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LAMBPLAN Terminal Indexes for NSIP breeders

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LAMBPLAN EBV reports for NSIP clients with terminal sire breeds feature two different indexes, Carcass Plus and LAMB2020. This article will attempt to briefly explain the current differences between the two indexes and their implications for U.S. breeders.

History of Carcass Plus and Lamb 2020 in Australia

Carcass Plus is the original index for terminal breeds in LAMBPLAN and is based on post-weaning weight (PWT), fat depth (PFAT) and eye muscle depth (PEMD) in a 60:20:20 ratio. Carcass Plus is a "desired gains" index, designed to produce an optimal pattern of change in its three components. Carcass Plus rewards high growth and muscle depth, as well as increased leanness. Leanness is not optimized in Carcass Plus, thus the index value is always increased by decreasing PFAT.

LAMB2020 was introduced in December 2008, in an attempt to better reflect the future demands of the Australian lamb industry, projected to the year 2020. In general, LAMB2020 is intended for terminal sires used to produce 22 kg (48.4 lb) carcasses from either Merino or Merino-crossbred ewes. LAMB2020 is structured as an economic index, rather than a desired gains index like Carcass Plus, and generally has smaller index values and a narrower range. The traits used in Carcass Plus (PWT, PFAT, and PEMD) are likewise included in LAMB 2020. However, weaning weight (WWT) is also considered to accommodate an increased number of Australian producers selling younger lambs. Birth weight (BWT) and worm egg count (PWEC) EBVs were also included. The inclusion of birth weight was an attempt to limit future increases in birth weight, realizing that growth (WWT and PWT) and birth weight are positively correlated. WEC was included to combat significant lamb industry economic losses due to parasitism. The following table shows the traits included in LAMB2020 index and their relative emphases. Emphasis is determined by the relative percentages of the predicted response that can be attributed to each trait.

LAMB2020 Trait	Relative Emphasis
BWT (kg)	8%
WWT (kg)	24%
PWT (kg)	25%
PFAT (mm)	9%
PEMD (mm)	22%
PWEC (%)	12%

Relative Economic Values (REV) allow calculation of index value from individual EBVs. A table of trait REVs for Carcass Plus and LAMB 2020 is shown below. Indexes are calculated by multiplying each EBV in the index by its respective REV factor, summing products and adding to 100. Be aware that some discrepancies may exist due to rounding error when index scores are calculated from reported EBVs.

REV	**BWT**	**WWT**	**PWT**	**PFAT**	**PEMD**	**PWEC**
Carcass Plus			5.057	-13.362	7.832	
LAMB2020	-0.21	0.315	0.4725	-0.55	1.54	-0.04

Analysis using NSIP Suffolk parameters

Valid concern exists whenever indexes are applied outside of the population for which (and from which) they were derived. Genetic response to index selection over time is a direct function of the genetic parameters within the population, i.e. the amount of variation present within traits and the interrelationships of those traits. Simply put, while skillfully crafted to fit the needs of the Australian sheep industry and sheep populations, these indexes may not prove to be equally applicable or useful for the U.S. sheep industry. In order to discern how LAMBPLAN's terminal indexes should be best used by NSIP clients, basic analysis was completed using current genetic parameters generated from the NSIP Suffolk database.

Estimates of genetic variance components for terminal traits were similar between NSIP Suffolks and LAMBPLAN Terminals. The only major exception was for postweaning body weight (PWT). Genetic variation in PWT for U.S. Suffolks was over double that of LAMBPLAN Terminals. This difference would allow growth traits to have a greater effect on the index in NSIP breeds compared to Australian Terminals, so long as growth is not negatively correlated with other component traits in the index.

However, the genetic correlations between traits do reveal an antagonism between growth (PWT) and eye muscle depth (PEMD) for NSIP Suffolks (r_g = -0.38) that is considerably larger than that derived from Australian data. In addition, the genetic correlation between PWT and fat depth (PFAT) was -0.51, which is larger (more favorable) than that for the Australian data. Thus within U.S. Suffolks, faster growing lambs are also genetically leaner but have smaller eye muscle depth at the same body weight; their phenotype could perhaps be described as more "extreme".

Additionally, genetic correlations revealed an antagonism between leanness (PFAT) and muscling (PEMD) for NSIP Suffolks (r_g = -0.16), indicating that leaner lambs are also genetically slightly lighter-muscled. This antagonism is in sharp contrast to the same inter-trait relationship in the Australian data, which was characterized by a much stronger and positive correlation value, but it is consistent with the pattern of development revealed by correlations among PWT, PFAT, and PEMD. Note that the current lack of PWEC EBVs for U.S. terminal breeds will not have a meaningful effect on LAMB2020 index values. All lambs will have an assumed EBV of zero for this trait.

Heritability estimates are (h^2) are a critical part of the development of selection indexes. No major differences were found between U.S. and Australian estimates, although NSIP estimates were slightly greater for BWT, PWT, and PEMD. Heritabilities for other traits were nearly identical (WWT and PFAT) or not available (PWEC).

The differences revealed in genetic parameters between the U.S. and Australian data can potentially cause the indexes to reward different types of animals when applied in different populations. Additionally, the likelihood that Carcass Plus and LAMB2020 will reward the same animals may be reduced. The genetic correlation between Carcass Plus and LAMB2020, calculated using NSIP Suffolk parameters, was $r_g = 0.79$.

Recommendations for U.S. breeders of terminal sire breeds

U.S breeders should certainly make use of Carcass Plus and/or LAMB 2020, but should do so with caution, understanding the differing markets, cut size, physiological type, and genetic parameters involved in producing American vs. Australian lamb. Breeders need to understand that the economic weightings for traits in the pooled indexes are not likely to be identical between the two countries, and they should therefore continue to pay attention to the individual EBVs in addition to the calculated index values. However, both Carcass Plus and LAMB2020 do likely rank lambs in a credible and useful manner for the U.S. market.

In general, weightings for Carcass Plus give opportunity for extremely lean sheep to dominate the index. Selection on an index with no optimization for leanness may have negative ramifications on carcass quality, given that the U.S. terminal sire population appears to already be relatively more extreme (i.e., genetic antagonisms between growth and fat and between fat and muscle). In response to that situation, LAMBPLAN is considering revision of the Carcass Plus index, so you should be alert for possible future changes.

LAMB2020 is the more balanced index in terms of its optimization of leanness. NSIP clients should note, however, that its target carcass weight (22 kg) is lighter than that at which most U.S. lambs are marketed. Additionally, no NSIP flocks with terminal sire breeds are currently reporting fecal egg counts, so it is important to note that relative weightings of other traits in LAMB2020 differ when PWEC is excluded. Finally, the dollar values estimated with LAMB2020 do not convey to U.S. market conditions and should not be taken literally. Ultimately, it appears U.S. terminal sire breeders would benefit from an economic index designed specifically for U.S. market conditions using genetic parameters specific to U.S. sheep. However, until such an index can be developed and directly compared to LAMBPLAN indexes, the considered use of the Carcass Plus and LAMB202 indexes should serve NSIP clients reasonably well.