Maximizing Fine Wool Income

- Principles — D. Cottle
- Practice — R. Jopp

TGMLI Tussock Grasslands & Mountain Lands Institute

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Maximising fine wool income — Principles

Dr David Cottle*

Introduction

Wool producers considering management options need to balance the benefits against costs. Options developed by scientists may realise extra returns but may also involve extra costs. Their adoption by farmers will depend on attitudes towards the risk of spending more to earn more. With high interest rates, the cost/benefit of an option needs to be clear cut. Few runholders record the amount of wool produced per class (and breed) of sheep, so often decisions about stock management are made without good objective data (Kerr and Lefever, 1983).

Hill and high country farmers in the South Island receive 40-50 percent and 60-70 percent respectively of their gross income from wool (Kerr and Lefever, 1983). The most numerous sheep breeds are Merinos (44-50 percent) and Halfbreds (33-44 percent).

The wool production of a flock depends mainly on its genetic worth or estimated breeding value (EBV), the feed it consumes and its health status. The income derived from this wool depends on the quantity and quality of the wool produced, its preparation and marketing. This paper outlines some basic principles in all these areas .

The genetic worth of a breeding flock is determined equally by the EBV of rams and ewes used. In a flock breeding its own rams (e.g. studs) the genetic improvement in the flock is heavily influenced by ram quality, as about 80 percent of the total selection pressure (differential) is achieved from ram selection. Similarly in a commercial flock, genetic improvement is largely influenced by the choice of sire source, rather than flock ewe

* Wool Science Department, Lincoln College

selection. This paper deals with ram management and breeding and selection policies, because they are critical to genetic progress.

Most wool returns are obtained from ewes and/or wethers. Stock nutrition determines how much of the genetic potential for wool production is achieved. Thus pasture development, grazing management and feed planning for different classes of stock are also discussed. Flock health management and wool preparation are briefly discussed.

Ram management

Rams should have high quality semen, a high semen output and a high serving capacity. The relationship between semen test results and subsequent ram fertility is very poor, whereas there is a high correlation between ram activity in the paddock and the percentage of ewes becoming pregnant. Therefore rams should be in good working order, with healthy libidos and should be assessed at least six weeks prior to mating, so replacements can be obtained if necessary.

Each ram should pass the 4T's test.

Tossle – no ulcers on the penis or sheath, freely moving penis, no swellings.

Testes – firm, equal, good size, no lumps, well off ground, no skin lesions, no brucellosis.

Teeth – unbroken, not overshot, not undershot.

Toes – trimmed, even feet, no foot abscess or footrot, free joint movement, no joint swelling.

Principle 1. It is financially advantageous to run fewer, sounder, superior, (more expensive) rams.

This assumes inbreeding is not a problem i.e. large flocks are being considered. Each gram of testicular tisue produces about 20 million sperm per day, and provided 400g of testis is allocated per 100 ewes, the sperm-producing capacity of the rams is adequate to achieve normal fertility (Gherardi *et al.*, 1980). As individual rams have paired testes weights of 200-800g, rams are generally able to cover ewes adequately at mating percentages around one percent under Australian pastoral conditions. Testicular tissue is highly sensitive to fluctuations in nutrition – changes in testicle size always precede live weight change. In the Mediterranean climate of Western Australia rams fed daily with 500g lupin seed for two months prior to mating often have testes twice the size of control rams. The reduction in rams needed per 100 ewes has made the lupin feeding a more profitable method of providing the minimum amount of testicular tissue, than buying additional rams.

Mating percentages in the hill and high country are usually 3.5 - 5.5 percent. Mating percentages required in New Zealand high country farms are probably higher than in Western Australia as there are more obstacles to ram/ewe contact. If it is rainy and windy, mating activity slows down. This seems to depend on the previous experience of sheep, as the effect is more pronounced in young sheep which may never have experienced rain before. However in the drier, high country areas, if feed is poor during mating and sheep are spread out over a wide area, it may pay to round sheep up to facilitate contact. Other obstacles to ram/ewe contact in high country would be large paddock sizes, the topography, vegetation (scrub etc) and possibly poor feed. These factors can all cause flock dispersion and can be combated, if they are real problems, by apprioriate action, e.g. increased subdivision or keeping mob sizes down to 500.

Weaned ram lambs tend to run in a monosexual environment which may stimulate abnormal behaviour in young rams. Up to 30 percent of young rams are non-workers due to lack of experience or abnormal sexual experience (Fowler, 1976). This problem can be reduced by running cull ewes with young rams either on the stud or the commercial property. Young rams can be mated in a ratio of two older rams: one young ram to older ewes, so the older rams compete with each other leaving the younger subordinate ram free to mate and gain experience.

Rams can be used as soon as they are big enough to efficiently serve ewes and on a well-managed property this should be as two-tooths, not four-tooths. It is better to purchase a few young rams each year rather than purchase a larger quantity at less frequent intervals. The choice of how long to use purchased rams is a compromise between maximising rate of genetic gain and getting value (i.e. progeny) out of the purchased ram. From both a genetic (James, 1979) and fertility viewpoint rams should not be kept past five years of age.

Examination of rams for the 4T's should take place when rams are shorn three to four months before mating, just prior to mating and three months after mating.

If rams are harnessed, the harness should be fitted at the inspection prior to joining so the harness can settle in and be adjusted. Harnesses not only facilitate lambing management, but inspection of raddle wear enables detection of non-active rams.

Shearing, crutching and dipping of rams should not occur within six weeks of mating as sperm production takes six weeks to recover from temporary infertility caused by heat or stress.

Manual inspection of the rams will ensure they have the equipment, but not necessarily the desire or libido. Libido can be tested in the pen, but serving capacity tests are of questionable value in practice, given the difficulty of conducting them, the high proportion of rams that don't serve and the low heritability of the trait (Purvis *et al.*, 1984). More worthwhile gains may be made by measuring testes size which is genetically correlated with lambing percentage (0.26) and highly heritable (0.69) (Purvis, 1987). Serving capacity tests on New South Wales studs were promoted by Phil Holmes, a private consultant, with some major clients e.g. Bonooke. Holmes claimed that 20 percent of 5000 rams surveyed running on properties in New South Wales were not getting ewes pregnant, 60 percent due to physical problems and 40 percent due to libido problems (Holmes, 1983). A rapid improvement in lambing percentage occurs in a flock using libido tested rams. However, as 50 percent of 2-tooths don't display libido, selection pressure on wool traits would be drastically reduced with rams of this age.

Finally, rams should not be left in an inaccessible paddock and ignored until shearing or the next mating. They should be kept near the home or in a paddock which is frequently passed. Problems will then be picked up earlier.

Breeding and selection

One of the most important questions a flock owner must ask is – what is my breeding objective? The objective may be to maximise the net returns/ha from the flock. This objective must then be translated into selection criteria or traits in individual sheep (usually lambs or hoggets).

The relative emphasis placed on a trait should be related to $a \times h^2 \times \delta p$, where a = relative economic value (REV), h^2 = heritability and δp = standard deviation of the trait (a measure of variability). The higher the financial value, heritability and variability of a trait, the larger the predicted response to selection and hence increased returns to the grower, if sheep are selected on their observed or phenotypic values for that trait.

If several traits are important, information on all these traits must be combined somehow to make selection decisions. Alternative approaches to combining these traits are to use tandem selection, i.e. select for each trait in turn, independent culling levels (i.e. have cut-off cull levels), selection indices (i.e. weighting each trait) or combinations of these, or visual classing, an intuitive, subjective version of the above methods.

Index selection results in the highest rate of predicted financial gain in all situations. The superiority of index selection is greatest when there are a large number of selection traits and they have similar importance. Index selection however has the highest cost, because all the traits have to be measured or assessed and the data processed. It does not result in an "aimless" increase in financial returns as suggested by Jopp, (1982), as the response of each individual trait to index selection can be predicted.

When Merino sheep are considered, the high returns from wool (70 percent of income in a ewe flock, 92 percent of income with wethers, Saunders, 1983) dictate that wool traits be given major emphasis. As most Merino flocks do not keep records of birth/rearing status, the main traits used in an index are body weight, fleece weight and fibre diameter. Subjective traits such as body conformation, wool colour, handle and staple conformation (Jopp, 1982) have low, difficult-to-define REVs. If considered, they would have independent cull levels and would have minor impact on selection decisions, and would lower the predicted responses of the main traits. If a sheep with poor conformation manages to produce a fleece worth a lot of money, should it be culled? The inclusion of additional wool measurements in a selection program has been discussed by Elliott & Cottle, (1988).

Should body weight be considered in a selection index? New Zealand breeders (e.g. Jopp, 1982) appear to place emphasis on body size, as do Australian ram buyers (Dunlop and Wilson, 1987). There is a belief that big sheep are better than small sheep. When selecting hoggets this feeling is hard to overcome. However, if the higher feed intake of bigger sheep is considered in relation to finite feed supplies and the REV of liveweight is calculated for surplus sheep sales, the percentage reduction in total returns resulting from omitting hogget liveweight from a selection index is only 0.1-5.4 percent, depending on the flock structure (Ponzoni, 1986). Increasing liveweight by selection is more beneficial the higher the stocking rate and the higher the proportion of ewes in the flock (Buchanan and Lewer, 1986).

This section compares the benefit/cost of index selection, combining fleece weight and fibre diameter only, with single trait selection and random selection, (i.e. no change or response to selection and no selection 'costs').

Three Merino strains were simulated for 20 years with the starting values shown in Table 1. The flow of genetic improvement was calculated by giving selected hoggets a lifetime EBV (and phenotype) = average of parent's EBV $+ i_{(E or R)} \times \delta_p \times h^2$, where $i_E = 0.665$ and $i_R = 2.16$ Thus the response shown in Table 1. was equal to $(i_E + i_R)/2 \times h^2 \times \delta_{p,}$ where i = standardised selection differential.

The genetic parameters assumed were $h^2FD = 0.5$, $h^2CFW = 0.4$, Genetic correlation, $(r_G) = 0.16, \delta_{p,FD} = 1.4 - 2.0.$ and $\delta_{p,\ CFW} = 0.4 - 0.5.$

These values have been corrected for sex, maternal handicap etc. If this is not done in the field, then responses will be lower.

These values were assumed to stay constant, although in practice changes in gene frequencies in the population would cause h^2 and r_G to change and reduce the response to selection. The annual rate of improvement in Trangie CFW selection flocks has remained constant at one percent/year for 25 years (McGuirk, 1982). This is a similar figure to that predicted here for CFW selection flocks (see Table 1), which suggests the predicted responses can be obtained in practice. Wool prices were derived from an analysis of NZWB auction prices (1983-87).

For each strain and selection method the cumulative increase in wool returns compared to a random flock was calculated as (average EBV of ewes, rams, or sale rams in the flock -starting value) x number of ewes, rams or sale rams. In the case of sale (surplus) rams in the stud the extra EBV (individual wool value) when multiplied by 50 estimates the increased value of these rams to commercial buyers in terms of increased production from all future progeny of the ram (Cottle, 1986).

The test cost was calculated on the basis of all hoggets being tested. Only testing a portion screened on GFW would be even more cost effective.

Table 1. Response to selection, in a self replacing flock assuming all hoggets are measured; 60% of ewes and 4% of rams are kept

Sheep Type	Selection Method	Average Fleece Traits after 1 generation of selection in both sexes			Increase in Average Fleece Value/generation ($)
		FD	CFW	$	
19μFD	1.1 Index	18.02	3.035	30.78	5.54
3.0kg CFW	(1.3 CFW-FD)				
$25.24/fleece	FD constant index	19.00	3.216	27.07	1.83
	(26.3 CFW-FD)				
	GFW-Index	18.00	3.001	30.53	5.29
	(GFW-1.6 FD)				
	1.2 FD only	17.97	2.960	30.28	5.04
	1.3 CFW only	19.15	3.222	26.28	1.04
	1.4 GFW only	19.18	3.204	25.94	0.70
	1.5 Visual GFW	19.06	3.061	24.45	0.21
21 μ FD	2.1 Index	20.02	3.586	26.41	3.35
3.5kgCFW	(1.9 CFW-FD				
$23.06/fleece	FD constant index	21.00	3.750	24.71	1.65
	(25.7 CFW-FD)				
	GFW Index	20.07	3.544	25.96	2.90
	(1.4 GFW-FD)				
	2.2 FD only	19.86	3.454	25.86	2.80
	2.3 CFW only	21.16	3.756	24.27	1.21
	2.4 GFW only	21.20	3.727	23.96	0.90
	2.5 Visual GFW	21.06	3.568	23.33	0.27
23 μ FD	3.1 Index	21.96	4.146	25.44	2.38
4.0kg CFW	(3.2 CFW-FD)				
$23.06/fleece	FD constant index	23.00	4.274	24.62	1.56
	(28.1 CFW-FD)				
	GFW Index	22.32	4.084	24.52	1.45
	(2.3 GFW-FD)				
	3.2 FD only	21.59	3.948	24.74	1.68
	3.3 CFW only	23.20	4.290	24.40	1.34
	3.4 GFW only	23.25	4.250	24.10	1.04
	3.5 Visual GFW	23.08	4.075	23.37	0.31

In the case of index selection. the benefit/cost of selecting only rams in the stud was studied, as well as ewe selection in a commercial flock. When ewes were unselected they were given the average EBV of their parents.

Table 2. Accumulated extra returns and costs in a stud after 20 years of selection, compared to a random breeding flock

Sheep Type	Selection Method	Extra Returns (x$1000) Breeding Ewes	Rams	Sale Rams xEBV	Sale Rams +Sales	Extra test Costs (x$1000)	Benefit-cost (x$1000) xEBV	+ Sales
Fine Wool	1.1 Index	246.1 *(164)	11.6 (10)	67.9(44)	3,178 (2061)	80.8(40.4)	245 (178)	3355(2195)
	1.2 FD	222.7	10.5	61.4	2,877	60.8	234	3049
	1.3 CFW	46.0	2.2	12.7	594	64.8	-4	577
	1.4 GFW	30.9	1.5	8.5	400	4.8	36	428
	1.5 Visual	9.3	0.4	2.6	120	2.4	10	127
Medium Wool	2.1 Index	147.3 (97)	7.0 (6)	40.9(25)	1,916 (1171)	80.8(40.4)	115 (88)	1191(1234)
	2.2 FD	124.0	5.8	34.2	1,601	60.8	103	1670
	2.3 CFW	53.4	2.5	14.7	689	64.8	6	680
	2.4 GFW	39.6	1.9	10.9	512	4.8	48	549
	2.5 Visual	12.0	0.6	3.3	155	2.4	14	165
Strong Wool	3.1 Index	105.2 (69)	4.9 (4)	29.0(20)	1,359 (937)	80.8(40.4)	58 (53)	1388 (970)
	3.2 FD	74.2	3.5	20.5	959	60.8	37	976
	3.3 CFW	59.2	2.8	16.3	765	64,8	14	762
	3.4 GFW	46.0	2.2	12.7	594	4.8	56	637
	3.5 Visual	13.8	0.6	3.8	178	2.4	16	190

x EBV = current individual wool value
+ Sales = discounted value of all future progeny
* (Ram only selection)

Table 2 cont.

b) 10 years of selection

Sheep Type	Selection Method	Extra Returns (x$1000) Breeding Ewes	Rams	Sale Rams xEBV	Sale Rams +Sales	Extra test Costs (x$1000)	Benefit-cost (x$1000) jxEBV	Benefit-cost (x$1000) + Sales
Fine Wool	1.1 Index	40.8 (20.0)	3.0 (2)	14.3(54)	670 (234)	40.4(20.2)	18 (7)	673(236)
	1.2 FD	37.0	2.7	12.9	605	30.4	22	614
	1.3 CFW	7.6	0.6	2.7	125	32.4	-22	101
	1.4 GFW	5.1	0.4	1.8	84	2.4	5	87
	1.5 Visual	1.5	0.1	0.5	15	1.2	1	25
Medium Wool	2.1 Index	24.6 (11)	1.8 (1.6)	8.6(4)	403 (187)	40.4(20.2)	-5 (-3.6)	389(180)
	2.2 FD	20.6	1.5	7.2	337	30.4	-1	329
	2.3 CFW	8.9	0.7	3.1	145	32.4	-20	122
	2.4 GFW	6.6	0.5	2.3	108	2.4	7	113
	2.5 Visual	2.0	0.1	0.7	33	1.2	2	34
Strong Wool	3.1 Index	17.5 (5)	1.3 (1)	6.1(2.0)	286 (117)	40.4(20.2)	-16(-12)	264 (103)
	3.2 FD	12.3	0.9	4.3	202	30.4	-13	185
	3.3 CFW	9.8	0.7	3.4	161	32.4	-19	139
	3.4 GFW	9.6	0.5	2.7	125	2.4	9	131
	3.5 Visual	2.3	0.2	0.8	38	1.2	2	39

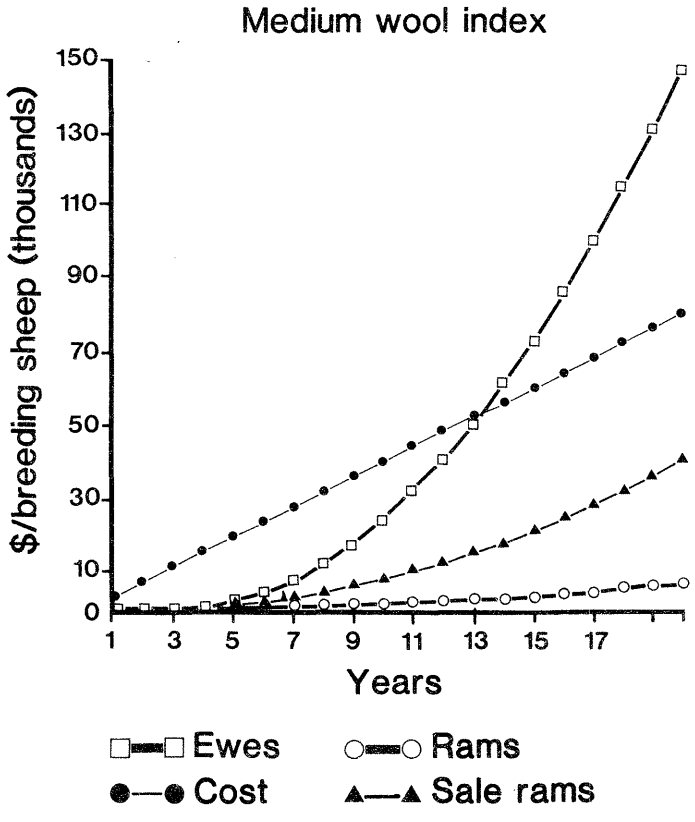

Figure 1. Medium wool. Cumulative costs and returns using Index Selection in a 1000 ewe stud flock. Both rams and ewes measured, sale rams — individual value only (see text)

The results (see Figure 1 and summary in Tables 2 and 3) suggest a number of conclusions:

Principle 2: The predicted additional returns from using objective measurement in a stud are well in excess of the additional costs of measurement.

Most of the returns in Table 2 accrue through the worth of higher performing sale rams. If this is disregarded the costs of objective measurement are still covered by the extra wool income generated by the ewe portion of the flock after 9-14 years.

Commercial breeders with medium and strong wool ewe flocks should not bother measuring ewes for CFW and FD, as the cost involved will not be covered by extra wool returns. With fine wool Merinos the cost was not recovered until after 14 years of accumulated gain. This assumes the response to selection for fitness will be linear for 14 years, i.e. 4.4 microns finer/14 years. There is probably a physiological limit to fineness response.

Table 3. Accumulated extra returns and costs in a commercial ewe flock with or without 20 years of selection of ewes using a selection index, assuming rams are purchased from a stud using index selection.

Sheep Type	Ewe Selection	Extra returns Ewes (wethers)*	(x$1000) Difference with ewe selection	Extra Costs
Fine	+	170	67	40
	-	103		-
Medium	+	102	41	40
	-	61		-
Strong	+	71	27	40
	-	44		-

* extra returns in a wether flock will be similar to the returns in a ewe flock with no selection

The benefit/cost ratio is highest for index selection. As seen in Table 2 there is a substantial loss in keeping FD constant, given the premium for finer wool in the current market. Breeders who have clients who want stronger woolled rams could run a subflock for this purpose.

The best approach for a commercial breeder would be to purchase rams from a stud breeder with the same breeding objectives. Prices should be based on the ram's genetic merit, calculated by the relevant index or selection criteria. Ewes should be selected on greasy fleece weight only.

The benefit/cost of measuring both rams and ewes is favourable in studs as the extra response to ewe selection covers the costs of testing. In commercial flocks running and breeding both ewes and wethers, the costs of testing ewes may be justified in fine wool flocks if there is a continuing response to selection.

A breeder may also want to consider the structure of the breeding enterprise.

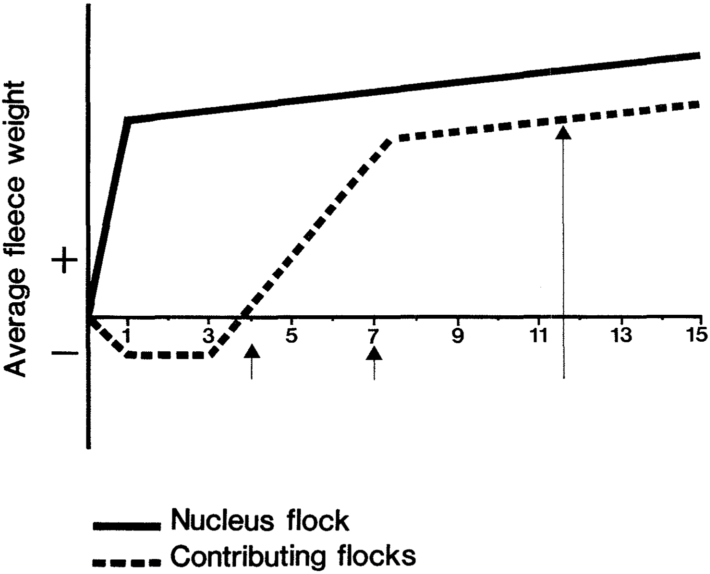

Figure 2. Progress of fleece weight in a nucleus flock and contributing flocks.

It can be shown theoretically that an open nucleus scheme (e.g. group breeding scheme, GBS) is 10-15 percent more efficient in the response to selection than a closed nucleus scheme (e.g. traditional stud structure) due to the greater selection on the path of dams to breed males, more than compensating for the lesser selection on the path of sires to breed females (James, 1977). The rate of inbreeding is halved, which can be important when the total flock population is small. The predicted progress in GBS is shown in Figure 2 and the optimum structure of schemes is shown in Figure 3.

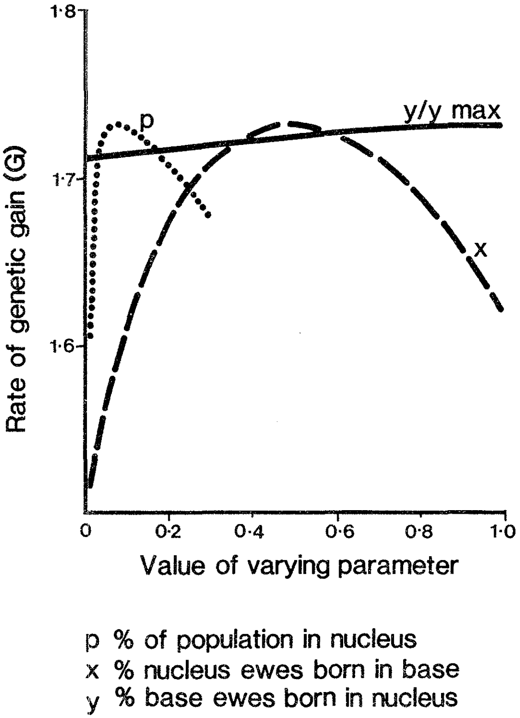

Figure 3. Sensitivity of steady rate of genetic gain (G) to variation to one parameter while others are kept at the optimal values (1% males kept, 80 % females kept) James, (1977).

Principle 3: In group breeding schemes about 10 percent of the population should be in the nucleus, half of the nucleus female replacements should come from the base population, and all nucleus-born females not needed as nucleus replacements should be used in the base population.

The decision to join an established GBS can be made on the basis of the superiority of the potential contributing flock. If the contributors are all in similar environments then one shouldn't join (unless selfless) if the average EBV of the flock is δ_p above the average EBV of the GBS with similar contributors or $2\delta_p$ above the EBV of the GBS with contributors of varying merit, e.g. 0.4 or 0.8 kg CFW (del-Bosque-Gonzalez and Kinghorn, 1987a). The difficulty of course, is evaluating the EBV of flocks in different environments. Variations in size and EBV of contributing flocks have small effects on rates of gain, the greatest response occurring if more sheep are taken from flocks with the highest EBV (del-Bosque-Gonzalez and Kinghorn, 1987b).

It is probably better to have a set proportion of each flock contributing to the nucleus, than to take a set number from each flock, as the latter will result in a high percentage of ewes being taken from smaller flocks, which may have lower EBVs.

If all the flocks involved in a GBS are run in different environments then an open scheme is only superior to a closed scheme (or stud) when the genetic correlations between environments is over 0.55 (del-Bosque-Gonzalez and Kinghorn, 1987c). For a GBS to be worthwhile performance in all the environments needs to be highly related, i.e. little G x E interaction.

These considerations can be used to evaluate the recently formed Otago Merino GBS (Jopp, pers. comm.). This scheme selects nucleus females by culling hoggets above average in micron, or over 19 micron and then selecting the best 50 on CFW. This selection method (independent cull levels on FD and single trait selection on CFW) is not as efficient as index selection (Index 1.1 or 1.2, Table 1). For example a flock with high feed levels and low stocking rates may have its heaviest CFW 19.1 micron sheep culled, along with a 16 micron ewe ranked 51 on CFW. While these are extreme examples, they show the problems of not using an index of overall fleece value. The scheme proposes to have all members contribute 10 hogget ewes/year and receive 2-4 rams/year. This suggests the size of the nucleus is well below 10-20 percent of the base population (assuming 20 contributors). Another policy is to have the fraction of nucleus ewes replaced from the base $\geqslant$50 percent, instead of 40-60 percent.

Both these policies result in rates of genetic gain below the optimum, essentially because the size of the nucleus is too small.

This may be because the GBS is a trial for the contributors, who don't wish to commit valuable resources until the GBS is proved successful. It is an unfair trial of the GBS concept, as the predicted rate of gain is not much higher than a traditional closed structure. This can be seen from the fact that only 2-4 rams/year will be sent to contributors' flocks, mating only 100-200 ewes. The rams' impact will be relatively small in larger flocks. However the scheme can be a very valuable forum in which ideas and information are exchanged.

Another alternative to forming a GBS is to breed rams in a nucleus flock, selecting rams by objective measurement. The costs and returns from the ram breeding enterprise can be compared with those from a wether enterprise occupying the same area of land. Morley, (1987) studied this comparison, assuming 10 percent rams were culled at weaning, all were fleece weighed ($1.20/hd), 50 percent were tested for CFW and FD ($3/hd), 15 percent were tested for fertility and serving capacity ($7.30/hd) and five percent were retained. His analysis suggested each ram retained had a comparative cost of $A288, $A242 if no objective measurements were made, $A262 if GFW only was recorded. However, this analysis did not compare the costs of purchasing selected flock rams from studs which a comparative EBV and possible sales of surplus rams. Such a study is more difficult and complex to model and is beyond the scope of this paper.

Pasture development

The principles of improving pastures in high country have been detailed by Allan, 1985; Allan *et al.*, 1985 and Pedofsky and Douglas, 1987. The potential returns from oversowing, topdressing, fencing, irrigation and rabbit control are described by Pedofsky and Douglas, 1987. Figure 4 shows the wool production for Tara Hills High Country Research Station where, in 1985, 13.4 kg wool/ha was produced compared to a high country average of 3.5 kg/ha. This development obviously costs money, but the potential returns are substantial.

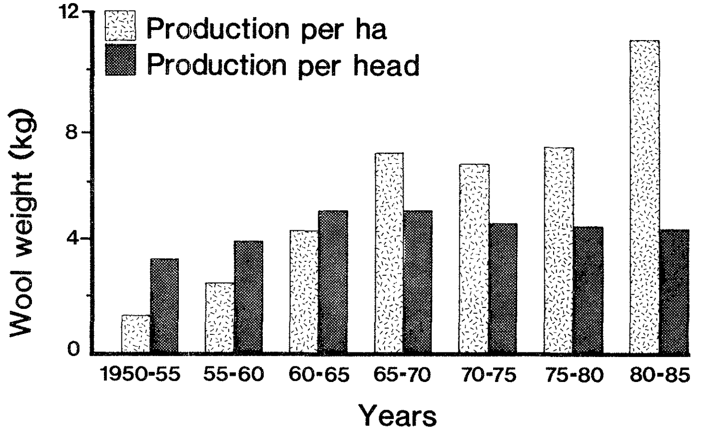

Figure 4: Tara Hills High Country Research Station. Wool Production 1950-1985. Pedofsky and Douglas (1987).

Oversowing usually occurs in early August on low sunny faces to late September on high shady faces. Legume seed needs to be inoculated and mob stocking can be useful to trample seed into the ground. The species usually sown are listed in the Proceedings of the 1985 Hill and High Country Seminar (p.57). Generally cocksfoot, maku lotus and lucerne are used in drier, hotter areas while ryegrass, white, red and alsike clovers are used in wetter areas .

Principe 4: The best utilisation of oversown tussock country occurs when the country is rotationally grazed at high stocking rates, i.e. increased subdivision is required.

An example of this is shown in Figure 5.

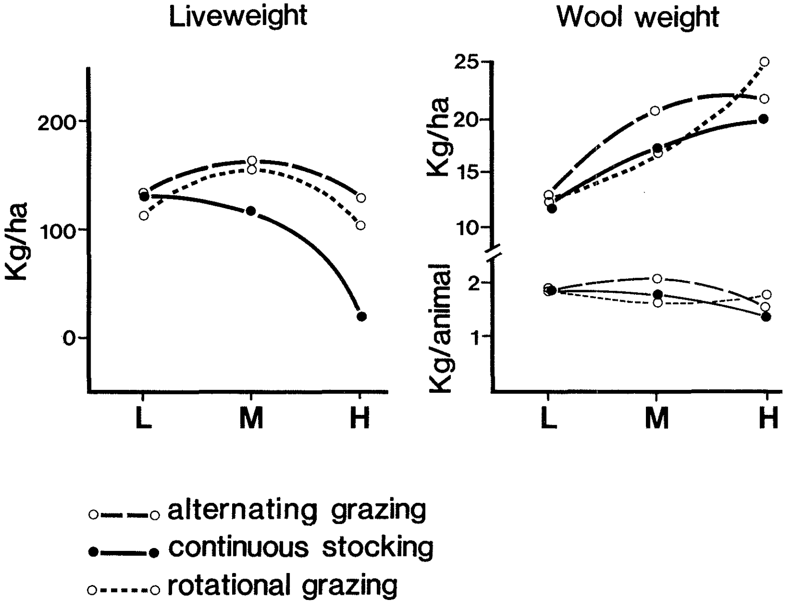

Figure 5: The response in Merino hogget liveweight gain (kg/ha) and clean wool growth (kg/animal and kg/ha) to stocking rate of different management practices on oversown tussock country. L low, M medium, H high stocking. •——• continuous o——o alternating o....o rotational grazing (2-3 weeks). Allan *et al.,* (1985).

Brown (1981) described the principles of tussock country management as:

- set stocking from lambing to weaning, rotating the ewe hoggets around three or four blocks.
- rotationally grazing ewes post-weaning, moving up to higher altitudes.
- flushing and mating on the high oversown blocks and moving stock down as desired to graze top growth.
- rotationally grazing ewes and hoggets at one block/week in winter. Some supplementary feeding needed in drier areas.

Feeding different classes of stock for wool production.

When the feed supply is limiting during periods of the year, it is necessary to understand the feed requirements of different classes of stock to assess their priority for different pastures and/or need for supplementation. An understanding of ruminant metabolism enables the prediction of wool growth responses to various feed supplies.

Ewes
Wool follicles in an unborn lamb are initiated up to the time of birth and maturation of the follicles continue for the first 4-5 months of life. At birth only about 20 percent of the follicles in a Merino are producing fibre.

Principle 5: Poor nutrition of the pregnant ewe can limit the initiation of follicles in the foetus and this will be a lifetime limitation.

It is difficult to quantify "poor" nutrition, as most experiments conducted have studied extreme levels of feeding. If the ewe experiences "poor" nutrition during lactation, the reduced milk production can delay the maturation of the follicles and permanently reduce the ability of these follicles to produce fibre in later life.

Subsequent adult production of lighter, coarser fleeces cause lower fleece values. This is an environmental effect, not genetic, so sheep subjected to these conditions will breed better sheep than their phenotype suggests. Therefore at selection time, some corrections should be made for sheep from ewes with poorer nutrition. This "maternal handicap" also results if sheep are born and reared as twins or if sheep are born from maiden ewes

(0.1-0.2 kg CFW/year less production). Schinckel, (1953) found that the secondary/primary fibre (S/P) ratios in 15 month old sheep for singles ex adult, singles ex maidens, and twins ex adults were 17.3, 15.5 and 13.8 respectively.

Short, (1955) found that adverse maternal nutrition resulted in a six-month fleece with higher FD (22.9 v 20.7) and lower S/P ratios (9.8 v 13.9).

Table 4: Measurements performed on sheep at 2-3 years of age following different pre- and post-natal nutritional environments. At time of measurement, each sheep was offered a good quality diet, in proportion to its liveweight

Treatment	H/H	H/L	L/H	L/L
Liveweight 2 years (kg)	53	48	49	44
No. of Fibres (millions)	64	69	58	44
Fibre Weight (g)	37	30	37	37
Wool Growth (g/day)	8.7	7.6	7.9	6.9
Secondary to Primary ratio	22.3	21.2	23.0	16.5

Source: Schnickel, P.G., and Short, B.F., (1961)

Schnickel and Short, (1961) studied the effects of nutrition during pregnancy and during the first four months of lactation (Table 4). These studies indicated that pre-natal nutrition affects the number of fibres per sheep, the body size and skin area of the sheep, while post-natal nutrition mainly affects the amount of wool grown and follicle maturation. Once the lamb is five months old maturation of follicles is complete and it is resilient to poor nutrition. In contrast to the pre-weaning period, post-weaning nutritional limitations have little permanent affect on wool production. This also appears to be the case with body weight (see Table 5) where a growth check before weaning can cause a permanent live weight disadvantage.

Table 5: Experimental nutritional treatments and bodyweights at different stages of the experiment.

Group	Preweaning nutrition (0-6 mths)	Weight at 6 months kg	Post-weaning nutrition (7-12 mths)	Weight at 12 months kg	Post experimental period Weight at age 18 mths, (kg)	Weight at age 48 mths, (kg)
H.H.	High	28.0	High	35.3	50.3	59.6
H.L.	High	28.5	Low	24.4	48.9	59.0
L.H.	Low	20.6	High	28.2	44.3	56.5
L.L.	Low	20.9	Low	20.2	41.7	55.7

Source: Allden, 1970.

Everitt, (1967) studied the residue effects of pre-natal nutrition on the wool production of Merino offspring at 18 months of age. Grazing Merino ewes were run at different stocking rates . At 90 days post-conception the High (H) group weighed 41 kg and the Low group (L) 32 kg. Each group was then divided and given high and low pasture allowances until 140 days post conception, at which time the ewe liveweights were 52, 47, 44 and 38 kg for the HH, LH, HL, LL groups respectively. The S/P ratio in 18 month old offspring from these four groups were 15.8, 14.3, 14.2 and 11.6 respectively. Everitt, (1967) concluded that nutrition from 0-90 days was only important if lambs were sold, as it only influences lamb growth rate for about seven months, whereas from day 90-140 nutrition had the residual effect reported by Short and Schnickel, (1961) of producing lighter, coarser fleeces.

Hutchinson and Mellow, (1983) also found these affects in Scottish Blackface sheep, despite their higher FD and lower S/P ratios. Primary follicle initiation was not influenced by pre-natal nutrition, whereas secondary follicle initiation was lowered by underfeeding (0.5-0.7 x requirements) from day 115-135. Poor feeding up to day 115 had little effect on S/P ratios at birth. Contrary to these studies Williams and Henderson, (1971) found pre-natal nutrition had little effect on follicle initiation in Corriedale lambs but influenced subsequent maturation. This result is similar to those cited for Romneys (Wildman, 1958) and Cheviots (Ryder, 1955).

In summary, during the last five weeks of pregnancy a merino ewe should receive adequate nutrition (60 MJ ME/week) or her offspring will suffer from lifetime wool return losses, which will be financially severe if fine wool receives a high premium. Lactating ewes have the highest energy requirements of 100 MJ ME/week in the first month and 80 MJ ME/week for the next two months. Less adequate nutrition may permanently affect the wool production of unweaned lambs, although Allden, (1970) and Langlands *et al.*, (1984) found wool production of adult ewes not affected by their stocking rate as unweaned lambs.

Weaned lambs and hoggets

It is only under the most extreme conditions that permanent damage will result from nutritional stress as a weaned lamb. The most damaging consequence is the loss of production that occurs during the stress and recovery periods. In the case of weaned lambs poor maiden reproductive performance could be expected due to the lower body weights at first mating. Compensatory body growth but not wool growth occurs in weaned lambs if conditions improve. This growth is more economic than supplementary feeding of weaned lambs for production during poor summer periods. The economics of feeding for survival depends on feed costs and stock prices. It is usually not economic to improve wool growth or body growth and subsequent reproductive performance by supplementation (Scarlett, 1982). A satisfactory weaning weight is considered to be 20 kg. When feed shortages occur lambs can be weaned at 13 kg provided they are placed on the best (high protein) feed available on the property. Weaned lambs need to be 32 kg before experiencing the first feed shortage period (summer) or their survival rates decline rapidly.

Feeding of hoggets affects their survival through winter and as they are still growing their protein requirements are relatively high (8-10 percent CP). The first mating of hoggets will be more successful the higher the liveweight (greater than 35 kg) they achieve by autumn. This is because of the relationships between ewe liveweight and ovulation rate (each extra kg = two percent extra ovulation rate, Morley *et al.*, (1978)) and between ram liveweight, testes size and sperm production.

In Australia nearly all ewes are joined for the first time when they are 18 months of age. The maiden ewe flock should be mated and lambed separately from adult ewes. There is no merit in waiting until ewes are 4-tooths before joining. Even the subsequent reproductive efficiency of ewes joined at seven months of age is normal.

Stocking rate

Wool production/head is an important selection criteria, but wool production/ha is more closely associated with economically efficient wool production. Wool production/head often declines linearly with stocking rate (Wool/head = a - bx (sheep/ha), Jardine *et al.*, 1975, Langlands *et al.*, 1984). If this is the case, then wool/ha is curvilinearly related to [a - bx (sheep/ha] x sheep/ha.

The maximum wool/ha ($a^2/4b$) is attained at a stocking rate of a/2b. The economic optimum stocking rate will be lower than this because liveweight is more sensitive to changes in stocking rate (McArthur and Dillon, 1971). As stocking rate increases, the length, strength, fibre diameter, colour, handle and character of the wool decreases (Langlands *et al.*, 1984).

Principle 6: The most economic stocking rate is a complex decision involving production per unit area, maximum stability of pasture, minimum stress to animals, maximum soil conservation, appearance of livestock and managers attitude to risk.

The importance of maintaining a flock during seasonal feed shortages means there is a minimum liveweight, which the flock should be kept above. As stocking rate increases the minimum liveweight decreases by about 1.5 - 2 kg with each extra sheep/ha, clean fleece weight decreases by 0.15 - 0.2 kg/head, and fibre diameter declines by 0.25-0.35 microns. The lower fibre diameter only partially offsets the economic effect of a decreased fleece weight/head, but can increase returns on a per hectare basis. The differences in fleece weight and fibre diameter, caused by higher stocking rates, arise mainly during the seasonal feed shortage period, so staple strength could be reduced.

Despite limited availability of herbage, highly stocked sheep often consume more feed/head than lightly stocked sheep. This feed is not used as efficiently, probably because there is less green feed consumed. Sheep grazing natural pastures at Trangie, when allowed access to dryland lucerne for only one day/week, increased wool production by 11 percent (Williams, 1982).

In summary, improvements in wool production/ha require increases in available pasture during critical periods. Further increases in efficiency come from running genetically superior sheep which respond to favourable feed conditions in spring. With a seasonal feed supply, a larger increase in annual fleece weight obviously occurs with a percentage lift in production during the period of maximum wool growth. Wool production of sheep during this period is still limited by a scarcity of sulphur containing amino acids (SAA).

Supplementation for wool growth.

As wool fibres consist almost entirely of protein, with a high SAA content (9-13 percent) it is not surprising that wool growth responds to supplements of protein, in particular SAA, that are undegraded in the rumen and reach the intestines for absorption. A Merino with 3.3 kg CFW deposits about 9 g protein (1.5 g N, 1g SAA) daily in wool. As the efficiency of wool production is only about 12 percent in relation to absorbed protein, about 75 g protein must be absorbed daily to produce this wool. Rumen microbes only supply about 20-50 g protein/day, so some undegraded (bypass) feed protein must reach the intestines to achieve reasonable wool growth rates. A pasture or supplement, e.g. grain, silage, or hay, is used more efficiently for wool growth if it contains high levels of bypass feed protein, high in SAA content.

Knowledge of the factors controlling wool growth should enable R & D personnel to develop better pasture species and supplements and to predict or model wool production changes in different management and feed supply situations.

Flock health

There are a large number of diseases which do not cause obvious symptoms and often are only suspected when production records are examined.

Principle 7: Observation, recording and good management planning are of paramount importance to good preventative health practice on the farm.

A successful farmer needs to know the normal behaviour of sheep, so that anything wrong is quickly recognised. One needs to be able to accurately describe symptoms to assist in any investigation into health problems and be aware of any recent changes that have occurred environmentally or through management. Hazards should be identified on a property e.g. poisonous plants, swampy areas (fluke), low dams (algae). Good observation can stop diseases before they happen. A farm diary should be written up every day. Dates should be recorded when stock are changed from paddock to paddock, when they are drenched, vaccinated, marked, shorn, crutched, jetted etc., when rams are put in and out and the date of weaning. Records should be made of shearing and marking tallies, or whenever stock are counted.

The first indication of a disease may be when variations occur in records compared to previous records, e.g. dropping lamb marking percentages. Better records assist investigations into flock health problems, and with microcomputers, they are easier to keep and retrieve.

A calendar of yearly husbandry operations should be planned in advance. It is beyond the scope of this paper to detail drenching, vaccinating and footrot control programs (see Familton, 1981), but advice on these issues is available for all regions.

There is a growing trend in Australia for groups of graziers to employ a veterinarian full time to monitor production levels in their flocks and pick up diseases before they become chronic. Many of the computer-based health programs now being used by the Department of Agriculture, e.g. Drenchplan, are based on preventative measures rather than curative (Marshall, 1988).

Clip preparation

Factors which influence the method of classing within individual clips are (i) the class of wool – whether Merino, Halfbred or Crossbred, (ii) the size of the clip – more lines can be made in a large clip, whereas in a small clip more blending of lines is required to avoid star lots and (iii) the properties of the clip – the higher grade wools require more care in preparation than lower grade wools, where a greater variation of type is acceptable to the manufacturer.

Principle 8: Attention to clip preparation is more important the higher the quality of the wool, as the penalty for wool faults is more severe.

Clip preparation has been discussed by Tinnock, (1982).

Stains, e.g. urine and coloured fibres, must be kept out of main fleece lines, as white tops exceeding a limit of 10 dark fibres/100 g can suffer a reduction in value of 4-15 percent (Foulds *et al.*, 1983). This is the equivalent of one dark staple/10 fleeces, or four staples (1 g)/bale of wool, or 10 g dark fibres/tonne wool or 10 dark fibres/million white fibres. As individual farmers have only a 1/1000 chance of this level of contamination being detected in core samples, detection is done at the top stage, by which time the wool has been blended with other wool and is therefore anonymous. The problem is therefore difficult to control.

The economics of classing out a small, finer line from the main line is risky. If done visually on the basis of quality number (QN) and handle the very poor relationship between fibre diameter and QN, combined with the extra selling costs of creating another line make the practice of little benefit. If done objectively by using individual test results on sheep, the practice will only benefit wool returns if the fine line is in a micron range with a higher linear Price/FD relationship than the main line. After adding the extra selling costs to the test costs and sheep drafting or wool handling costs and allowing for the broadening of the residual main line, this practice will often result in no net benefit. Unfortunately the commercial success of the practice cannot be estimated until the test results are obtained, the micron range is known and the expected market prices determined.

Finally as part of clip handling, if midside samples of wool are being removed from sheep for yield and FD determination it is vital that samples are taken from a consistent site on each sheep. As these variables change from site to site on the sheep it is obvious that samples taken from other sites, e.g. neck, breech, belly and flank, are a waste of time for sheep selection and would be better left in the clip.

Summary

Fine wool income can be improved if these principles are followed:

1. Run fewer, sounder, superior rams,
2. Use objective measurement and index selection,
3. Have an open rather than closed nucleus structure for breeding rams,
4. Rotationally graze oversown tussock country with high stocking rates,
5. Feed ewes well in late pregnancy,
6. Try to find the most economic stocking rate,
7. Observe, record and plan for preventative health control,
8. Skirt and class the clip to maximise net returns.

References

Allan, B.E. (1985) Pasture species most suited to non-arable Hill and High Country. *Proc. 1985 Hill and High Country Seminar,* Lincoln College.

Allan, B.E., Lowther, W.L. and Walton, P.J. (1985) Chapter 2: *In:* Burgess, R.E., Brock, J.L. (eds) Using Herbage Cultivars. *Grassland Research and Practice Series No. 3.* N.Z. Grassland Association, Palmerston North.

Allden, W.G. (1970) The effects of nutritional deprivation on the subsequent productivity of sheep and cattle. *Nutrition Abstracts and Reviews 40:* 1167-84.

Brown, G.R.L. (1981) Profitable grazing management. *Proc. 1981 Hill and High Country Seminar,* Lincoln College.

Buchanan. A.N. and Lewer, R.P. (1986). Economics of liveweight in WA Merino flocks. *Proc. WA S.A.P. Seminar.* p70.

del-Bosque-Gonzalez, A.S. and Kinghorn, B.P. (1987a) Effects of differences in size and mean genetic volume among contributing flocks in Group Breeding Schemes. *Proc. Aust. Assoc. Anim. Breed. Genetic 6:* 328-31

del-Bosque-Gonzales, A.S. and Kinghorn, B.P. (1987b) The effect of flock genetic merit on the decision to join a GBS. *Proc. Aust. Assoc. Anim. Breed. Genetic 6:* 336-9.

del-Bosque-Gonzalez, A.S. and Kinghorn, B.P. (1987c) Consequences in genotype x environment interaction in group breeding schemes. AWC Conference – Leura p.437.

Cottle, D.J. (1986) How much is a superior ram worth? *Wool Tech. Sheep Breeding 34:* 110-3.

Elliott, K.H., Cottle, D.J. (1988) Practical Programmes for Sheep Improvement using wool measurements *in* Lincoln College Wool Bulletin No.3. (eds. Sanderson R.H., Cottle, D.J. and Story, L.F.), Lincoln College.

Everitt, G.C. (1967) Residue effects of prenatal nutrition on the post natal performance of Merino Sheep. *Proc. N.Z. Soc. Anim. Prod. 27:* 52-68.

Familton, A.S. (1981) Methods to treat and control footrot. *Proc. 1981 Hill and High Country Seminar,* Lincoln College.

Foulds, R.A., Wong, R. and Andrews, M.W. (1984) Dark fibres and their economic importance. *Wool Technology and Sheep Breeding 32:* 91-100.

Fowler, D.G. (1976) Reproduction in the ram *In* Sheep Production Guide, LGPA, NSW.

Gherardi, P.E., Lindsay, D.R. and Oldham, C.M. (1980) Testicle size in rams and flock fertility. *Proc. Aust. Soc. Anim. Prod. 13:* 48-50.

Holmes, P. (1983) Ram fertility. NSW Young Merino Sheep Breeders Assoc. Seminar. Hay.

Hutchinson, G. and Mellor, D.J. (1983) Effects of maternal nutrition on the initiation of secondary wool follicles in foetal sheep. *J. Comp. Path. 93:* 577-83.

James, J.W. (1977) Open nucleus breeding schemes. *Anim. Prod. 24.* 287-305.

James, J.W. (1979) Selection theory with overlapping generations. *Livestock Prod. 6:* 215-22.

Jardine, R., O'Brien, S. and Frew, M.V. (1975) Relationships of wool production to stocking rate in Victoria. *Aust. J. Exp. Agric. Anim. Husb. 15:* 357-62.

Jopp, R. (1983) Selection in N.Z. fine wool flocks. *Proc. Merino and Halfbred Producers Seminar,* Lincoln College.

Kerr, I.G.C. and Lefever, K.R. (1983) High Country Farming 1966-1982. *Tussock Grasslands and Mountain Lands Institute, Review 42.*

Langlands, J.P., Donald, G.E. and Paull, O.R. (1984) Effects of different stocking intensities in early life of the productivity of Merino ewes grazed as adults at two stocking rates. *Aust. J. Exp. Agric. Anim. Husb. 24:* 34-46.

Marshall, J. (1988) Flock Health Schemes *In* Australian Sheep and Wool Handbook, (ed. Cottle, D.J.) INKATA Press, Melbourne (in press)

Morley, F.H.W. (1987) Cost of selection using objective measurement in a nucleus flock of Merino Sheep, AWC Conference – Leura p.93.

McArthur, I.D. and Dillon, J.L. (1971) Risk, utility and stocking rate. *Aust. J. Agric. Ec. 15:* 20-35.

Morley, F.H.W., White, D.H., Kearney, P.A. and Davis, O I.F. (1978) Predicting ovulation rate from liveweight in ewes. *Agric. Systems. 3:* 27-45.

McGuirk, B.J. (1982) Fleece Measurement and Merino breeding programmes. *Proc. Merino and Halfbred Producers Seminar,* Lincoln College.

Purvis, I.W. (1987) Genetic Improvement of reproductive efficiency in Merino sheep - selection criteria. *Proc. Aust. Assoc. Anim. Breed. Genet. 6:* 242-6.

Pedofsky, J.F. and Douglas, M.H. (1987) The development and production of Tara Hills High Country Research Station. *Proc. N.Z. Grassland Assoc. 48:* 59-64.

Ponzoni, R.W. (1986) Liveweight – its place in breeding programmes for SA Merino Sheep. *In* Are Big Sheep Best? *Proc. Seminar W.A. Soc. Anim. Prod.* eds. I.W. Purvis and I.H. Williams, Perth.

Purvis, I.W., Kilgour, R.J. Edey, T.N. and Piper, L.R. (1984) Variation in testis diameter and serving capacity within and between 14 Merino lines . *Proc. Aust. Soc. Anim. Prod. 15:* 545-48.

Saunders, L. (1983) Ewes or Wethers? *Proc. 1983 Hill and High Country Seminar,* Lincoln College.

Schnickel, P.G. and Short, B.F. (1961) The influence of nutritional level during pre-natal and early post-natal life of adult fleece and body characteristics. *Aust. J. Agric. Res. 12:* 176.

Short, B.F. (1955) Development modification of fleece structure by adverse maternal nutrition. *Aust. J. Agric. Res. 6:* 863.

Scarlett, E.C. (1982) Field studies on weaner sheep growth. *Proc. Seminar for Sheep and Wool Officers.* Dept. Agriculture. Orange Paper 26.

Tinnock, B.M. (1982) Fundamental requirements for effective clip preparation. *Proc. Merino and Halfbred Producers Seminar,* Lincoln College.

Williams, P.M. and Henderson, A.E. (1971) Effect of nutrition of the dam on wool follicle development of Corriedale lambs. *Proc. N.Z. Soc. Anim. Prod. 31:* 114-20.

Maximising fine wool income — Practice

Mr Robert Jopp*

We are in the midst of an exciting revival of the fine wool industry in New Zealand and are possibly poised to make major production advances with the more concentrated use of genetically superior sheep. But, at the same time, the very existence of the fine wool industry in its traditional home of the South Island high country is possibly more threatened than any other time for 30 years by the old basics – "our fathers problems" – rabbits and provision of quality feed.

Table 1. Fertiliser expenditure in Central Otago

		1985	1986
Total fertiliser expenditure by clients		m$3.258	$1.623
Expenditure per stock unit (Fine wool sub sample)	High	$5.16	$2.62
	Low	$1.14	$0.01
	Average	$2.45	$1.35
Meat and Wool Board's Economic Service estimate of maintenance requirements			$5.00

Source: Pedofsky, Ibbotson and Cooney, Alexandra, pers. comm.)

* Moutere Station, Alexandra

There are increasing areas of Central Otago and the Mackenzie where rabbits are severely limiting income and the figures in Table 1 tell their own story about fertiliser maintenance, even in one of New Zealand's main Merino wool growing areas.

We may have to be very careful to ensure that such basic requirements do not once again become the major limitation to the production of any fine wool income at all, let alone maximising it.

We are all well aware of the new economic climate in which we operate – very different from the 1970s and early 1980s when our big increases in production came from major pasture development programmes. These are now things of the past.

Providing we are able to maintain that development then the future means of improving fine wool income will depend on "fine tuning" our farming operations rather than the grand scale development of the past. Fine tuning will produce less dramatic results and will require a different psychological approach which many will have difficulty accepting. For a start, we should emphasise nett income more than gross income. Careful planning and long term consistent actions will be required to produce results – which will also tend to be long term.

A major element of this fine tuning – and a future major contributor to increased nett wool income – will be increased emphasis on genetic improvement of our sheep.

This will occur because:

- There are now clearly demonstrated differences in genetic performance which in turn produce major income differences. This is shown in the Central Otago Merino wether trial. (Table 2).

- There is widespread interest in genetic improvement throughout the Merino industry e.g., large attendances at stud Merino tours, ram sales, wether trials and the establishment of many new studs and a group breeding scheme.

- Now that Merinos are being fed better, the genetic factors limiting their performance are becoming more apparent.

Table 2. Production example Central Otago Merino wether trial

Av. Yield	Greasy Wt	Clean Wt	F. Dia.	Fleece Price Clean c/kg	Wool value $	Liveweight kg
.83	7.18	5.80	23.30	758.00	42.70	49.80
.79	7.04	5.38	22.30	815.00	42.22	48.80
.70	6.78	4.63	19.90	963.00	42.12	54.80
.72	6.72	4.66	22.00	827.00	36.99	55.80
.77	5.82	4.35	21.60	855.00	35.31	43.80
.80	7.46	5.80	26.10	607.00	35.20	45.00
.75	6.52	4.72	23.10	767.00	35.01	54.20
.76	6.44	4.74	24.50	668.00	31.17	48.80
.75	6.32	4.60	24.60	664.00	30.08	52.00
.73	6.14	4.33	25.60	610.00	26.39	48.20
	Top 7 Average				Top 7 Total	
.76	6.79	5.05	22.61	798.86	269.56	50.31

Averages are calculated from the top seven animals ranked on fleece value.

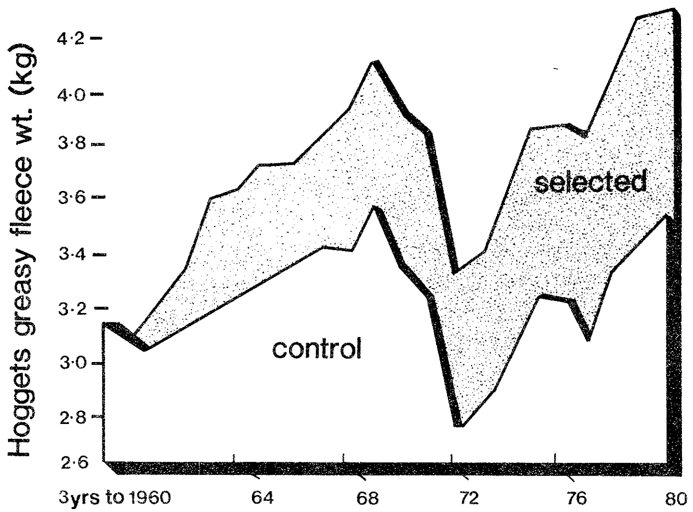

Figure 1. Massey fleece weight selection flock results

- Genetic gains are cumulative and permanent (Figure 1), they can't be removed by rabbits, shortage of tucker, nor even by Roger Douglas!

- Changes in tax treatment of development and livestock will make development prohibitive when it is non-deductible but one of the few good things about the new livestock taxation system is that it encourages the breeding of superior stock.

- We now have some very useful techniques – "tools" if you like – to increase the speed of genetic gain e.g., computers, artificial insemination and embryo transplants. The creation of "designer sheep" with the use of genetic engineering techniques may not be far away.

The basics of performance breeding in Merinos are fairly widely known and I only want to look at three topics where I feel we have problems:

- Commercial flock selection programmes
- Accuracy of performance data
- Use of that data for comparisons.

My opinions on these subjects are, of course, coloured by my background as a stud Merino breeder, albeit one committed to the sound, practical application of modern genetic principles of performance breeding. Objective measurement and managing to ensure selection accuracy has been a "way of life" at Moutere for 40 years. We have had plenty of time to find out that performance breeding works but it is not a panacea for all breeding problems.

Commercial flock selection programmes

I think that in New Zealand (and especially in fine wool flocks) we have a tendency to get carried away with the techniques of genetic improvement (i.e., the electronic gadgetry) rather than concentrating on objectives and how to achieve them. In setting up a breeding programme in a commercial flock situation we need to consider that:

- Up to 90 percent of our genetic gain will depend on the rams we use.

- The programme has to be consistently carried out for a long time to produce results.

The importance of rams is obvious – hence Dr Cottle's advocacy of fewer, sounder rams. Also obvious, if we think about it, is the relative unimportance of the selection of your ram breeder, rather than the selection of individual rams.

Dr Cottle quoted the cost of breeding rams in Australia compared with running wethers in their place. The cost of a ram bred with full objective measurements in 1987 was N.Z.$351. I would think the average N.Z. Merino ram price in 1987 was still around this figure – $350. This emphasises the commitment that N.Z. fine wool ram breeders have made to producing quality rams at a reasonable cost for our traditional clients. Possibly that approach has to change – there may be more demand for individual superior rams which will, of course, cost the earth! I hope this does not occur at the expense of our traditional high country clients.

This brings me to ewe selection. There is a wealth of evidence to show that, assuming we are able to winter sufficient hoggets, then selecting on greasy fleece weight alone is the cost effective system. As Figures 2 and 3 show the correlation between greasy fleece weight and clean fleece weight is very high.

In his paper Dr Cottle demonstrated that the cost benefit of more expensive, complicated systems such as including measured yield and fibre diameter, is suspect, even in a fine Merino flock – unless the objective is ram breeding. Any system has to continue for many years to produce results and an expensive, complex one is highly likely to be abandoned before real benefits have accrued. Usually this occurs because of financial stress – for example the dairy industry's herd testing programme.

Selection on greasy fleece weight is simple, cheap, interesting and effective. Selection for fibre diameter can be done through the rams and possibly eye appraisal to cull the strong edge.

Dr Cottle has stated that subjectively assessed traits such as conformation and wool colour have low REV's i.e., relative economic values. This may be so today, but I would suggest that this is because continual selection pressure on these traits in the past has reduced the incidence of faults to a negligible level. Further, if selection pressure is not maintained for these traits (resulting in very low culling levels anyway) then these traits can become REPs – real economic problems.

To sum up on selection in flocks – if 90 percent of genetic gains comes from the rams, then I suggest 90 percent of the money and effort that goes into selection, should go the same way.

It is axiomatic that performance breeding depends on accurate data on which to base selection. Accuracy is especially important as we place more emphasis on the identification of top individual sheep rather than top performing groups of sheep. Two aspects of accuracy concern me.

Firstly, managing for accuracy. Day to day management of a performance bred stud must ensure that comparative performance data reflects true genetic differences. This means that sheep to be compared with each other must be run together and in an environment that is comparable to that of commercial flocks. Luxury style treatment for a few sheep from a mob completely eliminates them from comparison with the remainder of the mob. Even when all possible care is taken in management to ensure data accuracy, significant differences in performance may arise without being immediately obvious. These could be due to influences during lambing – even during gestation as Dr Cottle has explained – such as paddock to paddock differences.

Secondly, in N.Z. much of the performance data we base our selection on is obtained from the sheep as a hogget – say 10-12 months old. Further the hogget usually has not been shorn as a lamb – i.e., the lamb tip is present in the test wool sample. The heritabilities of fleece weight and fibre diameter at 12 months are not significantly lower than those at 18 months or 30 months and the repeatabilities are very high (see Table 3).

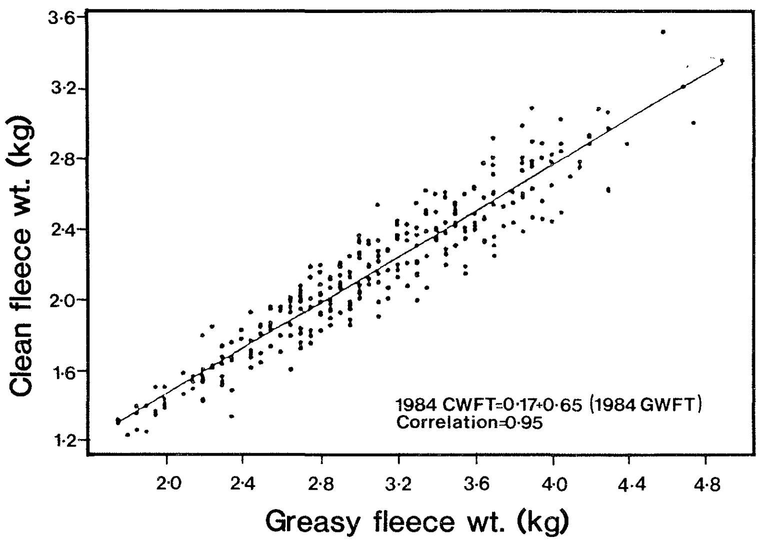

Figure 2. Phenotypic correlation between 1984 clean fleece weight and 1984 greasy fleece weight.

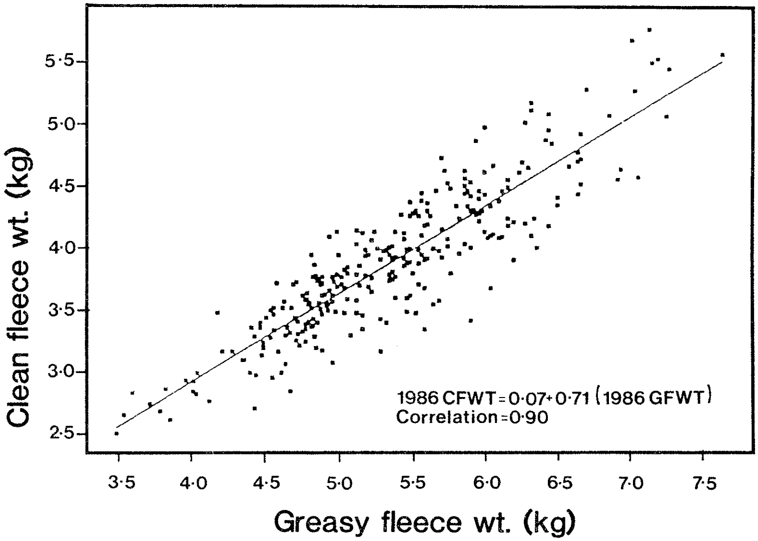

Figure 3. Phenotypic correlation between 1986 clean fleece weight and 1986 greasy fleece weight.

Table 3. Repeatabilities for greasy fleece weight, clean fleece weight, fibre diameter and staple length

	1984-85	1985-86	1984-1986
Greasy fleece Weight	0.72	0.90	0.66
Clean fleece Weight	0.71	0.89	0.66
Fibre Diameter	0.80	0.92	0.81
Staple Length	0.65	0.77	0.61

Note: Sheep were hoggets in 1984.
Source: Central Otago Merino Wether Trial

Thus in a group situation, culling on 12 month fibre diameter or fleece weight will be fairly accurate. The problems arise when we are selecting individual sheep as in ram selection (see Table 4).

Table 4. Individual fibre diameter changes

	Hogget 1984		2Th 1985		F.D. Change	
	Hogget F.D.	Rank	Rank	2Th F.D.	1985-1984	F.D.
	20.1	5	6	22.6	2.1	
	20.9	7	7	23.0	2.1	
	18.0	1	1	19.4	1.4	
A	19.1	3	4	21.5	2.4	
	21.2	8	10	24.4	3.2	
	18.5	2	2=	20.7	2.2	
	19.9	4	2=	20.7	0.8	
	20.2	6	5	22.0	1.8	
	22.1	9	9	23.6	1.5	
	22.7	10	8	23.5	0.8	Av.=1.8
	18.8	7	9	20.7	1.9	
	17.9	1	4=	19.7	1.8	
	19.9	10	10	21.0	1.1	
	18.0	2=	4=	19.7	1.7	
	19.2	8=	3	19.4	0.2	
B	18.1	4	2	19.0	0.9	
	18.0	2=	1	18.8	0.8	
	19.2	8=	7	20.1	0.9	
	18.4	5	6	19.8	1.4	
	18.7	6	8	20.3	1.6	Av.=1.2

It is possible the inclusion of the lamb tip in our wool samples could be the cause of much of the problem. In Australia some of the test houses will not test samples with a lamb tip. The obvious solution is to shear the lambs in the autumn to remove the tip – this is certainly possible in Marlborough but it is a bit difficult in Central Otago because of our climate. Another partial solution is to re-test rams at 18 months but by this time most have already been sold.

Because of the influence hogget fibre diameter can have on the sale price of a ram, it seems to me that it is important that means are found to give us more confidence in this measurement.

Comparison of sheep

To identify top sheep we must be able to make valid comparisons between sheep. This is easier in a "within flock" situation than "between flocks" but in general the difficulties and means of making valid comparisons in either situation are not well understood.

How often do we hear a ram being quoted as an "18 micron ram" or "cut 20 kg"? These are totally meaningless figures quoted by themselves yet their use is widespread, even by organisations that should know better (e.g., MAF – "Southern North Island Merino Breeders Newsletter" and Elders Breeding Services – "1986 Ram Directory").

In particular, this "micron madness" where a single fibre diameter figure is quoted as "god" could well land our industry alongside the lunatic fringe of the goat industry, where the motto seems to be "a fool and his money deserve to be parted."

To make valid use of performance figures of individual sheep we need to know:

- something of the background of the flock the sheep comes from;

- details on date of birth, date of test, age at test, months of wool growth and number of sheep in the test group;

- How the individual's data relates to the performance of the entire group. This is shown in deviations from average and these deviations are the important figures – not the actual fleece weights or fibre diameter.

The details shown in Table 5 about the stud and its sheep on offer enable someone who knows nothing about that stud to make valid assessment of the sheep offered. Table 6 is from the Forest Range sale catalogue and, although actual measurements are quoted the presentation does enable us to make valid comparisons between the rams on offer. Certainly more background information on the flock could be a help to a novice buyer. We have considerably more difficulty producing valid data in the National Merino Ram Sale because of widely varying ages of rams, rearing environments and age testing. Comparisons can really only be made between rams on offer by the one vendor in this case.

Table 5. Australian OM ram sale catalogue entry

Average flock fleece line fibre diameter last five years	19.5 um
Average ram fibre diameter over last five years	18.8 um
Details of ram group from which sale team was drawn	
Lambed	Sept/Oct. 1980
% Drop tested	75%
Age when tested	12 months
Date shorn	17.9.81
Wool growth when tested	7 months
Average yield of all rams tested	75%
Average fibre diameter of all rams tested	18.5 um

Pen	Tag	CFW%	Y%	um Dev.
1	29	124	80	2.0
2	81	115	75	-0.2
3	96	120	78	0.6
4	105	109	74	-1.8
5	200	128	78	1.5
6	194	119	81	0.0

Source: Armidale objectively measured ram sale catalogue – N.S.W. Australia.

This brings me to the difficulty of making "between flock" comparisons. Wether trials are the best means we have in N.Z. at the moment but these were not designed for this purpose and therefore have limitations. I would suggest the establishment of a reference flock for the N.Z. Merino industry is a matter of great importance.

A reference flock is a closed breeding unit that is maintained in a genetically stable state by random mating i.e., the performance of the flock will not improve or get worse. Rams from such a flock can then be used by the industry in progeny tests to determine genetic differences between flocks and also, over a period of years, genetic progress within an individual flock. Reference flocks exist in South Africa and I believe one is to be established in Australia. They needn't be large and little money would be required.

Table 6. Forest Range ram sale catalogue

Number	Clean Fleece Wt. (kg)	Fibre Diam. (mic.)	Yield %	Body Wt. (kg)	Purchaser Price
Lot 26					
15	2.7	18.5	75	50	
	2.6	18.5	70	48	
	2.7	18.5	75	43	
310	2.7	18.5	77	50	
Lot 27					
236	2.5	18.5	74	53	
385	2.5	18.5	79	46	
599	2.5	18.5	74	43	
Lot 28					
123	1.7	18.5	70	48	
299	1.7	18.5	65	44	
549	1.6	18.5	62	43	
634	1.7	18.5	65	39	
Lot 29					
203	2.4	18.5	72	44	
277	2.4	18.5	74	44	
340	2.4	18.5	73	44	

I am particularly concerned about the hawking around N.Z. of unproven, even untried, Merino ram semen. There almost seems to be the implication that semen in a tube or pellet is automatically better than semen on four legs. As far as Australian semen is concerned, the few of us that have knowledge of Australian studs and experience with their rams can probably make reasonable judgements as to their various sires' worth in N.Z. But the vast majority who do not have that advantage are provided with very little "real" information. One ram can have a tremendously widespread influence through artificial insemination and it seems the least we should expect is a bit more information about the donor sire than we provide for 15 month old flock rams.

Providing we can keep the rabbits at bay and the quality feed growing, then much of the future increase in fine wool income will depend on genetic improvement of our sheep. We have some very useful techniques to help us in this improvement available now, and some very exciting developments in the pipeline. However, the use of these techniques is not an end in itself. Success in genetic improvement will depend on the collection of accurate data compared on a valid basis and used in well planned, cost-effective breeding programmes.