in the season also contains less vegetable matter (Table 2).

### Effect of shearing frequency

Wool revenue can be increased by shearing twice a year relative to once a year, mainly through improvement in wool colour and under some conditions, a small increase in fleece weight (Sumner & Armstrong, 1987). However, the cost of the additional shearing exceeded this increase in revenue (Table 3).

### Effect of wool preparation at time of shearing

Different levels of skirting have a minimal effect on the staple length of the fleece wool line whereas changes in yellowness can be achieved (Tables 4 and 5). The impact on revenue of different levels of clip preparation vary with the length of the wool, because there is a greater difference in yellowness between fleece and belly wool in once-

yearly shorn sheep than in twice-yearly shorn sheep. For full wool, heavier skirting provides a small gain in wool revenue when skirting is able to change the yellowness of the fleece wool in lines with either good or poor overall colour. For fleeces with little overall discolouration, skirting does not change the yellowness of the fleece wool and the level of skirting has no impact on wool revenue (Table 4).

For second shorn clips, the opposite is the case. Lighter skirting will provide higher wool revenue regardless of colour as little change in yellowness can be induced. The more wool in the higher value fleece lines then the greater the return (Table 5).

## DISCUSSION

The developed spreadsheet calculator has enabled simple sensitivity analyses to be undertaken by changing the proportion of components within a clip, without changing the overall characteristics of

the 'example fleece'. As such the calculator works within a defined framework and does not require validation with respect to its capacity to predict a situation outside of its basic specifications. The analyses of Sumner *et al.* (2008) indicated that the calculated wool characteristic:price relationships were not significantly curvilinear. Thus, the trends for wool revenue indicated in this analysis will retain their relativity to each other as wool prices change.

Ideally, from the perspective of minimising yellowness and therefore ensuring maximum flexibility of end use of the wool, shearing should occur as early as practicable in the spring in both the North and South Islands. This timing will ensure maximum wool brightness, minimum wool yellowing and reduce the likely vegetable matter contamination. The combination of these factors would likely result in higher wool revenue. While this protocol is widely practised with young sheep that were not joined with a ram the previous autumn, it is not always practical for breeding ewes. The increased feed intake of recently shorn sheep (Elvidge & Coop, 1974) may affect available feed supplies. The associated costs may negate any potential benefits from higher wool returns from early-shorn breeding ewes through increased lamb losses or reduced lamb growth rate (Sumner & Willoughby, 1988). Overall sheep are shorn later in the South Island than the North Island because of the greater chances of inclement weather in the South Island during the spring, and hence the risk of stock losses following shearing is much higher.

Based upon the assumptions in the analyses presented, shearing ewes twice-yearly returns higher wool revenue than once-yearly shearing (Table 3), with the benefits being highest for fleeces with relatively poor colour grading. However, the net margin is less for twice-yearly shearing because of the additional shearing costs. The net margin is greatest for full wool fleeces with good colour grades. However, there are flock management benefits associated with shearing ewes twice-yearly, and these may outweigh the poorer net margin from the wool enterprise. Further, twice-yearly shearing can provide some flexibility in integrating shearing to suit other management constraints.

The spreadsheet calculator shows that when shearing once-yearly growers should tend towards heavier, rather than lighter skirting. This is likely to result in slightly longer barbe length, better yellowness and brightness assessments, and thus a higher price for the fleece lines. This result could be achieved without additional cost in the wool shed at the time of preparation. This result is in line with the findings of Sumner (2009) where the price implications of subjective outlier assessments favour good standards of clip preparation. In the

case of fleeces shorn twice-yearly growers can potentially skirt more lightly to optimise the amount of wool placed in the fleece lines without having a significant effect on the yellowness of the oddment lines. Lines visually assessed by buyers as being outliers due to carrying noticeable faults will be financially penalised (Sumner, 2009).

In individual cases where specific lots may be purchased as a specific component to produce a specific product, the price differential relating to a specific characteristic may vary considerably from the industry mean. Similarly, the arrangement under which the fibre enters the supply chain may also affect potential price differentials. The financial implications of a contracted grower preparing an individual clip at the point of shearing to meet defined specifications, may be different from a grower preparing their clip for auction for a variety of end-uses. Thus price differentials applying under contract growing are likely to be greater than when the wool is sold at auction as different standards of preparation may be required. Removing outlier fleeces will always be important to ensure buyers perceive that a line of wool meets their visual expectations.

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