DECISIONS FACING MEAT SHEEP BREEDERS IN THE YEAR 2000, AND THE INFORMATION TO MAKE THEM

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INTRODUCTION

This paper summarises the methods by which available genetic variation is likely to be exploited, and then examines the ways in which the required information is delivered. This approach highlights the point that maximum efficiency of utilisation of genetic and feed resources is not simply a matter of having knowledge, or simply having genetic evaluation for a series of traits: the ideal approach is to develop the evaluation system using available knowledge as fully as possible, and as profit is generated in commercial production, to use some fraction of that profit to generate new and "targeted" knowledge.

The present situation of the lamb industry and its available genetic resources are outlined. The delivery system for genetic information is then described, including developments in that delivery system. Finally, some ramifications of the anticipated increased genetic efficiency for industry structure are discussed.

THE LAMB INDUSTRY TODAY

Production statistics for the Australian lamb industry (Banks, 1990, Fogarty et al, 1992) reveal a product that is barely maintaining its market share. Lamb so far is positioned as a "traditional" component of the Australian diet, and its low unit value and comparative unattractiveness (excessive fat, small cuts) mean that a proportion of lamb use is as a "loss-leader". In addition, its cost per unit lean tissue to the consumer does not offer any advantages of competing meats.

Thus the industry is disadvantaged in both cost of production and in product quality (as assessed by average portion sizes and amount of fat).

The first question that must be addressed therefore is, how much scope for addressing these problems is offered by animal breeding. This is covered in some detail in the next section: for the moment it is worth expanding the question to ask "where does genetics fit in with other technologies in solving this set of problems?"

Up until very recently it was very difficult to objectively answer this question: the extent to which breeding, feeding, and management could be jointly optimised was not really addressed in any production research. This has begun to change significantly with the MRC Elite Lamb Program (MRC, 1991) in which the scope for manipulating these three factors together is being directly addressed. For example, work at Cowra is examining the interactions between sires' EBV's for Weight and Fat, sex (cryptorchid vs wether vs ewe), and feeding regime. This has shown that sires rank consistently across sexes and feed regimes, but that there are scale G x E interactions. Already this sort of result has lead to the suggestion that breeding and feeding for Elite lamb (heavy and lean) be different from that for trade lambs.

While definitive answers are still being obtained, it is clear that even over the initial 18 months of the Elite Lamb program breeders, producers and researchers/advisors are all beginning to think much more in terms of linked components of an overall production and marketing system. In the context of applying genetics, this is likely to refine breeding objectives by recognising that some problems can be partly or completely addressed by non-genetic approaches, leaving more selection pressure to be applied to problems that do require genetic solutions. An example of the latter is development of genotypes that can be grown out to heavier weights without becoming overfat: while use of cryptorchids is very important here, the effects of genotype and sex appear to be additive thus increasing the scope for production of heavy lean carcases.

Thus at present the lamb industry faces serious product positioning problems, but is beginning to tackle those problems in a coordinated way. Importantly, efforts are being made to increase the proportion of lamb that is objectively traded. My comments in the rest of this paper assume that these latter efforts are successful, so that price signals flow clearly from consumer to processor to producer to breeder.

THE GENETIC RESOURCES AVAILABLE TO THE AUSTRALIAN LAMB INDUSTRY

In examining the available genetic resources, it is important to note that most rapid genetic improvement will come from simultaneous exploitation of within- and between-breed variation, both additive and non-additive. All four sources will be addressed here.

<u>(i) Within-breed Additive Variation:</u>
Extensive detail on within-breed genetic variation available to the Australian lamb industry are provided elsewhere in these proceedings (Brash, 1992). The situation can be summarised as follows:

* heritabilities for weight and fat in all breeds analysed provide scope for simultaneous improvement in these traits,
* genetic variation is available for muscle depth and area at least within the sire breeds,
* genetic variation is available for reproductive traits and wool weight, both of which are expressed by the prime lamb dam.

This within-flock genetic variation is sufficient for 2% improvement per annum in all traits with the exception of muscling. In addition results from Central Progeny Testing suggest that there is some between-flock genetic variation for at least weight, leanness, and muscling.

<u>(ii) Within-breed Non-additive Variation:</u>
This source of variation might be expected to be important if there were any differentiation within breeds into semi-isolated lines. All analyses of meat sheep data (Fogarty, 1978; Brash, 1992) suggest that this is not the case. A possible source of such differentiation is the use of New Zealand imports within the terminal sire breeds. Whether or not there are sufficient genetic differences between New Zealand and Australian flocks, and if so provides for hybrid vigour in crosses, this source is not being deliberately exploited.

Three of the terminal sire breeds (Poll Dorset, White Suffolk, and Coolalee) are recent synthetics. This should mean that some non-additive variation has been retained within these gene pools, but again there is no deliberate attempt to maintain or exploit such variation, except where selection for performance acts to retain heterosis.

(iii) Between-breed Additive Variation:

This area can be simply summarised by asking: are there particular breeds that are clearly superior for either the terminal sire or prime lamb dam role.

Taking the terminal sire sector first, the limited evidence available suggests that only very small differences exist for growth rate and leanness amongst the major breeds available so far. This situation seems certain to change once Australian production records are obtained for US Suffolks (first Australian progeny around Spring 1992), and Texels (due for release in mid-1993). Overseas evidence suggests that US Suffolks might have a growth advantage of around 10%, and that Texels will have a similar or larger advantage for leanness at constant weight. Exactly how such breed differences might be exploited cannot be accurately predicted, but there is almost certain to be some infusion of "exotic" genes into existing breeds.

Possible consequences of such infusion can be examined using multi-breed:multi-trait simulation software (Kinghorn, 1986), in which animals from different breeds are selected solely according to their additive and non-additive merit for defined production traits. The breed means used here are where possible based on research data:

Breed Means	Weight @ 12 mths	Fat @ 60 kg
Poll Dorset	60 kg	14 mm
Texel	58 kg	11 mm
US Suffolk	66 kg	15 mm
Heterosis for Weight and Fat		5% or None

The following table gives proportions of genes from the different breeds at generation 10, and means for weight and fat depth at that time.

HETEROSIS	BREEDS	BREED PROPORTION			MEAN G_{10}	
%		PD	TEX	US	WT	GR
0	PD	1.00			71.7	7.3
0	PD,T	0.94	0.06		71.0	7.8
5	PD,T	0.67	0.33		76.8	7.6
0	PD,T,S	0.05	0.08	0.87	79.6	9.1
5	PD,T,S	0.29	0.00	0.71	81.7	9.0

Several observations can be made about these results:

(a) Where only a small fraction of exotic genetic material is retained, the importation occurs in generations 2-3, and thereafter selection is basically within a closed flock/breed.

(b) Texels appear to offer little except where heterosis is important.

(c) This simulation does not include reproductive traits - for which heterosis may be significant, or muscling, in this simulation. If these are given economic value the likely effect would be to increase the proportion of Texel genes retained in the synthetic, and to even up the breed proportions for Poll Dorsets and US Suffolks in order to increase retained heterosis.

(d) US Suffolks look very useful on this result: obviously skin value will have an effect. If they are 10% superior for weight, this represents about 5-8 years progress, and hence all other considerations aside, they would be heavily used.

On the basis of these results (and therefore dependent on the assumptions used), systematic exploitation of between-breed additive effects will be of great value within the terminal sire sector.

Within the "maternal sector" the situation is less clear and harder to predict. Breed use within this sector now seems to reflect rainfall: in dryer areas lambs are produced out of Merinos, in medium rainfall areas (broadly the slopes of the dividing range) Border Leicester-Merino first-cross ewes predominate, while in the higher rainfall areas a range of dual-purpose breeds including "comebacks" and dual-purpose Merinos are used.

The picture is not clarified by the existence of good comparative data on breeds and crosses: what exists is not as useful as ideally because of design limitations (problems with numbers of observations, sire sampling, trait sampling, and season sampling). This situation is further complicated by the likely greater scope for manipulation of maternal performance by management. This potential needs to be clarified before research funds are invested in breed comparison work in the maternal area.

(iv) Between-breed Non-additive Variation:
In the simulation results presented above, the inclusion of heterosis for growth and leanness clearly modified expected outcomes. Evidence for such heterosis has been reviewed (Ch'ang and Atkins, 1982), and suggests that substantial paternal and maternal heterosis is available. The situation for maternal heterosis is complicated by the apparent existence of genotype-by-time of lambing interactions: the Border Leicester-Merino exhibits considerable heterosis for lambs weaned per ewe joined in Autumn joining, but none (or even negative heterosis) in Spring joining.

Currently, the lamb industry makes substantial use of individual and maternal heterosis through a structured crossing system. Little or no use is made of paternal heterosis.

DELIVERING INFORMATION ON THE AVAILABLE GENETIC RESOURCES

This simple review shows that the genetic resources available offer scope for improvement in productivity (weight of lamb per ha) and in carcase characteristics. How well described to the commercial producer are these resources?

The available within-breed additive variation is described through the on-farm and central progeny test components of LAMBPLAN. Adoption of these is increasing steadily, and particularly central progeny testing is beginning to encourage producers to source flock rams from LAMBPLAN flocks.

No attempt is being made to formally describe within-breed non-additive variation: if this is utilised it will be via favourable effects on the production traits for which estimates of additive merit are provided.

Evaluation of breed resources in the terminal sire sector is being subsumed within the central progeny testing program. While certainly not statistically ideal for breed evaluation, this approach should be as effective in commercial terms as more formal breed evaluation and substitution, and will be far cheaper. Within the maternal sector, the most cost-effective approach to rationalising breed use will involve initial modelling studies which incorporate manipulation of production (quantity and quality) through management, and attempts to link past genotype evaluations using methods analogous to the linked wether trial analysis (Hygate and Atkins, 1988).

It is important to note that LAMBPLAN is seen as a single system for delivering these different components of an integrated information system, so that as far as possible the industry can make decisions about all available genetic variation. The close integration of breeding, nutrition and management aspects in the Elite Lamb Program reinforces this approach.

Anticipated "technical" developments in the delivery of genetic information are discussed elsewhere in these proceedings (Banks, 1992), but it is worth noting here that the ultimate aim will be unification of within- and across-flock (and possibly across-breed, at least for the terminal sire sector) evaluations, primarily to minimise confusion about the meaning of EBV's calculated from different bases.

EFFECTS OF GENETIC CHANGE IN THE LAMB INDUSTRY

If we assume that use of more objective marketing methods in the lamb industry increases, the logical conclusion is that a clearer separation will become apparent between those breeders and producers willing and able to use more objective methods, and those who are not, and by and large, it will be the former that remain in the industry. The dairy industry in this and other countries provides an excellent illustration of this process, and it is worth noting some of the changes that result:

* the seedstock sector contracts as competition becomes more based on standard evaluation language,
* the commercial sector contracts, with fewer producers turning off more product each,
* a higher level of expertise is required for advisors,
* the number of researchers contracts,
* part or all of the delivery system becomes "privatised".

It could be argued that the last two of these changes may be artifacts of wider political change: whether this is true or not is not as important as whether genetic improvement continues in the commercial production sector. In the dairy industry this has clearly been the case.

Finally, given these likely changes, what benefits does AAABG offer the industry under such circumstances? I suspect that now is the time to be addressing this issues: experience suggests that the combination of an integrated genetic evaluation system and clear market signals make commercial genetic improvement very likely. Once this begins, the structural changes and effects on the R&D (including AAABG) sector are really very rapid.

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