LIMITATIONS TO GENETIC IMPROVEMENT OF LAMB PRODUCTION

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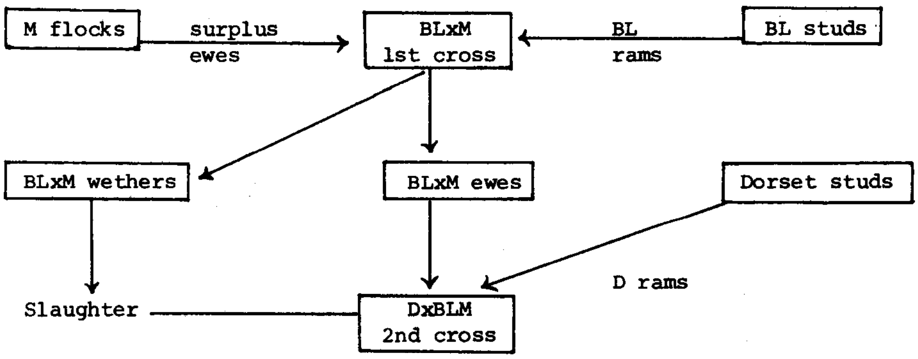
Most Australian prime lambs are produced from a tiered crossbreeding structure. In N.S.W. and Victoria at least, where more than 75 percent of lambs are slaughtered, the industry is based largely on the Merino (M), Border Leicester (BL) and Dorset (D) breeds (see Fig. 1). M ewes, often cull or cast for age, are joined to BL rams (purchased from BL studs) in marginal climatic areas of the wheat-sheep zone to produce BLxM first cross lambs. The wether lambs are slaughtered. The ewe lambs are grown out and sold to second-cross lamb producers in more favourable areas. The BLxM ewes are joined to Dorset or other shortwool rams and all the progeny are slaughtered as prime lambs. These structures and breeds account for most of the Middle East and other export markets, and changing domestic market requirements may affect this structure and the breeds used to some extent in the future.

FIGURE 1: Structure of the Prime Lamb Industry



ADVANTAGES OF CROSSBRED STRUCTURE

The above crossbreeding structure has developed over the last 60 years. It provides for very efficient use of breed and land resources and has inbuilt flexibility for the lamb producer. Advantages include:

- the large base population of wool producing M ewes is utilised to produce more valuable lambs.
- less valuable marginal farming land is used for breeding and growing out first cross ewes.
- producing first cross ewes in marginal areas diversifies sources of income.

- valuable land in favourable areas is used for more intensive second cross lamb production where good nutrition is critical to maximise ewe reproduction and lamb growth.

- commercial producers have considerable flexibility to change the emphasis of their production relatively quickly according to market trends or other exigencies.

- maximum maternal heterosis is exploited in the first cross ewe.

- maximum individual heterosis is achieved in the second cross lamb.

LIMITATIONS TO GENETIC IMPROVEMENT

Breeding objectives and selection criteria for improving lamb production were outlined by Dun *et al*, (1970) and reaffirmed at a subsequent national Workshop (A.P.C., 1974). Detailed selection indices for flocks at various levels in the above structure have been derived and theoretically evaluated (Stafford and Walkley, 1979; Ponzoni and Walkley, 1981). These indices assessed response in terms of gain to the prime lamb producer and included various measures of growth, wool production and reproduction. However, a selection index that maximises genetic gain and profit to the prime lamb producer may not maximise gains to breeders at other levels in the structure. Performance recording schemes to aid in implementation of selection programs are available in most States, but their usage is low (Walkley, 1981).

Major limitations to genetic improvement in lamb production include:

- lack of vertical integration between levels in the structure.

- lack of direct financial incentive to stud breeders implementing improvement programs.

- low and variable prices for prime lambs.

- desire for prime lamb producers to diversify income by optimising both wool and lamb production.

- long interval from selection decisions in the stud to ultimate response in lamb production, especially on the dam side.

- hierarchical structure in stud flocks increases genetic lag.

- stud flock dependence on show ring performance for ram sales.

- small size of most stud flocks.

- relatively short existence of many studs.

- low net reproductive rate and viability in many stud flocks.

- high rate of inbreeding in pure breeds.

- selection goals vary for different levels in the structure.

- industry antagonism to twins, especially in M flocks.

- important traits are difficult to assess in the live animal.
- important traits are sex limited.
- response to selection for production traits will be slow and less tangible than some appearance traits.
- lack of industry perception of a need for further improvement.
- lack of flocks demonstrating realised response to selection.
- high level of heterosis in crosses.

Industry Structure

Lack of vertical integration of the structure results in only second cross lamb producers capitalising on any genetic improvement for lamb production made at other levels. The number of levels and breeders involved and their widespread dispersion restricts influence of commercial lamb producers on selection decisions in studs that ultimately bring about genetic change. This is accentuated by the hierarchical structure that exists within the pure breeds in which most studs are simply multiplier flocks. There is an improvement lag of about two generations between levels and three levels exist in the DH hierarchy (Fogarty 1978c). The low price of Australian lamb and the fact that show ring performance rather than production traits determine financial success of the stud breeder mitigates against improvement programs. Hence there is little incentive for the non-altruistic stud breeder to implement genetic improvement programs in which the benefits of his patient and expensive endeavours are reaped by others.

Studs

Further limitations are imposed by the small flock size and relatively short existence of studs (e.g. in 1973, only 3 percent of DH studs had more than 400 ewes and 40 percent were less than 10 years old; Fogarty, 1978b). These obviate implementation of effective selection programs in a majority of studs. Poor net reproductive rates have been reported in BL (Trounson and Roberts, 1970) and D (Plant *et al*, 1976) stud flocks, which reduces possible selection pressure. Causes include high levels of dry ewes and lamb and adult mortality, with pneumonia susceptibility in BL and a high incidence of dystocia in D flocks being particular problems (Fogarty, 1971). The high level of inbreeding that exists in DH (Fogarty, 1978b) and probably other pure breeds, would also contribute to the low net reproductive rate.

Parameters and Measurement of Traits

Response to selection for production traits is slow and not expressed by dramatic phenotypic changes. Usually a number of traits are incorporated in selection programs, heritability is low for many important traits even though considerable variation exists, and low reproductive rates reduce selection differentials. These may be further diluted because of the need to maintain physical soundness in the flock and conform to Breed Society standards. Selection goals may vary for flocks at different levels in the structure, e.g. wool receives greater emphasis than twinning in M flocks. Important traits for lamb production, particularly those associated with reproduction, are difficult and/or expensive to measure and may require repeated records, e.g. out of season breeding ability, ovulation rate, ram serving capacity and ewe fertility. Some traits are sex limited, such as ewe reproductive rate, yet greater selection pressure can be applied to rams. Other traits such as carcase characteristics can only be accurately evaluated after slaughter.

Industry Perceptions

It should be stressed that many stud breeders fail to perceive there is a problem of genetic improvement. The major conclusion on this subject of a national workshop convened to discuss genetic improvement in the sheep industry (A.P.C. 1974) stated:

> " ... the sheep industry does not recognise the need to alter its current selection and breeding practices. The sheep industry is generally conservative in its attitude to technical innovation. Among ram breeders there is opposition to any change from the traditional selection procedures which have been employed in the industry for many years".

In the ensuing years many developments have occurred in the wool industry, but there has been little real change in the methods used for genetic improvement in the lamb industry. The problem in the lamb industry is accentuated by the lack of appropriate flocks in which response to selection for production traits has been demonstrated. In addition, heterosis is important, particularly in the BLxM (McGuirk, 1967) and overcomes many of the problems and deficiencies in the parent breeds. This dramatic increase in performance of the crossbred tends to swamp the relatively small selection increments possible in the parent breeds, and any selection gains are halved in the crossbred.

POTENTIAL PRODUCTION

The major energy costs in lamb production are associated with maintenance of the ewe flock and replacement females. Considerable improvement in efficiency can be achieved by increasing the total weight of lamb/ewe joined/year (Dickerson, 1978). This can be achieved by increasing litter size weaned and/or lambing frequency and an earlier age at first joining. The BLxM has outperformed other dam types (see Fogarty, 1978a) and deserved its predominance because of good spring lambing, mothering ability, wool production and easy care management. These features will ensure continued widespread use of the BLxM for extensive prime lamb production on mixed farms. However, an annual lamb turnoff of 100-130 percent will not be sufficient for financial survival in the years ahead for commercial lamb producers on expensive land in favourable areas. A ewe with potential for higher lambing rate and year round joining ability, suited to intensive production and capable of being exploited for cumulative genetic improvement is urgently required. An example of the level of lamb production that is possible under very intensive management is the 3.5 lambs turned off/ewe joined/year over 5 years from unselected Finn x Dorset ewes joined every 7 months in Scotland (Robinson and Ørskov, 1975. A dramatic increase in lamb production of the BLxM ewe is not possible using traditional genetic improvement methods, although a quantum increase in ovulation rate could be achieved by infusion of the Booroola major gene (Piper, pers. comm.).

ALTERNATIVE FOR FUTURE INTENSIVE PRODUCTION

The success of more intensive lamb production in the future depends on increasing the weight of lamb turned off each from ewe joined/year, through increasing litter size born and lambing frequency and by attaining high levels of lamb survival and lamb growth rate. Judicious selection and combination of available genotypes into a self replacing breed can increase litter size and length of the breeding season (allowing greater flexibility of joining time and the possibility of accelerated lambings). The development of a highly productive self replacing breed will provide direct incentives for implementation of genetic improvement programs and should realise more rapid cumulative genetic gains in lamb production. The "Hyfer" being developed from Dorset, Booroola Merino and Trangie Fertility sheep, is an example of this approach. Early results of this program reported at this Conference (Fogarty and Hall, 1982) are very encouraging.

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