Sheep GENETICS

MEAT & LIVESTOCK AUSTRALIA

Terminal indexes

A ram breeder's guide

Why use a selection index?

A selection index is an important tool to drive genetic improvement in ram breeding programs when there are a range of traits of economic or functional importance. Collectively, these traits make up the "breeding objective", which aims to improve profitability in commercial sheep enterprises.

Indexes are useful for two main reasons:

1. They balance genetic improvement appropriately across a range of traits, with the emphasis placed on each individual trait determined by its relative importance.
2. Because indexes balance improvement across traits, they can be used to overcome economically antagonistic relationships *between* traits.

> "Appropriately designed indexes are central to the goal of breeding more profitable sheep for your ram buying clients.

How Sheep Genetics develops selection indexes

When Sheep Genetics develops standard selection indexes, a breeding objective is defined for each breeding scenario. This involves an analysis of commercial flock production data to calculate the economic value of improving traits which affect profit, based on flock structure, production and price data.

The second step is to translate the breeding objective into the index by linking profit traits to ASBV traits through genetic correlations. Often the profit and ASBV traits are the same, for example early growth rates (weaning and post-weaning weights) are key profit drivers in commercial maternal flocks and are also easy to measure in ram breeding flocks. For profit traits which are hard to measure however, other correlated traits may need to be relied upon to drive improvement in the objective. An example of this is ultrasound scan measurements of muscle and fat to improve carcase yield. More recently, genomic information has become increasingly important for genetic improvement of these hard to measure traits.

By combining the economic values of traits with the genetic relationships between traits, we can determine the appropriate relative weights which allow is to combine ASBVs into a single value for each animal.

> "The changes in individual traits from using an index depend on the information you record in your flock. If you want to improve, or even just maintain a trait, you must record it to ensure ASBVs are sufficiently accurate for the index to do its job.

LAMBPLAN Terminal indexes

LAMPLAN has three standard indexes for terminal sire breeds:

- Terminal Carcass Production (TCP)
- Eating Quality (EQ)
- Lamb Eating Quality (LEQ).

These indexes target improved performance of terminal sires in lamb production enterprises. TCP, EQ and LEQ vary both in the level of emphasis they place on eating quality relative to the improvement of carcase yield, and in the number of traits included. Effective genotyping strategies such as genomic testing of young rams also complement these indexes with respect to balancing improved eating quality with increased carcase yield.

Ram breeders can use any of the indexes, however it is important to choose an index that is relevant to your breed and the objective of your ram buyer clients, including future lamb markets that may be targeted.

Terminal Carcase Production (TCP) index

Summary of the TCP index

- The TCP index targets improvement of terminal sire performance in prime lamb production systems.
- TCP balances increased lean meat yield with modest improvements in eating quality.
- Genotyping young rams makes TCP more effective by improving the accuracy of carcase and eating quality ASBVs.

Production system outline

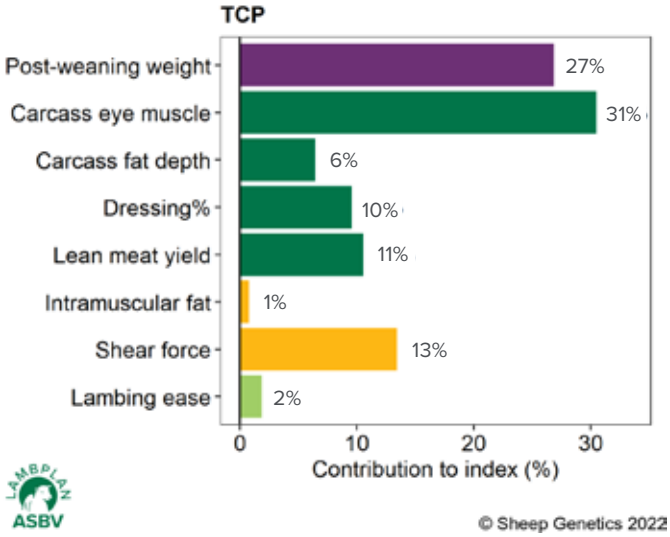
This production system is for a prime lamb operation where terminal sires are joined to ewes of a Merino/ maternal breed or cross. The TCP index focuses on increasing weight and muscle while reducing carcass fat, which contribute to higher lean meat yield. TCP also has emphasis on modest improvements in eating quality.

Trait contribution

Figure 1 illustrates which traits are in the index and how much they contribute to the overall balance of the index. The longer the bar, the greater the impact on the index, and the greater impact on the profitability of the production system.

In the Terminal Carcase Production system, growth and improved carcase eye muscle contribute the most to the index, with smaller contributions from carcase fat depth, lean meat yield and dressing percentage. Improvements in intramuscular fat and shear force contribute to maintaining lamb eating quality, and the inclusion of lambing ease reduces the incidence birthing difficulties.

Figure 1: The traits in the TCP index and how they contribute to the overall balance of the index in the top 10% of current terminal progeny



Eating Quality index (EQ)

Summary of the EQ index

- The EQ index targets improvement of terminal sire performance in prime lamb production systems.
- EQ balances large improvements in eating quality with modest increases in lean meat yield.
- Genotyping young rams makes EQ more effective by improving the accuracy of carcass and eating quality ASBVs.

Production system overview

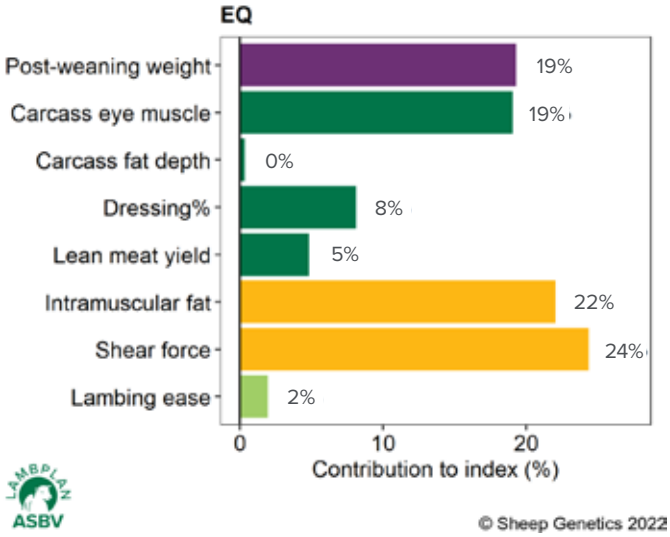
This production system is for a prime lamb operation where terminal sires are joined to ewes of a Merino/ maternal breed or cross, and where producers are interested in improving the eating quality of their lambs to a greater degree than is possible with the TCP index.

Trait contribution

Figure 2 illustrates which traits are in the index and how much they contribute to the overall balance of the index. The longer the bar, the greater the impact on the index, and the greater impact on the profitability of the production system.

The EQ index has large contributions from increasing body weight and carcass eye muscle, with smaller but still favourable impacts from reduced carcass fat depth with increases in dressing percentage and lean meat yield. Large improvements in intramuscular fat and shear force contribute to improved lamb eating quality and the inclusion of lambing ease reduces the incidence of birthing difficulties.

Figure 2: The traits in the EQ index and how they contribute to the overall balance of the index in the top 10% of current terminal progeny



Lamb Eating Quality index (LEQ)

Summary of the LEQ index

- The LEQ index targets improvement of terminal sire performance in prime lamb production systems where internal parasites may cause economic losses.
- LEQ balances large improvements in eating quality with modest increases in lean meat yield, and includes emphasis on worm egg count ASBVs.
- Genotyping young rams makes LEQ more effective by improving the accuracy of carcass and eating quality ASBVs.

Production system outline

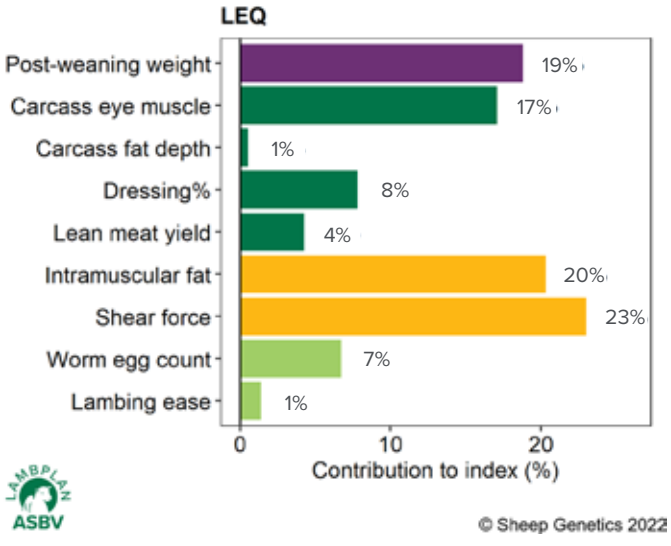
This production system is for a prime lamb operation where terminal sires are joined to ewes of a Merino/ maternal breed or cross in high rainfall and/or high input management systems where internal parasites may cause significant economic losses. Producers are interested in improving the eating quality of their lambs to a greater degree than is possible with the TCP index.

Trait contribution

Figure 3 illustrates which traits are in the index and how much they contribute to the overall balance of the index. The longer the bar, the greater the impact on the index, and the greater impact on the profitability of the production system.

The LEQ index has large contributions from increasing body weight and carcase eye muscle, with smaller but still favourable impacts from reduced carcase fat depth with increases in dressing percentage and lean meat yield. Large improvements in intramuscular fat and shear force contribute to improved lamb eating quality and the inclusion of lambing ease reduces the incidence of birthing difficulties. There is a modest level of emphasis on reducing worm egg counts in LEQ.

Figure 3: The traits in the LEQ index and how they contribute to the overall balance of the index in the top 10% of current terminal progeny



Selection advantage in LAMBPLAN Terminal indexes

Tables 1 and 2 below show the selection advantage for the top 10% of the current progeny drop selected on each of the LAMBPLAN indexes. The numbers show how much better the ASBVs of the top 10% are compared to the average of the drop. For example, ASBVs for post-weaning weight for the top 10% of progeny on TCP are 2.2kg higher than the average of the drop.

Table 1 shows the selection advantages for the direct index traits. TCP shows greater selection advantages for post-weaning weight, carcase muscle and fat, and lean meat yield. The EQ and LEQ indexes still show improved performance for these traits, but have better responses for the eating quality ASBVs, intramuscular fat and shear force. The inclusion of lambing ease in these indexes leads to a reduced incidence of birthing difficulties. Inclusion of worm egg count in LEQ leads to a greater reduction in the trait.

Table 1: The selection advantage for the top 10% of the current terminal progeny drop selected on each of the indexes

	TCP	EQ	LEQ
Post-weaning weight (kg)	2.2	1.9	1.9
Carcase eye muscle (mm)	1.14	0.85	0.83
Carcase fat depth (mm)	-0.25	-0.01	-0.02
Dressing %	0.81	0.68	0.67
Lean meat yield (%)	0.84	0.4	0.41
Intramuscular fat (%)	0.07	0.28	0.28
Shear force (N)	-1.02	-2.1	-2.07
Worm egg count (%)	1.14†	-9.02†	-13.88
Lambing ease	0.23	0.28	0.21

† Trait not in index

Table 2 shows the selection advantage for traits which are not in the indexes but are of interest either in their own right (birth weight) or because they provide useful information to improve the accuracy of ASBVs for traits in the index (weaning weight, post-weaning eye muscle and fat). By improving the accuracy of index traits, their information also contributes to overall index accuracy.

Table 2: The selection advantage for the top 10% of the current terminal progeny for key traits that are not included in the TCP, EQ and LEQ indexes

	TCP	EQ	LEQ
Birth weight (kg)	-0.3	-0.7	-0.7
Weaning weight (kg)	1.2	0.9	1.0
Post-weaning fat (mm)	0.1	0.3	0.3

In addition, genomic testing helps to improve LAMBPLAN terminal index accuracy by increasing the accuracy of ASBVs for carcass and eating quality traits.

When selecting on LAMBPLAN terminal indexes, long-term responses in individual traits will vary depending on features of the breeding program including traits measured, level of pedigree recording, use of genomic testing, flock structure, and selection emphasis on the index. The selection advantages shown in tables 1 and 2 give an indication of the likely direction and relativity of responses for TCP, EQ, and LEQ indexes.

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