Analysis of genetic improvement objectives for sheep in Cyprus

A.P. Mavrogenis
Agricultural Research Institute
P.O. Box 22016, 1516 Nicosia, Cyprus

SUMMARY – An account of the methodology employed and the procedures used for the genetic improvement of sheep in Cyprus is presented. Breeding objectives, breeding goals and selection criteria are described and justified. The breeding structure is dictated by the economic and social environment in Cyprus. Future developments in selection and evaluation procedures are presented.

Key words: Sheep, breeding, genetics, Cyprus.

RESUME – *"Analyse des objectifs d'amélioration génétique des ovins à Chypre". Un compte-rendu de la méthodologie employée et des procédures utilisées pour l'amélioration génétique des ovins à Chypre est présenté. Les objectifs de sélection, la finalité de l'amélioration et les critères de sélection sont décrits et justifiés. La structure de l'amélioration est dictée par l'environnement économique et social de Chypre. Les futurs développements des procédures de sélection et d'évaluation sont présentés.*

Mots-clés : *Ovins, sélection, génétique, Chypre.*

Introduction

Genetic improvement aims for the active use of the genetic variation both within and between breeds. It is a directional improvement of the genetics of animals in a particular breeding goal.

Genetic improvement helps to achieve the objectives by: (i) defining the breeding goal; (ii) identifying the best animals (estimating the breeding value); and (iii) utilizing those best animals (breeding structure).

Breeding goals are nothing else but the individual or the sum of those animal traits that the farmers would like to improve. The tools used in deciding on which animals will be the parents of the next generation is the index (when more than one traits are involved).

Hence, the breeding goal is the aggregate genotype and the tool the selection index. Our efforts are to maximize the correlation between the two (aggregate genotype and index) in order to achieve maximum response.

Making genetic improvement

The two key questions in animal breeding are where to go and how to get there (Fig. 1), or in other words:

(i) What is the breeding objective (which traits to improve and how important are the traits in relation to each other.

(ii) Is reproductive technology required (AI, embryo transfer, etc.).

(iii) How many and which animals do we need as parents for the next generation.

(iv) How to mate the selected males and females.

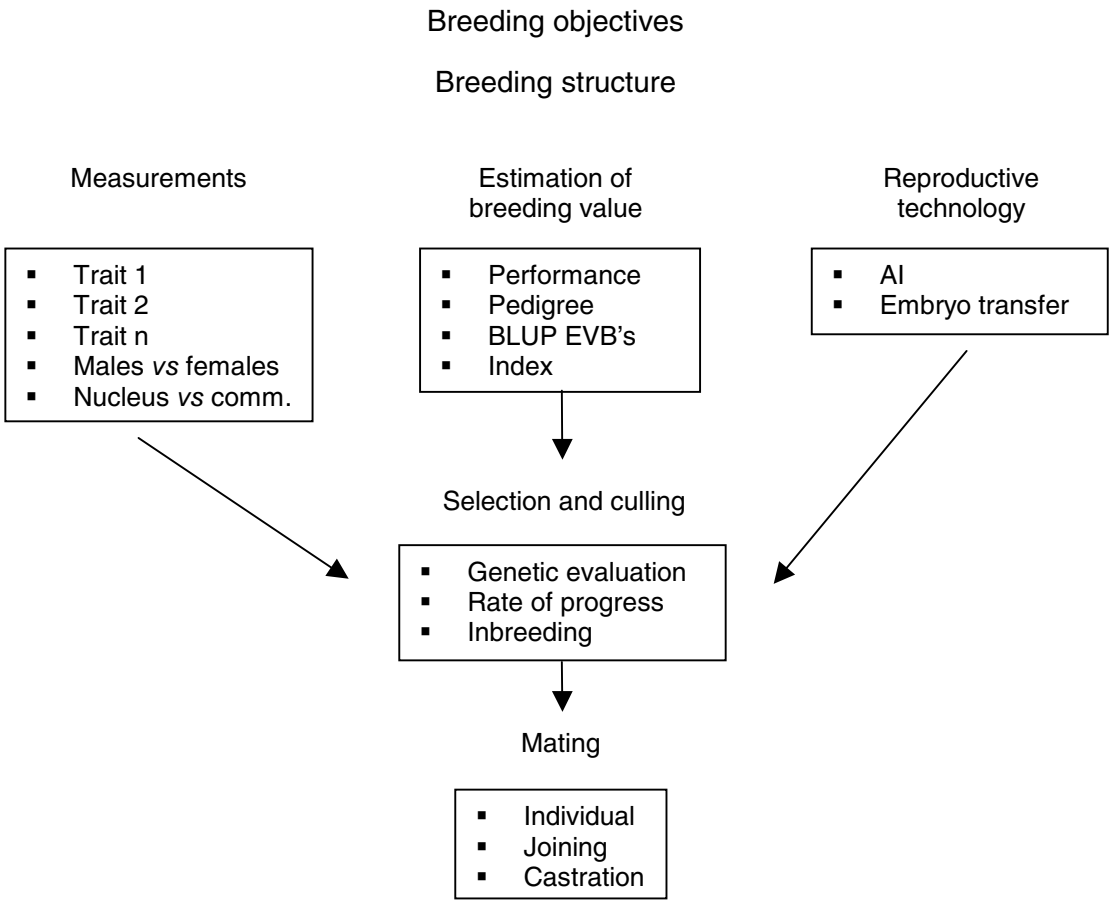

Fig. 1. Key questions in animal breeding.

Breeding objectives

Define clearly the breeding objectives and identify selection criteria that can be easily and accurately measured. Exclude irrelevant traits from the breeding goal definition. Breeding objectives must reflect current and future needs of the farmers. Before any selection decisions can be made there is a need to define the selection criteria.

The amount of genetic improvement that can be made depends primarily on:

- The selection intensity
- The genetic variation within or among breeds
- The accuracy of selection
- The generation interval.

For each animal we must transform phenotypic information info Estimated Breeding Values (Genetic Evaluation).

- The simplest form is to consider individual performance only.
- We must correct for environmental effects (herd, season, age, etc.).
- Use BLUP (if links are available), advantages (info from relatives).
- When more traits are considered we need relative economic weights for each trait.
- The selection index combines information on genotype and relative economic values.
- Multi trait selection, combines EOV, again weighted by economic values.
- Optimize generation intervals, and number of families in each generation to minimize inbreeding.

The case of Cyprus

Genetic improvement objectives

The breeding program aims at the genetic improvement of milk and meat output. To achieve these goals there are generally two pathways. Through the utilization of genetic variability among breeds or within breeds.

We have used both methods of improvement exploiting both the additive genetic variance and the dominance (or epistatic) variance using systematic crossbreeding schemes involving mostly 2 breeds (rarely 3) or selection strategies with 2 pure-breds, the Chios sheep and the Damascus goat. The breeds involved in crossbreeding were the Local Fat – tailed sheep, the Finn sheep, the Ill de France, the East Friesian and the Awassi.

We shall not refer in detail to the crossbreeding efforts, suffice to say that some utility crosses presently utilized, are in effect involving the CFT and the Awassi, and the Chios and E. Friesian. Each cross has a value for different production systems.

Most of our efforts have been always concentrated on the genetic improvement of two pure-bred breeds, the Chios sheep and the Damascus goat:

(i) Breeding goals (sheep and goats)
- Improve milk production.
- Maintain quality characteristics of milk, mainly of fat content.
- Improve meat output.
- Improve type characters.

(ii) Goal traits (criteria of selection)
- Part-lactation milk production (60-days) adjusted for constant fat content, 6.0 fat content for sheep and 4.0 fat content for goats.
- Growth rate (postweaning growth), 60-day post weaning growth rate in sheep, 90-day post weaning growth rate in goats.
- Twinning rate.
- Type traits – mammary gland (prototype).

(iii) Selection index (males, females kept apart)
- 60-day milk yield/sheep and goats; information on dam, grandam.
- Growth rate.
- Adjustments.
  - Milk: season, dam parity.
  - Growth rate: season, dam parity, type of birth.

The selection of individual traits was based on estimates of genetic parameters (Tables 1 and 2).

Table 1. Heritabilities, additive and phenotypic variance for milk production and growth rate

Trait	Parameter		
	h^2	σ^2_A	σ^2_P
A. Milk production			
60-days	0.30	1830	1600
90-days	0.31	1430	4635
Total	0.34	1700	5024
B. Growth			
Weaning weight	0.46	2.95	6.41
105-day weight	0.68	9.38	13.75

Table 2. Genetic and phenotypic covariances and correlations between milk production and weights

Trait	Milk production					
	60-days		90-days		Total	
	Genetic	Phenot.	Genetic	Phenot.	Genetic	Phenot.
Covariance						
Weaning weight	–0.40	–6.50	–0.56	–7.49	–0.34	–11.58
105-day weight	2.40	–3.80	2.80	–2.71	3.37	–9.22
Correlation						
Weaning weight	–0.04	–0.05	–0.07	–0.06	–0.02	–0.06
105-day weight	0.16	–0.01	0.19	–0.02	0.11	–0.03

Breeding structure

The breeding structure in Cyprus is based on a closed nucleus flock system with three tiers. The first tier represents the nucleus which is closed to outside flow because of veterinary restrictions. Both male and female replacements come from the nucleus units (2 units with almost identical feeding, management and breeding programs). Males are trained to mate as lambs and are used for breeding only one breeding season (mate approximately 30 ewes each). The intensity of selection is between 5 and 10 percent. The ewe average productive life is 3.5 parities starting at the age of 13-16 months as lambs. Hence, replacement rate of females is high (25-30%). The population of the nucleus is approximately 600 ewes and 500 goats.

The second tier (multipliers) are flocks under recording by an official authority (the Dept. of Agriculture). The population of ewes and goats under recording ranges between 3 to 4 thousand ewes. (The total population of ewes and goats in Cyprus is approximately 0.6 million). Replacement of males in this tier comes mostly from the nucleus unit, but also from within the flocks or occasionally from other recorded flocks. Most female replacements in this tier are within flocks, with a small number originating from the nucleus. The third tier are the commercial producers, who obtain breeding males mostly from the multiplier tier, but also directly from the nucleus.

Evaluation procedures in the nucleus unit are based on an index combining milk and growth rate, utilizing information on both pedigree and individual performance. Evaluation procedures in the multiplier tier are also based on the index, but information available pertains to the individual and his dam only (no full pedigree available).

The mating procedures are different in the elite and the multiplier tiers. All matings in the nucleus flock are individual hand-matings, following the detection of animals in heat by vasectomized males. No rams are joined freely with ewes. In the multiplier and commercial flocks breeding males are joined with ewes in two breeding seasons that last 60 to 70 days each (spring and autumn seasons). All other males are removed from the flocks (young and old) at the age of 4 to 5 months.

Further reading

Mavrogenis, A.P. (1982). Environmental and genetic factors influencing milk production and lamb output of Chios sheep. *Livest. Prod. Sci.,* 8: 519-527.

Mavrogenis, A.P. (1988). Genetic improvement of sheep in Cyprus by selection and/or crossbreeding. In: *Increasing Small Ruminant Productivity in Semiarid Areas,* Thomson, E.F. and Thomson, F.S., (eds), Kluwer Academic Publishers, The Netherlands, pp. 189-195.

Mavrogenis, A.P., Louca, A. and Robison, O.W. (1980). Estimates of genetic parameters for pre-weaning and post-weaning growth traits of Chios lambs. *Anim. Prod.,* 30: 271-276.