PERFORMANCE RECORDING AND GENETIC EVALUATION IN THE AUSTRALIAN WOOL SHEEP INDUSTRY

I M ROGAN

Hassall and Associates Pty Ltd
PO Box 4
Trangie, NSW 2823

INTRODUCTION

The Australian wool sheep industry is undergoing something of a re-birth in the mid 1990's, from several points of view. This is primarily in terms of profitability and increased focus on wool buying customer requirements.

Most significantly, wool prices have increased from the depressed levels of 1991 - 93. This is starkly demonstrated by comparison of the Eastern Market Indicator from wool auction sales in late 1993 of 500 cents per kg clean wool, with the same indicator price of around 800 cents per kg clean in early 1995. In terms of the profitability of wool production, the gross margin from Merino breeding flocks from a sample of Hassall and Associates clients in the period 1991 - 93 was $6.98 per dry sheep equivalent (d.s.e.). At early 1995 wool prices, it is estimated that the equivalent figure is $16.43 per d.s.e. The current market prices for wool and surplus Merino sheep used in this analysis of typical medium wool self replacing Merino flocks indicate that 70% of income in these flocks arises from wool sales, the balance from surplus sheep sales for sheep meat.

While the proportions of returns to Merino sheep breeders contributed by wool and sheep meat may have not changed markedly, another development during 1993/94 was the successful marketing of large numbers of Merino lambs into the large, lean lamb trade which has been driven by 20 to 30% increases in exports of these types of lamb to North America, Asia and the Middle East (AMLC 1994).

Apart from the overall increase in wool prices, another feature of the recent de-regulated Australian wool market has been the establishment of relatively clear premiums and discounts for variation in the major quality characteristics of wool. Stott and Hanson (1994) summarise the premiums and discounts associated with variation in wool quality for wool sold at auction in Australia for the second quarter of the 1994/95 selling season. Average fibre diameter remained clearly the most important determinant of the auction price, accounting for 83% of the variation in auction price of clean Merino fleece wools.
For wools in the range of 19 to 23 micrometers average fibre diameter, which represents the vast majority of Australian Merino wool production, the clean price realised at auction in the second half of 1994 decreased by between 20 and 29% for each one micrometer increase in average fibre diameter.

For wool with a fibre diameter of 23 micrometers and higher, the price decreased by 2 to 3% for each one micrometer increase. These fibre diameter premiums are similar to the wool market of the late eighties, but are high by historical standards.

In these same analyses (Stott and Hanson, 1994), staple strength was the next most important determinant of wool value, accounting for 6% of the variation in clean wool prices at public auction. For Merino

fleece wools of mid range average fibre diameter the clean wool price was discounted by about 5% for each 5 Newtons/kilotex decrease in staple strength below 30 Newtons/kilotex. Price premiums for wools of staple strength greater than 30 Newtons/kilotex were negligible.

Vegetable matter content (measured), style (subjective grade), staple length (measured) and scoured wool colour (measured) are other wool quality characteristics routinely assessed prior to auction sales and these accounted for 2%, 2%, 1 % and 1% respectively of the variation in clean wool price in the first half of the 1994/95 wool selling season.

These wool and sheep meat market features must be appreciated before a discussion of the adoption and features of performance recording and genetic evaluation schemes in the Australian wool sheep industry.

THE DEVELOPMENT OF PERFORMANCE RECORDING SCHEMES

Ponzoni (1994) presents the most recent and thorough analysis of the history of adoption of genetic evaluation and performance recording in the Australian wool sheep industry. At the time of that publication it was estimated that 35% of Australian Merino ram breeders used measurement as an important component of their breeding program, up from 15% in the early 1970's.

In terms of the level of performance recording activity, independent of interpretation of the extent to which such measures are used in breeding programs, the most comprehensive summary of the status of the industry in the early 1990's is provided by Brien (1994). That report includes comprehensive statistics for the level of fleece testing services provided by WOOLPLAN accredited laboratories in 1991/92.
The 21 WOOLPLAN accredited laboratories, located in all mainland states of Australia, represented slightly less than half the known fleece measurement laboratories in Australia at that time. In 1991/92 these accredited laboratories measured 511,181 samples submitted by 5,206 clients. Of these samples, 177,901 were known to have originated from rams while a significant proportion of the 192,468 samples from animals of unspecified sex are likely to have also originated from rams.

Approximately 10% of the clients submitting these samples requested and received WOOLPLAN type reports incorporating estimated breeding values and index calculations in addition to phenotypic performance records (deviations from group averages) and/or actual physical fleece measurements.

To put these numbers in some sort of context, the Australian Association of Stud Merino Breeders (1993) estimates that in 1992, 1,879 ram breeders registered with their association, mated approximately 1.3 million ewes and sold approximately 181,700 rams. These stud Merino flocks account for an estimated 80% of the new rams mated each year in the Australian wool sheep industry (Hamersley 1987).

ADDRESSING CURRENT INDUSTRY REQUIREMENTS

Concerns in some sections of industry about WOOLPLAN, precipitated a series of reviews and workshops in 1993, culminating in a number of recommendations about a new approach to genetic improvement programs for the Australian wool sheep industry. The major features of this new approach were (Banks 1993):

a) To establish a unified, national, practical and simple genetic language covering all traits of importance in wool producing sheep.

b) To ensure direct and effective involvement of ram breeders and commercial sheep breeders in the design and implementation of industry genetic improvement programs.

c) To design and co-ordinate the delivery of genetic evaluation services in a flexible but technically sound way throughout Australia.

d) To establish a co-ordinated system for focused research, extension and consulting activity directed to optimising the use of Australia's available genetic resources for wool production.

The Wool Research and Development Corporation (now International Wool Secretariat - IWS) has taken overall responsibility for the new program, as a technology transfer activity to complement the significant investment by that organisation, on behalf of wool producers, in sheep breeding and genetics research and development.

IWS is investing approximately $2.4 million in this research area in 1994/95. It was further recommended that the costs for the provision of support for development, promotion and facilitation of genetic improvement programs would be strongly linked to a strategic plan and milestones - industry funding would not extend to the operational costs of within-flock performance recording and between- flock sire/bloodline evaluations. These would be met by participating breeders.

From this foundation, RAMPOWER : Wool Breeding Services was funded as a technology transfer project of IWS from February 1994. A strategic plan to June 1996 has been developed and circulated to industry organisations and extension service providers. IWS has approved a project budget of approximately $160,000 per year, until June 1996, subject to achievement of strategic plan milestones. The project is directed by a National Co-ordinating Committee, with majority representation by wool producers and Merino ram breeders from all Australian mainland states.

The balance of committee membership comprises a sheep classer, wool processor, fleece measurement laboratory operator, geneticist and technology transfer representative. See Brien (1993) for a full outline of committee membership. The author is employed on a part time contract basis as National Co-ordinator and executive officer of the National Co-ordinating Committee.

The specific tasks of the RAMPOWER project relate to:

- sheep breeder liaison
- R & D group liaison
- technology transfer
- performance recording services
- across-flock genetic evaluation schemes

Sheep Breeder Liaison

Monitoring breeders wants/needs for performance recording and genetic evaluation services is a key area in ensuring that ram breeders have ownership of RAMPOWER. Metcalfe and Brien (1992) summarised the outcomes of a number of surveys of ram breeders and clients of fleece measurement laboratories. Conclusions from those surveys indicate widespread skepticism of the accuracy of fleece measurement, particularly of fibre diameter measurements on 10 to 12 month old rams and of the perceived marginal value of estimated breeding values and multi trait index values, over and above basic performance records on fleece weight, fibre diameter and possibly other measures or scores of wool quality.

More recently (early 1995), RAMPOWER initiated a survey of 177 of Australia's largest Merino breeders and sellers. These breeders represent an estimated 9% of Australian Merino ram breeding flocks but account for about 51% of all Merino rams sold annually. At the time of writing, 59 responses (33% of those surveyed) had been received from a wide cross section of both conservative stud breeders and non-registered performance breeder groups.

In the previous 12 months these respondents had sold an estimated 40,000 rams, fleece measured 41,243 rams, of which 23,918 (58%) were aged 12 months or less. They had also fleece measured 29,371 ewes. Greasy fleece weight was measured on 74% of ewes and rams tested; 24% were measured for clean wool yield; average fibre diameter (96%); liveweight (12%); within-fleece fibre diameter variation - coefficient of variation (53%); other indicators of within fleece fibre diameter variation such as % fibres greater than 30 micrometers or coarse edge (19%); staple strength (5%).

45% of responses indicated breeders and/or their classers used fleece measurements in conjunction with visual assessment of young rams to select replacement sires and to grade rams for sale to commercial sheep breeders. 23% of responses indicated breeders used performance records or an index of measured characteristics as the substantial basis of sire selection and grading of rams for sale.

When asked to express their attitude toward problems with performance records the most frequent responses were:

- measurements perceived to be inaccurate or poorly repeatable (37% of responses)
- measurements available don't reflect the full range of wool quality characteristics of importance to breeders (18%)
- ram buying clients do not understand measurements (12%)

When asked to comment on their perceived priorities for attention by RAMPOWER, the most frequent responses related to:

- educate breeders on understanding performance records, genetic improvement principles and genetics research results (34%).

- increase accuracy of sampling and laboratory measurement and develop standards for sampling and measurement (29%).

- develop software and support services so that breeders can develop individualised pedigree and performance recording systems for their own breeding objectives (10%).

There were a wide range of other suggestions which included proving that index selection works in "real" commercial conditions (4%) and determining which wool quality traits really are important for breeders to pay attention to (10%).

R & D Group Liaison

RAMPOWER aims to ensure that industry needs are being reflected in the planning, funding and conduct of major industry funded sheep breeding and genetics R & D projects. The National Co-ordinating Committee and National Co-ordinator, on its behalf, is attempting to influence the

direction of industry R & D funding in this area and is encouraging breeder involvement in the planning and management of major projects such as the multi trait index selection demonstrations at Trangie. Other major projects such as the "Fine Wool Project" based at CSIRO Armidale, and the "Turretfield Base Flock Project" with strong wool Merinos are key projects which will generate accurate genetic information required by breeders.

Breeder involvement in these well designed, key projects which are contributing to fundamental principles for performance recording and genetic evaluation systems will help improve breeder ownership of the ultimate systems offered to them.

In a formal sense, IWS has established a number of mechanisms to ensure that the industry funded research portfolio is addressing wool grower priorities for technology development. These include the recently established three zone advisory committees for allowing wool grower input into research priority setting and assessment of research proposals on a geographic zone basis. The RAMPOWER National Co-ordinating Committee is recognised by the IWS Board as having a role in assessing research and development priorities and proposals, specifically in the field of sheep breeding and genetic improvement.

The expectation that the RAMPOWER project will contribute to improved communication to industry of results from sheep breeding and genetics R & D, necessitates a close relationship between the National Co-ordinator and major research groups.
However, in a broader sense, improved awareness by sheep breeders of the activities and outcomes of sheep breeding and genetics R & D groups will increase ownership and ultimately adoption of those outcomes by industry.

Technology Transfer
State Departments of Agriculture have historically maintained specialist extension services for the sheep industry, sometimes with major programs in support of Merino sheep breeding and genetic improvement. These services remain an important part of the sheep breeding technology transfer process, though with smaller and declining resources and personnel. Departments of Agriculture in three states (Q'ld, NSW, WA) have closed fleece measurement services formerly operated, in favour of private sector providers. Some state departments have reduced sheep and wool extension officer numbers by 50%.

Almost in contrast to this trend of reduced state government resources for sheep breeding and genetics technology transfer, has been the establishment of Advanced Breeding Services (ABS) by NSW Agriculture. This group has developed advanced software and provides individual consulting services to sheep breeders on a partial cost recovery basis. Features of the software and service include individualised breeding objective development, monitoring selection differentials and genetic progress, calculation of breeding values and selection indices based on multiple records, across-year information and information on relatives (pedigrees). Another important feature is the capacity to link, and analyse, data from on-property sire progeny tests with data from public Merino sire evaluation schemes. The services offered by ABS are now provided to 83 Merino flocks in 5 states, and training programs in the use of their software have been conducted in several states.

Other significant recent developments in sheep breeding and genetics technology transfer include the development of SHEEPBREEDER, a computer aided learning package developed by a team led by Dr Mary Rose of the Queensland Department of Primary Industries. The package is designed to provide training for advisory officers, sheep breeders and tertiary education teachers and students in the disciplines

of genetic principles, performance recording and the design of sheep breeding programs. The program will be released commercially in the near future.

Another successful technology transfer initiative is the Merino Breeders Worm Control Network established by CSIRO in conjunction with the University of New England and the West Australian Department of Agriculture. Following research by these organisations to investigate genetic variation within and between Merino flocks in resistance to internal parasites, IWS is funding a project to evaluate and demonstrate the technology in stud and commercial Merino flocks in the major worm-risk areas. Over 130 breeders are now involved in the project, with some undertaking selection for worm resistance as part of their breeding objective and monitoring selection response over time.

As in other activities, RAMPOWER is playing a facilitation role in the communication of research outcomes. As a result of its strong association with sheep breeder groups and wool producers in general, RAMPOWER is assisting R & D groups to make contact with breeders and in some cases is providing additional avenues for communicating the outcomes of research. Short, "laymens language" research reports have been written for rural press and breeders newsletters and presentations made to field days and breeder meetings around Australia.

In response to approaches by breeder groups, and to the feedback from the ram breeder survey referred to earlier, RAMPOWER will be running sheep breeding and genetics workshops for breeders, commencing in 1995. These workshops will present market analysis, breeding objective and selection exercises as well as providing assistance in understanding and applying performance records in sheep breeding and marketing.

Performance Recording Services

One of the successes of WOOLPLAN was the introduction of a scheme of accreditation of fleece testing laboratories. Under this accreditation, WOOLPLAN ran round trials, involving duplicate subsamples of greasy wool sent to participating laboratories. The individual laboratory mean fibre diameter and yield results and variability between subsamples were compared with the mean and variability across all participating laboratories.

Achieving results within acceptable limits in two successive round trials led to accreditation of a laboratory and public advertising as such. Following accreditation, laboratories participated in on-going round trials at approximately yearly intervals. Accredited laboratories were also required to demonstrate accuracy and rigour in data processing, which was checked using standardised data sets. This attempt at quality control over fleece testing laboratories was strongly supported by ram breeders who have always referred to measurement inaccuracy, and apparent significant laboratory contribution to that inaccuracy, as one of their major concerns about performance recording.

Twenty one laboratories were ultimately accredited under WOOLPLAN. Brien (1994) estimated there were another 30 laboratories operating in Australia that remained outside the accreditation system - there was a proliferation of such "laboratories" in the late 1980's corresponding with high wool prices. Many of these were likely to be processing small numbers of samples, some basically for private use by individual or small groups of breeders. Certainly a number of these laboratories closed during the wool price recession of the early nineties.

RAMPOWER is continuing with the laboratory accreditation scheme and is attempting to expand the participation by other laboratories. Five new laboratories joined the first RAMPOWER Round Trial in

late 1994 while two laboratories, previously accredited under WOOLPLAN have ceased business. The identity of those laboratories successfully participating in the RAMPOWER accreditation scheme will be widely publicised in rural press and sheep breeder newsletters. Leading breeder organisations have indicated that they will overtly encourage their members to favour RAMPOWER accredited laboratories for future fleece testing services.

As a matter of interest, the twenty four RAMPOWER participating laboratories tested an estimated 699,000 wool samples for 2,401 clients in 1993/94 - representing an increase of approximately 37% over the previous figure published by Brien (1994) for samples tested in the 1991/92 testing year. This increase in fleece testing activity is consistent with industry opinions that the acceptance and demand for objective performance recording in sheep selection and marketing has increased significantly since the early 1990's, following the wool recession and de-regulation of the wool market. The clearer price premiums/discounts for wool quality from the wool market and a greater client focus by wool producers and ram breeders, referred to in the introduction of this paper, are suggested as strong contributors to this trend.

Given that less than 200,000 Merino rams are sold each year, the level of performance recording within the Merino industry is high. Making the measurements more useful for breeders and buyers for the purposes of selection is an area that RAMPOWER needs to address.

A less successful activity of the WOOLPLAN scheme was the introduction of further data processing capacity into fleece measurement services, to allow calculation of estimated breeding values and multi trait index values for measured animals. Standardised software was developed by WOOLPLAN. Of the twenty four laboratories now participating in the RAMPOWER accreditation scheme, 12 are using WOOLPLAN software to some extent while a further 8 are using independently developed software to process basic fleece measurement data, with optional calculation of estimated breeding values, and multi trait index values. The remaining laboratories use independently developed software, without the capacity to further process data beyond actual measurements or phenotypic rankings.

There are several reasons why the further data processing capacity developed under WOOLPLAN received only limited adoption by the clients of fleece testing laboratories. Brien (1993) suggests that because WOOLPLAN reports were only available in one standard format, and that the full reports (including estimated breeding values, index values) were frequently sent to sheep breeders who neither requested nor understood the further data processing parameters, WOOLPLAN was rejected by many breeders. Further, the new and relatively complex parameters such as estimated breeding values and multi trait index values were not adequately understood by breeders. Many breeders could not see how these parameters "added value" to the basic fleece measurements and phenotypic rankings.

During 1995, RAMPOWER, in consultation with fleece measurement laboratories and breeders, will be beginning to develop data processing software with the following features:

- Breeders can nominate to receive estimated breeding values/index values or phenotypic rankings only.

- Reports will have the capacity to present phenotypic rankings and/or estimated breeding values for a wider range of traits (including staple measurements, fibre diameter variability, faecal egg counts, subjective classer scores).

- Greater flexibility in nomination of a breeding objective and selection index. This is likely to involve changes in how breeders are asked to nominate their breeding objective

when requesting further processing of their performance records. The former approach of nominating relative economic values of traits in the breeding objective, may be replaced by statements about the breeders expected rates of gain in different traits in the breeding objective over a 10 year period.

For the small, though growing, proportion of wool sheep breeders who wish to utilise pedigree records and across year/across flock information when further processing performance records, RAMPOWER considers that such services are probably best provided by specialist data processing bureaux such as Advanced Breeding Services.

These services can be provided by skilled operators who can receive by modem or other electronic communication, basic data from fleece measurement laboratories and breeders and transmit the processed information to the breeder directly or via the fleece measurement laboratory.

Across Flock Genetic Evaluation Schemes

The biggest advances over the past 5 years in genetic evaluation services for the wool sheep industry have been in the establishment of credible analyses of the comparative genetic merit of over 60 Merino bloodlines and the conduct of a number of central progeny test evaluations of Merino sires from different ram breeding flocks. Atkins et al. (1994) have published the outcome of analyses of data on Merino bloodline comparisons in 54 wether trials conducted from 1983 to 1993. These trials were conducted in a wide range of environments.

Where bloodlines are represented in a sufficient number of trials to provide adequate linkages between different evaluations, bloodlines which could not otherwise be compared are included in the analyses. IWS has recently provided funds for the conduct of further analyses to incorporate data from wether trials conducted elsewhere in Australia and, where numbers and linkages are adequate, the number of bloodlines presented in the report will be expanded to include most numerically important ram breeding sources in Australia. These bloodline comparisons are already being keenly sought by commercial Merino ram buyers, and are likely to contribute to increased mobility of ram buyers in favour of genetically superior ram sources.

There are now seven sites around Australia where there are public Merino sire progeny testing schemes underway. These schemes are operated under the auspices of the National Sire Evaluation Policy Committee of the Australian Association of Stud Merino Breeders and the Federation of Performance Sheep Breeders. In addition to stud breeder delegates, a number of members of the RAMPOWER National Co-ordinating Committee are also delegates to this umbrella group which is charged with monitoring and updating protocols for the conduct, analysis and publication of results from these across-flock sire evaluation schemes.

A recent publication by Casey et al. (1995), of the breeding values of 154 sires from 67 different ram breeding flocks, is the outcome of the analysis of linked results from four of the longer running sire evaluation central test sites. These linked analyses (across years, across sites) are made possible by the inclusion in each annual mating of new test sires, two link sires that have been mated in previous years and/or at other evaluation sites.

These Merino sire evaluation schemes, now operating in NSW (3 sites from the Northern Tablelands to the Riverina), Victoria (2 sites), Western Australia and South Australia, are predominantly funded by participating breeders who pay between $1,500 and $2,000 per sire to participate. Some commercial

sponsorship is contributed and IWS, via RAMPOWER is contributing towards the costs of including link sires between different schemes, and to the analysis and publication of linked results.

The continued expansion of participation by Merino ram breeders in public Merino sire evaluation schemes, as seems likely from responses to the recent RAMPOWER survey of Australia's largest ram breeding flocks, will accelerate the realisation of the impact on industry genetic improvement which artificial insemination has the potential to make (Brash 1994).

CONCLUSION

Best available evidence (Atkins 1993, Ponzoni 1994) indicates that overall rates of genetic improvement in productivity in the Australian wool sheep industry are a fraction of the potential. However a number of factors indicate there is potential for an improvement in this aspect of the industry:

- participation in objective performance recording by sheep breeders is increasing, such that a large proportion of ram breeders now objectively measure some animals.

- participate in across-flock genetic evaluation is beginning to increase, from a very low base.

The challenge for industry support services is to ensure that breeders utilise these tools for genetic improvement, more effectively than has been the case in the past. The probability of this occurring will be influenced by a stronger focus by commercial wool producers on understanding wool market premiums and discounts and then setting breeding objectives which are responsive to these market signals. Having set clearer breeding objectives they are likely to seek credible evidence of the comparative genetic merit of rams from different suppliers, and evidence that the ram breeders are pursuing a breeding objective that is complementary to their own.

Ram breeders which are not responsive to client demands in this way are less likely to prosper, than they have in the previous 170 year history of this industry.

REFERENCES

AMLC (1994) *Meat and Livestock Review*. June 1994.
ATKINS, K..D. (1993) *Wool Tech. Sheep Breed.* **41(3)** : 257.
ATKINS, K.D., COELLI, K.A., CASEY, A.E. and SEMPLE S.J. (1994) Supplement to Agfact A3.3.33 NSW Agriculture.
AUSTRALIAN ASSOCIATION OF STUD MERINO BREEDERS (1993) *Australian Stud Merino Flock Register* Volume **65**.
BANKS, R. (1993) WOOLPLAN Consultancy : Outline of Australian Wool Breeding Services. Draft Operating Plan 1993-98.
BRASH, L.D. (1994) *Wool Tech. Sheep Breed.* **42** (4) : 327.
BRIEN. F.D. (1993) *Wool Tech. Sheep Breed.* **41** (3) : 281.
BRIEN, F.D. (1994) *Final Report to the Wool Research and Development Corporation.* Project DAS30.
CASEY, A.E., COELLI, K.A., ATKINS, K.D., COTTLE, D. and EPPLESTON, J. (1995) *Merino Superior Sires* Volume **1**.
HAMMERSLEY, A.D. (1987) Proc. 6th Conf. AAABG : 149.
METCALFE, P.L. and BRIEN, F.D. (1992) Proc. 10th Conf. AAABG : 126.
PONZONI, R.W. (1994) *Proceedings of the World Merino Conference Uruguay*, April 1994.