1986

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R. W. Ponzoni
Department of Agriculture

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ECONOMIC EVALUATION OF BREEDING OBJECTIVES IN SHEEP AND GOATS - SUMMARY AND COMMENTARY

R.W. PONZONI, AUSTRALIA
Department of Agriculture
Adelaide, S.A., Australia 5000

INTRODUCTION

At the first and second World Congresses on Genetics Applied to Livestock Production some consideration was given to the definition of breeding objectives in sheep and goats. Having a whole Plenary Session dedicated to the evaluation of breeding objectives at the present Congress is an indication of the greater awareness about the importance of this area and the overall efficiency of breeding programmes. The chances of success of a breeding programme will be enhanced if during its formulation the following five steps are taken in meticulous order: (i) definition of the breeding objective; (ii) choice of selection criteria; (iii) organisation of the performance recording scheme; (iv) use of the information recorded to take selection decisions; and (v) use of the selected individuals. Because these five steps are sequential the success of all other operations intended for the genetic improvement of the population is dependent on an adequate definition of the breeding objective.

JAMES has discussed the general problems of defining breeding objectives in sheep and goats, whereas BRADFORD and MEYER concentrated on practical considerations and described examples for the two species. The purpose of this paper is to highlight the most important points made in those papers and to indicate areas in which further work is likely to yield valuable results. I hope my comments will lead to and stimulate a fruitful discussion.

GENERAL CONSIDERATIONS

Because of the diversity of climates, management and production systems under which sheep and goats are run, a multiplicity of breeds and strains have evolved, and these may have very different breeding objectives. JAMES pointed to the speculative nature of all breeding objectives, since they are based on predictions of economic and technological conditions at the time when results of current decisions come into effect. The degree of uncertainty is greater for improvement within a breed than for choice among existing stocks because of the longer lags involved.

In the development of breeding programmes it is important to distinguish the breeding objective from the selection criteria. The breeding objective comprises those traits which one attempts to improve genetically because they influence returns and costs to the producer. The selection criteria are the characters used in assessing the breeding value of individuals. Decisions about selection criteria can only be made after the breeding objective has been defined. Failure to observe this distinction is likely to
create confusion between means and ends, thus leading to reduced progress.

The problem of who should benefit from the breeding programme was discussed briefly by JAMES. This is a difficult area because conflicts of interest between different sectors (breeders, producers, consumers) are likely to arise. These conflicts can be exacerbated by legislation which may distort the "real" long term economic situation. It would appear unwise to base long term breeding programmes on artificial economic situations. However, the alternative of ignoring the current situation could force a breeder out of business before there is any demand for his animals.

JAMES has emphasized that the development of a breeding objective should begin with a specification of all items of income and expense. When this is done we are faced with the problem of how to combine returns (R) and costs (C). Two alternatives are: (i) the profit equation \( P = R - C \) and (ii) the ratio \( Q = \frac{C}{R} \) (or its reciprocal). JAMES indicated that the profit equation provides an appropriate way of estimating economic values in the short term (say, 10 years) and when there are fixed costs associated with the products. However, in the long term (say, 25 years) when there are no fixed costs, given the freedom to vary the scale of the enterprise, the ratio \( Q \) or its reciprocal is a better way of combining returns and costs. In some cases it may be necessary to impose restrictions on outputs or on inputs, and an example is given of a situation in which this approach is justified. It would be of interest and practical value to derive economic values in various ways (say, using \( P \), \( Q \) and imposing restrictions) for specific situations. Then, correlations among the various breeding objectives and among indices derived for each objective could be calculated. These correlations would assess the degree of similarity among objectives and indices. For instance, the importance of knowing the value of the correlation between an index derived from \( P \) and index derived from \( Q \) is obvious, since it would constitute a comparison between indices derived for short term and for long term breeding objectives, respectively.

Feed costs are a major component of the production costs in sheep and goat enterprises, and they are best accounted for by including feed consumption as one or more separate traits in the breeding objective. Because it is very difficult to measure feed consumption in grazing animals, this trait has often been excluded from the breeding objective. However, it is incorrect to do so, and this attitude is most likely a consequence of failing to distinguish clearly the breeding objective from the selection criteria. It should be noted that information on phenotypic and genetic parameters for feed consumption in sheep and goats is very limited, and that research on this area would yield information that is essential in the design of breeding programmes.

In the last section of his paper JAMES discussed the application of the discounted cash flow method to the definition of breeding objectives. Not all traits in the breeding objective are expressed with the same frequency nor at the same time. JAMES suggested that the discounted cash flow method was likely to produce results very similar to those obtained from an analysis of costs and returns within a year. PONZONI (unpublished) examined several specific situations and his findings totally support JAMES' suggestion.
The paper by BRADFORD and MEYER no doubt contributes with a useful conceptual framework for all those faced with the task of developing practical breeding objectives for sheep and goats. The paper also points to areas in which our knowledge is deficient.

The proposed general classification of breeds into: (i) maintained and used mainly as purebreds, (ii) specialised “ewe sire” breeds, and (iii) terminal sire meat breeds, is particularly helpful. The authors show that the traits in the breeding objective for the three breed types can be very different. The distinction between intensive and extensive feeding and management within breeds used as purebreds also appears of value, since the level of output and of input will be affected by the nature of the enterprise.

The further categorisation introduced by BRADFORD and MEYER distinguishing between “mature” and “less well developed” industries is also likely to be useful. Mature industries are characterised generally by well established breeds and markets, good estimates of genetic and economic parameters and by the existence of performance recording schemes. Less well developed industries have opposite characteristics, namely, often undefined breed types, paucity of information on genetic and economic parameters, and little or no formal performance recording. Evidently the approaches to be taken when developing breeding objectives in either case ought to be different, and the authors discuss this matter in detail.

For mature industries BRADFORD and MEYER reviewed and discussed several examples. Most of the work on development of breeding objectives for multiple purpose breeds (e.g. Merino, Romney) has been conducted in Australia and New Zealand, whereas work on terminal sire meat breeds has been carried out mainly in the latter country and in Europe and the U.S.A. Among multiple purpose breeds the relative importance of wool production, reproductive rate and growth rate is variable, depending on the breed and the production and marketing system. In terminal sire breeds growth rate is often the trait of greatest importance, but lamb viability and carcase attributes may be important also.

For less well developed industries screening of local populations and an examination of the possibility of utilising available breed resources may be necessary steps, prior to a definition of breeding objectives in a formal manner. BRADFORD and MEYER draw attention to some general principles which may help guide decisions: (i) the level of reproduction should be compatible with the feed and management level; (ii) the genetic improvement of wool production usually requires less change in input than improvement in reproductive rate or in growth rate; (iii) improvements in carcase merit are generally economically less important than those in reproductive rate, growth rate or wool production, and (iv) marked changes in growth rate or in mature size are not necessarily worthwhile.

There are several traits recognised as being of economic importance and for which there is in some cases evidence of genetic variation, but that have received little attention to date in formal definitions of breeding
objectives. These traits should be given consideration when developing refinements of current breeding objectives in established breeds and production systems, and also when attempting developments for new situations. Examples are: (i) lamb viability; (ii) longevity and disease resistance; (iii) easy care traits; (iv) feed conversion; (v) duration and time of occurrence of the breeding season; (vi) variability in litter size, and (vii) removing wool in mixed wool x hair sheep populations. BRADFORD and MEYER discussed practical situations in which the above mentioned traits are important.

Goats are very valuable animals in their own right in many areas. Where sheep or cattle are the dominant species the importance of goats may increase, particularly if regarded as a complement rather than as an alternative to the other species in grazing systems. In the final section of their paper BRADFORD and MEYER discussed several aspects of breeding objectives for goats. In this regard goats have received less attention than sheep. The breeding objectives for sheep and goats are often considered comparable (e.g. Merino sheep and Angora goats) and the approaches developed for one species are likely to be valid for the other. However, differences are large enough to justify detailed studies of breeding objectives in goat breeds. These studies would be similar in nature to those already carried out for some sheep breeds. The genetic improvement of dairy goats poses some special problems that should receive attention in future research.

Other topics that would be of interest in future work related to breeding objectives in sheep and goats are: (i) the possible non-linear relation between economic merit and the metric value of some traits, and (ii) the presence of genotype by environment interactions resulting from differences in feeding and management in stud and in commercial flocks.

CONCLUDING REMARKS

The two papers presented at this Plenary Session constitute an excellent contribution to our knowledge and understanding of the subject matter. While discussing in some detail several problems for which there is no unique best solution, the authors have succeeded in providing sufficient guidelines to enable us to revise current breeding objectives in established "mature" sheep and goat industries, or to begin developing appropriate ones for less well known breeds and environments. A systematic approach to the definition of breeding objectives can be described as consisting of four main phases: (i) specification of the production and marketing system; (ii) identification of sources of income and expense in commercial populations; (iii) determination of biological traits influencing income and expense, and (iv) calculation of the economic value of each trait. The task may be facilitated by co-operation between biologists and economists.

The formal definition of breeding objectives is valuable in its own right. It is the first and most important step in the design of a breeding programme. If the breeding objective is not correct the effort put in other phases of the breeding programme could lead to an economic deterioration of the population. But also, because of the comprehensive
nature of the information required, a formal definition of breeding objectives will reveal areas in which knowledge is deficient. The presentations made by JAMES and by BRADFORD and MEYER suggest that additional information or new approaches are required in the following areas:

(i) implications of combining returns and costs in various ways;

(ii) estimation of phenotypic and genetic parameters for the following traits:
   (a) feed intake in young and in adult animals,
   (b) lamb viability;
   (c) variability in litter size;
   (d) duration and time of occurrence of breeding season;
   (e) disease resistance;
   (f) easy care traits;
   (g) longevity;
   (h) wool production in crosses of wool x hair sheep;

(iii) non-linear association between economic merit and the metric value of some traits;

(iv) genotype by environment interactions involving stud and commercial sheep.

The identification of these deficiencies should stimulate appropriate research and development work.