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Genetic evaluation of milk traits, live weight, somatic cell score, and litter size at birth, and  
development of a selection index for dairy sheep

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## Abstract

There is interest in building alternative dairy production systems in New Zealand involving sheep. However, there is currently no national breeding scheme to ensure that genetic change will occur in the right direction. The objective of this study was to develop a prototype genetic evaluation of milk traits, live weight, somatic cell score, and litter size at birth, and a selection index for dairy sheep. The flock consisted of 123 crossbred ewes with a mixture of East Friesian, Highlander, Polled-Dorset and Poltex breeds. A total of 479 monthly flock tests for milk volume and percentages of fat, protein and lactose, and somatic cell count were obtained during the production season 2015-16. Corresponding first let-down time (FLDT) and yields (FLDY) were recorded at afternoon milkings. Ewes were weighed four times during the production season and litter size was recorded at birth (LS). Lactation curves for each ewe were derived using a random regression model with an orthogonal polynomial of 3<sup>rd</sup> order for fat and lactose daily yields, and an orthogonal polynomial of 4<sup>th</sup> order for milk and protein daily yields. Average  $\pm$  SE for lactation length (LL) was 126 $\pm$ 4.32 days and averages of accumulated yields were 234 $\pm$ 9.10 litres milk, 16.5 $\pm$ 0.65 kg fat, 13.0 $\pm$ 0.56 kg protein and 12.6 $\pm$ 0.48 kg lactose. Average FLDT and FLDY were 79 $\pm$ 2.02 seconds and 0.5 $\pm$ 0.01 litres, respectively. Averages were 17.5 $\pm$ 0.16 for somatic cell score (SCS), 75.9 $\pm$ 0.88 kg for live weight (LWT) and LS 2.0 $\pm$ 0.06 lambs born per ewe. The coefficient of variation was 38% for lactation length and between 42 and 47% for yields. Breeding values for the different traits were estimated from a multiple-trait animal model using heritability and genetic correlations published in the literature and phenotypic standard deviations obtained from the data set. Economic values (EV) were derived from relative economic weights desired by the farmer and genetic standard deviations of the traits. The economic values were \$0.516/day for LL, \$2.00/kg milk, \$6.73/kg fat, \$8.37/kg protein, -\$0.81/kg LWT, -\$46.80/unit of SCS, -\$1.80/s of FLDT, \$332.30/kg FLDY and \$44.00/lamb of LS. It is recommended that the Gunsons use these EVs to calculate a selection index for the ranking of ewes and rams to be selected as parents of the next generation. This will achieve genetic gain for each of the traits in the right direction, in the right proportion as well as producing progeny with improved milk yield, milk quality, milking speed and overall efficiency.

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### Table of Abbreviations

AI	Artificial insemination
BLUP	Best linear unbiased prediction
BO	Breeding objective
BV	Breeding value
DFREML	Derivative-free restricted maximum likelihood estimation
dsEBI	Dairy sheep economic breeding index
EBV	Estimated breeding values
EV	Economic value
FLDY	First let-down milk yield
FLDT	First let-down time
FY	Fat yield
GBV	Genomic breeding values
GLS	Generalized least squares
HYE	High-yielding ewe
LL	Lactation length
LS	Litter size
LWT	Live weight
LY	Lactose yield
LYE	Low-yielding ewe
MME	Mixed-model equations
MOET	Multiple ovulation and embryo transfer
MY	Milk yield
PY	Protein yield
REML	Restricted maximum likelihood estimation
REW	Relative economic weight
REV	Relative economic value
$r_{TI}$	Correlation between breeding objective and selection index
SAS	Statistical analysis software
SI	Selection index
SCS	Somatic-cell score
SNP	Single-nucleotide polymorphism
T	Breeding objective
TBV	True breeding value