Selection of Ewe Lamb Replacements for Commercial Sheep Enterprises

By Debra K. Aaron and Endre Fink

The goal in selection of ewe lamb replacements is to complement or improve the genetics of your current ewe flock.

I. Selection Goal

The first and most important step in designing a selection program is formulation of a goal. This step is crucial to the success of a long-term program for flock improvement. Your selection goal should provide a clear picture for the desired direction of genetic change in your flock. It should also provide a basis for day-to-day selection decisions and be realistically based on your accessible resources (labor, management, facilities, and available feed) and primary markets.

II. Genetic Improvement Principles

Selection of sheep for most economically important traits requires phenotypic measurement to identify the best-performing animals to become parents of the next generation. We hope selected animals will be genetically superior, but the genes that contribute to differences between high performing and low performing animals cannot actually be observed. For example, some of the best performing animals may have below average genetics but be exposed to superior environmental effects. In contrast, some of the worst performing animals may have superior genetics but be exposed to below average environmental effects.

The genetic merit of animals based on phenotype are estimated with partial knowledge.

Therefore, we must do all we can to ensure estimates of genetic merit are the truest and fairest possible. Some practical and conceptual aspects include:

A. Animal Identification

Accurate estimation of genetic merit requires identification of every animal in your flock as well as written records of measurements taken on traits deemed to be economically important. Animal identification must be:

1. Permanent
2. Unique
3. Computer-friendly

B. Production Records

An efficient selection program does not involve measurement of every possible trait for every animal in the flock. Your selection goal will determine the kind of production records required for selection of potential ewe lamb replacements. Production records include:

1. Parentage
   a. Sire
   b. Dam
2. Performance
   a. Date of birth
   b. Birth weight
   c. Type of birth and rearing
   d. Weights and actual dates weight measurements

are taken. Specific weights are determined by your selection goal and production system but may include:

i. 30-day weight
ii. Weaning weight (60 days)
iii. Postweaning weights (90, 120, 240 days)
iv. Market (harvest) weight

e. Other traits (wool, carcass) depending on your primary market

3. Adjustment for known environmental (nongenetic) effects

An initial step in the process of genetic evaluation is to adjust performance records for known environmental effects (called fixed effects). If these fixed effects are not taken into account, selection decisions will be biased in favor of individual lambs having the most favorable environmental conditions, but these animals are no more likely to be superior than any other animals. For fair comparisons, these effects must be definable from the records you collect and be accounted for in the genetic evaluation process.

a. Correction for age at measurement

Example: Weaning weight (WW, 60 days) corrected for age:

$$\text{Age-Corrected WW} = \frac{(\text{Actual WW} - \text{BW})}{\text{Weaning Age}} \times 60 + \text{BW}$$

BW = Birth weight.

b. Adjustment for fixed effects using multiplicative adjustment factors

Individual's age-corrected weight is multiplied by the appropriate adjustment factor (**Table 1**) for:

i. Ewe age
ii. Sex
iii. Type of birth and rearing

Table 1. NSIP Lamb Preweaning and Weaning Weight Adjustment Factors (*From SID Sheep Production Handbook, 2015 Ed., Vol 8*).

Item	Class	Generic Adjustment
Ewe Age	1	1.14
	2	1.08
	3-5	1.00
	>6	1.05
Sex	Ram	0.91
	Wether	0.97
	Ewe	1.00
Type of Birth and Rearing	S/S	1.00
	S/Tw	1.17
	Tw/S	1.11
	Tw/Tw	1.21
	Tr/S	1.19
	Tr/Tw	1.29
	Tr/Tr	1.36

C. Estimates of Genetic Merit

1. Contemporary groups

The environmental component of an animal's phenotype is not passed from parent to progeny and, therefore, needs to be separated from its genotype. Some of these environmental effects are known and can be accounted for by using adjustment factors (as described above). However, other factors, such as management or weather, may affect performance but cannot be accounted for very easily. These are referred to as unknown sources of environmental variation. The best method to account for unknown environmental effects is to compare animals within a contemporary group.

A contemporary group is a uniformly managed group of individuals of similar birth date, breed composition, age, and sex.

2. Trait ratios

By comparing performance of each individual to the average of its contemporaries, a more precise estimate of genetic merit can be attained than by using individual performance. Comparisons are easily made by trait ratios.

To calculate a trait ratio, divide the individual's own performance by the average performance of its contemporaries and multiply that result by 100. The average ratio is always 100.

Ratios should only be used to compare animals within a contemporary group.

3. Estimated Breeding Values (EBVs, **Figure 1)**
   Predictions of genetic merit are known as Estimated Breeding Values (EBVs) and result from application of genetic theory and statistics to performance records.
   a. Calculation by National Sheep Improvement Program (NSIP).
   b. Provide U.S. sheep industry with access to state-of-the-art, genetic evaluation methodology.
   c. Accept on-farm, performance records from participating flocks and return EBVs for reported traits.
   d. Enable breed-wide, across-flock genetic evaluations for those flocks and breeds that have an adequate system of genetic linkages among participating flocks.
   e. Part of LambPlan, the national sheep performance program of Australia.
   f. Assume average EBV in base population is zero; values expressed as deviation (+ or -) from the average.
   g. EBVs are comparable between two individuals within the same contemporary group or in different contemporary groups linked together by relative information.
   h. Traits:
      i. Birth Weight (BWT, kg) estimates direct genetic effects on weight at birth.
      ii. Weaning Weight (WWT, kg) provides an estimate of preweaning growth potential.
      iii. Maternal Weaning Weight (MWWT, kg) estimates genetic merit for mothering ability. This EBV mainly reflects genetic differences in ewe milk production, but other aspects of maternal behavior may also be involved.
      iv. Postweaning Weight (PWWT, kg) combines information on preweaning and postweaning growth to predict genetic merit for postweaning weight at 120 days.
      v. Number of Lambs Born (NLB, %) evaluates genetic potential for prolificacy. This EPD is expressed as numbers of lambs born per 100 ewes lambing. An EBV of +5.0 for Number of Lambs Born indicates that an animal is expected to produce daughters who will have an average of .05 more lambs at each lambing, or 5.0 more lambs per 100 lambings, than an average ewe.
      vi. Number of Lambs Weaned (NLW) evaluates combined ewe effects on prolificacy and lamb survival to weaning. The NLW EBV is expressed as numbers of lambs weaned per 100 ewes lambing. An EBV of +5.0 for Number of Lambs Weaned indicates that an animal is expected to produce daughters who will wean an average of .05 more lambs at each lambing, or 5.0 more lambs per 100 lambings, than an average ewe.
   i. Other traits:
      i. Body composition (carcass)
      ii. Wool
      iii. Parasite resistance
   j. Performance records adjusted for known nongenetic effects prior to using them in calculations of EBVs.

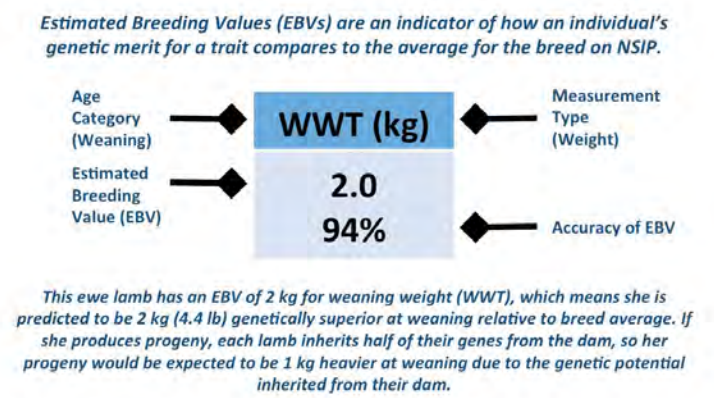

Figure 1. Anatomy of an EBV (*From NSIP Ram Buying Guide*).

4. Expected Progeny Differences (EPDs)
   An individual only transmits a sample half of its genes to each of its progeny. Therefore, it only transmits a sample half of its breeding value to its progeny. The concept of an EPD is very easy to understand, because it is truly the expected progeny difference in performance. An EPD = ½ EBV.
5. Accuracy (**Figure 1**)
   Accuracy values are associated with EBVs and EPDs and give an idea of reliability of an estimate. Accuracy values range from zero to one, with higher values indicating greater accuracy of selection.

D. Methods of Performance Evaluation

Selection can be practiced by sheep breeders using several methods of performance evaluation (**Figure 2**). These include:

1. Pedigree
2. Individual
3. Progeny (not applicable to ewe lambs)
4. EBVs

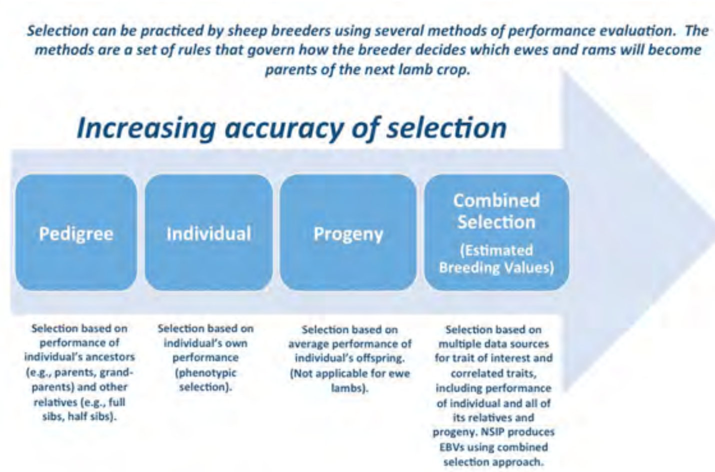

Figure 2. Methods of Performance Evaluation.

E. **DNA Tests (Genotyping)**

Molecular genetic technology has allowed us to identify animals as carriers or non-carriers of specific genes resulting in genetic defects (for example, spider lamb syndrome) and some genes with major effects on performance. In the future, it is expected the sheep industry will have access to genomic-enhanced breeding values for performance traits based on the specific DNA of the animal to be used alone or in combination with performance records. This will allow genetically superior animals to be selected with greater accuracy. However, there will always be a need to accurately measure performance in animals as an aid to effective selection.

III. Visual Appraisal

Visual appraisal is important but mainly from an evaluation of structural soundness standpoint. Generally, in commercial flocks, your primary focus will be on anything that might limit maternal productivity or longevity in the flock.

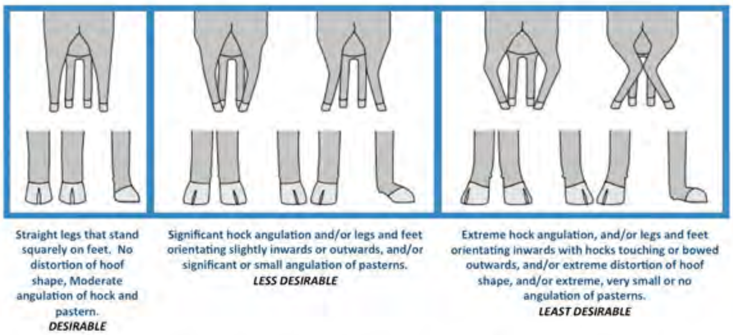

Figure 3. Feet and Legs (*From Visual Sheep Scores, Version 2, 2013, Australian Wool Innovation Limited*).

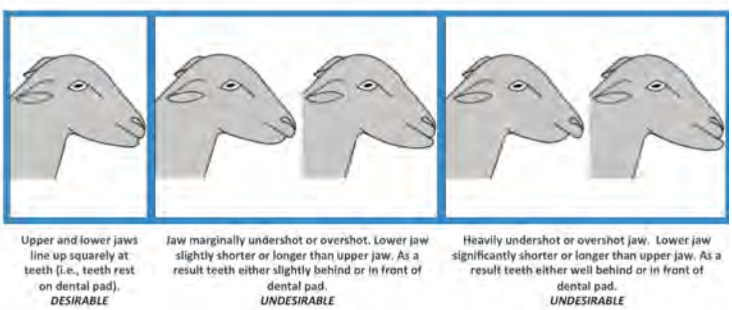

Figure 4. Jaws, Bite, and Teeth (*From Visual Sheep Scores, Version 2, 2013, Australian Wool Innovation Limited*).

A. **Structural Soundness**
   1. Feet and Legs (**Figure 3**)
   2. Jaws, Bite, and Teeth (**Figure 4**)

B. **Reproductive soundness** (teats, udder)

C. **Conformation or shape** (frame, volume, thickness, bone)

D. **Coat, Fiber, Color** (specialty flocks)

E. **Breed Character** (purebred flocks)

IV. Replacement Ewe Lamb Selection

A. **Number of Ewe Lambs Needed**

Calculation of the number of replacements needed is shown in **Table 2** for two levels of flock reproductive performance (average lamb crops of 140 *versus* 170). Other considerations include:

Table 2. Scheme for Replacement Ewe Selection (*From SID Sheep Production Handbook, 2015 Ed., Vol 8*).[a]

	Average Lamb Crop[b]	
Item	140	170
No. of ewes	100	100
No. of ewe lambs	70	85
No. of twin-born ewe lambs[c]	40	70
No. of twin-born ewe lambs that are above average in weaning weight	20	35
No. of ewe lambs exposed to rams	20	35
No. of selected lambs that are pregnant[d]	12	21

[a] Assumes 20% replacement rate (i.e., 20 ewe lambs needed each year to maintain flock size).

[b] Lambs raised per ewe exposed.

[c] Average lamb crop = 140: 40% of ewes have twins; average lamb crop = 170: 70% of ewes have twins.

[d] Final replacements (assumes 60% conception rate).

1. Ewe culling rate

   Customary to cull approximately 15 to 20% of ewes each year (USDA APHIS Animal Health Monitoring Service, 2014).

2. Ewe lamb conception rate (number ewes lambing/ number ewes exposed)

   Conception rates (1-year-old ewe lambs) across breeds as reported by Cases and coworkers (Journal of Animal Science 83:2743-2751):

   a. 40% in August
   b. 67% in October
   c. 75% in December
   d. 60% overall

B. **Source of Replacements**

1. Homegrown ewe lambs

   These ewe lambs come from ewes that have survived and produced within your home environment. They share some of the same genes that made their dams successful. In addition, raising your own replacements removes the disease risk associated with bringing outside sheep into your flock.

2. Purchased ewe lambs

   These ewe lambs may allow you to make faster genetic change in your flock and may provide you with more choices. However, you should only purchase replacements from reputable breeders.

C. **Age at First Lambing (Yearlings *versus* 2-Year-Olds)**

1. Advantages

   It is well-documented that ewes that lamb first as yearlings and are well-managed will produce more total pounds of lamb throughout their lifetimes than ewes that lamb first as 2-year-olds. The key to success centers around two words: well-managed. *See "News to Ewes."* A second reason for lambing ewes first as yearlings is that your lambs should be the best genetic material that you have. The sooner you get them into production, the better in terms of genetic improvement.

2. Breed differences
   Ewe lambs of earlier maturing breeds (for example, white-faced, maternal breeds) typically reach puberty earlier and are better suited to lambing first as yearlings that are ewe lambs of later maturing breeds (for example, fast-growing, heavy sire breeds).
3. Management considerations
   Yearlings require greater levels of management (for example, time, labor, and housing) than 2-year-olds. They will have higher nutritional requirements at breeding and throughout gestation and lactation. They may be more prone to lambing problems and may be more at risk to mastitis and parasite infection. As noted earlier, good management is the key to success.

D. Target Weight at Breeding

To optimize conception rates, ewe lambs should be at least 2/3 of their mature body weight at breeding (**Table 3**). This should be calculated based on average mature weight of dry, open ewes in your flock because there is variation in mature body weight both across and within breeds.

Table 3. Minimum Weight to Breed Ewe Lambs.

Average Mature Weight of Ewes in Flock (lb)	Minimum Weight to Breed Ewe Lambs (lb)[a]
100	67
120	80
140	94
160	109
180	121
200	134
220	150
240	161

[a] Minimum of 2/3 of ewe mature weight.
Mature weights are based on dry, open ewes.

E. General Strategy

1. Keep accurate records on all animals for economically important traits.
2. Use adjusted weights and trait ratios to fairly compare contemporaries.
3. Enroll in NSIP and use EBVs for genetic comparisons if flock is purebred.
4. Select replacements from multiple births that are early-born.
5. Select from multiple births from young ewes.
6. Keep triplet ewe lambs. They are more likely to have twins.
7. Keep ewe lambs that grow fastest (top 2/3 in ADG).
8. Do not retain any ewe lamb that has severe structural problems.
9. Do not retain any ewe lamb that has exhibited a rectal or vaginal prolapse.
10. Only breed ewe lambs having met a minimum target weight.

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