LAMBPLAN: GENETIC EVALUATION FOR THE AUSTRALIAN LAMB INDUSTRY

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INTRODUCTION

Australia produces approximately 16.5 million slaughter lambs annually, of which about 20% are exported. Average carcase weight is 18.5 kg, and the average subcutaneous fat level is 12-14 mm at the GR site (total tissue depth 110 mm from the backline at the 12/13th rib).

The industry has suffered declining real income and profit over the last 30 years, due to a combination of inefficient production methods, minimal investment in improved processing, and increasing consumer reaction against a product that is perceived as having too little lean meat and too much fat. Extremely insensitive price signals between sectors of the industry has inhibited any technological innovation, including that available through genetic improvement.

Offsetting this situation, the genetic structure of the industry (in both the breeding and commercial sectors) provides clear scope for highly cost-effective genetic improvement of commercial traits:

- the breeding sector comprises some 2,000 flocks of which 300-400 supply most of the annual commercial sire intake

- terminal sire and crossing breeds have significant genetic impact on the slaughter lamb:

Table 1: Proportional contribution to slaughter lambs by genotype

Dam	Sire				Totals
	Merino	Crossing	Dual-purpose	Terminal	
Merino	0.08	0.14	-	0.15	0.37
F1	-	-	-	0.35	0.35
Dual-purpose	-	-	0.15	0.13	0.28
Totals	0.08	0.14	0.15	0.63	1.00

Clearly, genetic improvement of the terminal sire, and of the crossing and dual-purpose breed populations, will have significant impact on slaughter lambs. Breeding objectives for Merinos in Australia concentrate on wool traits, and the Merino genetic contribution to slaughter lambs and to lamb dams reflects the widespread and cheap availability of aged Merino ewes. These are used to breed F1 daughters (Border Leicester is the main "crossing breed" used over Merinos), although an increasing proportion of slaughter lambs are F1 terminal sire x Merino crosses.

Until the mid-1980's, no wide-scale performance recording/genetic evaluation programs existed in the lamb industry. LAMBPLAN was introduced in 1989, following successful development work with a simple prototype program (based on phenotypic adjustment of weight and sub-cutaneous fat measures) in New South Wales. This prototype provided a database for estimation of genetic parameters for weight and subcutaneous fat depth for Poll Dorsets and other terminal sire breeds (Atkins et al, 1991).

DELIVERY OF GENETIC INFORMATION IN LAMBPLAN

LAMBPLAN was launched providing Sire Model EBVs for Weight and Fat Depth traits based on measurement of animals in terminal sire, crossing, and dual-purpose breed flocks at ages 6-18 months. Fat depths were measured at the C site (over the deepest part of the eye muscle, at the 12/13th rib) using A-Mode ultrasound equipment. Over the period 1989 to 1993, research was carried out in the following areas:

- evaluation of equipment and procedures for measuring eye muscle depth of young sheep in the field, and following establishment of appropriate measurement protocols, estimation of genetic parameters for eye muscle depth and subcutaneous fat depth allowing introduction of genetic predictions for eye muscle depth (Gilmour et al, 1994),

- estimation of genetic parameters for reproduction, wool, weight and carcase traits in a more complete range of the breeds used in the lamb industry (Brash et al, 1992, Brash et al, 1994),

- development of Animal Model BLUP software for use in meat sheep genetic evaluation (Gilmour and Banks, 1992).

The results of these projects provided the basis for substantial enhancement of LAMBPLAN (Fogarty et al, 1992). LAMBPLAN now provides genetic evaluations for the following traits:

Traits on Animals:

Age	Trait					
	Weight	**Fat Depth**	**Eye Muscle Depth**	**Greasy Fleece Weight**	**Fibre Diameter**	**Scrotal Circumference**
Birth	**bwt**					
Weaning	**wwt**					
Post-weaning	**pwwt**	**pwcf**	**pemd**			**psc**
Yearling	**ywt**	**ycf**	**yemd**	**ygfw**	**yfd**	**ysc**
Hogget	**hwt**	**hcf**	**hemd**	**hgfw**	**hfd**	**hsc**

Traits on Dams:

No. Lambs Born[1]	No. Lambs Weaned[2]	Lambing Opportunities
nlb	**nlw**	**lop**

1 Total number of lambs born in *lop* opportunities

2 Total number of lambs weaned in *lop* opportunities

The prediction models for measured traits are:

i.	***Weight***	Adjusted for birth and rearing type, age of dam, and age as a covariate.
ii.	***Fat Depth***	Adjusted for weight fitted as a covariate.
iii.	***Eye Muscle Depth***	Adjusted for weight fitted as a covariate.
iv.	***Reproduction***	EBVs are calculated using dams' lambing record, and/or scrotal circumference. A repeatability model is used to account for variable *lop*.
v.	***Greasy Fleece Wt***	Adjusted for birth and rearing type, age of dam, and age as a covariate.
vi.	***Fibre Diameter***	Adjusted for birth and rearing type, age of dam, and age as a covariate.

To date LAMBPLAN has provided selection indices for terminal sire and maternal (crossing and dual-purpose) breeds using a simple "desired gains" approach. The rationale behind this has been to simplify extension messages in the absence of clear flow of price signals in the lamb industry. The indices developed recognise breed role and likely underlying relative economic values, and as price signals improve, more detailed breeding objectives and formal economic values will be used to derive indices (Fogarty, 1987, Banks, 1990, Fogarty and Gilmour, 1993).

For example, selection indices for Terminal Sire breeds currently available through LAMBPLAN are:

LAMBPLAN Index Options for Terminal Sire Breeds:

Index Option	**Predicted 10 Year Response**		
	12-mth Weight (kg)	**12-mth Fat (mm GR)**	**Eye Muscle Depth (mm)**
High Growth	**11.0 (80)**	**- 0.1 (-2)**	**- 0.6 (18)**
Lean Growth	**9.0 (38)**	**- 2.7 (-38)**	**- 1.5 (-24)**
Growth 80	**11.0 (64)**	**- 0.8 (-14)**	**- 0.9 (-22)**
Growth 80 + EMD	**10.3 (80)**	**- 0.3 (-10)**	**0.3 (10)**
Lean Growth + EMD	**4.6 (33)**	**- 0.9 (-33)**	**1.1 (33)**

NB: assumes a 300 ewe breeding flock, with 2 age groups of rams and 5 of ewes, and i/l=0.53

values in brackets are responses for each trait in genetic standard deviations, as a proportion of total standardised response (ie sum of standardised responses for individual traits)

A similar range of index options is available for crossing and dual-purpose breeds.

LAMBPLAN processing is done by accredited LAMBPLAN Providers using 386 and 486 microcomputers, with centralised processing restricted to across-flock evaluations, parameter estimations, and research analysis.

INDUSTRY ADOPTION OF LAMBPLAN

When LAMBPLAN was launched, approximately 100 flocks were using its prototype in NSW. In the period 1989-1994, the number of flocks using LAMBPLAN has grown to nearly 300, and just over 50% of young terminal sires entering the commercial flock annually are now being tested and sold with LAMBPLAN information. The flocks using LAMBPLAN include all major sources of sires to breed sires in all the commercially relevant breeds of the industry. It is anticipated that the proportion of animals undergoing LAMBPLAN genetic evaluation will rise significantly over the next 1-3 years due to the combination of introduction of across-flock and across-years evaluation, the increased range of traits available,increasing objectivity in lamb trading, and improved prices for slaughter lambs for Australian producers.

The adoption of LAMBPLAN has been stimulated by a national program of central progeny testing of terminal sire breed rams, and by the release into the industry of American Suffolks (Milton and Banks, 1994), Texels, and Finnish Landrace sheep.Further, the total industry genetic improvement effort includes evaluation and use of Computerised Tomography (CT) for whole-body scanning, and screening LAMBPLAN databases for evidence of major genes.

The Australian lamb industry is now making widespread and increasing use of an integrated genetic information system. This is a significant change from the prevailing situation even up to the early 1980's, and has demonstrated that attitudes to genetic improvement and methods of achieving it can be altered rapidly under the influence of clearly demonstrated genetic differences, competition from new breeds and other food/protein products, and almost terminal decline of an industry. Australia is now seeing acceleration of genetic gain for commercially relevant traits, and closer examination of all aspects of producing and trading lamb in Australia. An integrated genetic information system has contributed to this evolution in industry thinking considerably.

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