Breeding objectives for a developing sheep industry in Brazil

P.R. Amer [1], B.F.S. Santos[2], T.J. Byrne[1], A.W. Campbell[1]

Introduction

Countries under development are experiencing big shifts in their food consumption profile. Changing lifestyles are leading to an increase in demand for protein from meat products. Brazil is a developing country that has faced enormous changes over recent years with Brazilian people interested in sheep meat as an option for special occasion meals. Recent prices for special lamb cuts have been higher than appraised beef meat which has always been an indication of acceptance by consumers.

Currently, sheep breeding in Brazil places most selection emphasis on animal appearance and performance recording or genetic evaluation is not considered. The role of animal breeding is vital for meeting consumer demands in terms of both the quantity and quality of meat products. Genetic improvement in major traits such as meat yield, growth, reproduction, survival and disease resistance are important foci of any small ruminant breeding programme targeting meat production. With appropriate recording and storage of data, coupled with commitment by breeders to record data and use genetic evaluation results, substantial industry returns from sheep breeding have been shown in developing countries (e.g. Amer, 2009).

To achieve breeding goals, a robust performance recording structure must be built. Performance recording requires identification of animals, measurement and controlled mating. Comprehensive sheep genetic improvement programs exist in many countries which are designed to maximize genetic improvement within and across flocks. For Brazil, we have developed the *OviGol*® program as a tool for improvement of meat production, to support farmers and breeders in selecting genetically superior individuals. Improvements in the genetic traits within the *OviGol*® program will lead to faster and larger productivity increases within the Brazilian sheep industry.

This paper describes the workings undertaken to define the breeding objective for meat sheep in Brazil and the inclusion of these traits in selection indices, incorporating BLUP genetic evaluations.

Material and methods

The goal of the breeding objective developed is to improve intensive lamb production. For this development, breeders recorded a number of previously un-recorded traits (discussed below). Breeding values were calculated for these traits and combined with appropriate economic weighting to produce an index. The genetic evaluation used multi-trait BLUP (best

---

[1] AbacusBio Limited – PO Box 5585, Dunedin 9058, New Zealand.
[2] Áries Sheep Breeding and Genetic Improvement Ltd. – C.P. 49, CEP 18.640-000, Pardinho, SP, Brazil.

linear unbiased prediction) methodology with inclusion of maternal genetic effects for traits influenced by the genes of the dam. Genetic and phenotypic parameters have largely been taken from the literature, but there will be scope to estimate these from the recorded data as more data becomes available.

As part of the *OviGol*® program, breeders record lamb live weights at regular intervals. From these data, breeding values for pre-weaning daily gain direct (*PreWDGd),* pre-weaning daily gain maternal (*PreWDGm)* and post weaning daily gain (*WDG)* are derived using the regression slopes of raw live weights on age at measurement, as the dependant variable, in BLUP genetic evaluation. Ultra-sound carcass scanning is performed 60 days after weaning. Mating and pedigree recording is carried out on farm, and litter size of ewes is derived from this information.

The traits of economic importance for which economic weights have been derived include: weaning weight (*WWT*), days to reach 35 kg live weight (*A35*), days to reach 35 kg of live weight maternal (*A35m*), eye muscle area (*EMA*), subcutaneous fat depth (*FAT*), number of lambs born (*NLB*) and survival from birth to weaning (*SUR*). Breeding values for WWT, A35 direct and A35 maternal are derived as follows:

$WWT_{BV} = BWT_{BV} + (90 * PreWDGd_{BV})$, considering mean BWT 4,0 kg and average weaning age 90 days.

$A35_{BV} = (PreWDGd_{BV} * -0.33) + (WDG_{BV} * -0.16)$, considering -0.33 days for each 1g of extra gain on *PreWDGd*; -0.16 days for each 1g extra gain on *WDG*; mean *BWT* 4,0 kg, *WWT* 25.0 kg, *PreWDGd* 0.250 kg/day, slaughter weight 35,0 kg and *WDG* 0.250 kg/day.

$A35m_{BV} = (PreWDGd_{BV} * -0.33)$, considering -0.33 days for each 1g of extra gain on *PreWDGm* and same assumptions of $A35_{BV}$.

Economic Selection Indices. Economic weights in breeding objectives must reflect the economic value per unit change of the trait in a single animal at a defined time, as well as accounting for the timing and frequency of expression of the trait (Amer, 1999). To estimate the economic value of breeding goal traits the program applied a whole-farm model with market values for expenses and income. Two economic selection indices, OviGol® Ram (IOR) and OviGol® Ewe Replacement (IOER), were derived using economic values, genetic parameters, and discounted genetic expressions. The ram index gives the total value of expressions of a commercial breeding ram genes per progeny born, where as the ewe replacement index gives the total value of expressions of a ewe replacement at approximately 1 year of age over the remainder of her life and from her descendants.

Table 1 shows the reference values for derivation of these indices. The final economic weight for mature weight is obtained by summing the economic values for the component traits with different expressions in replacement ewes, cull ewes, and annually by ewes. Economic values were derived for different breeding objectives considering factors such as feed costs, labour, extra value per lamb, and meat sold. **Lamb survival** was based on the value of extra lambs after accounting for feed, labour and health costs and total sale revenue, resulting in a total value of \$34.98 per lamb sold. **Age at 35 kg** was calculated considering seasonal premium price for younger lambs, savings on feeding and laboring costs (\$/day). This resulted in a total value of \$ 0.71/day. **FAT** and **EMA** values were estimated based on OviGol® dataset information. Assumptions included accounting for total fat yield, fat energy cost at 56 MJ/kg (Waldron, 1992), cost of 1 kg of lost lean from extra fat (\$/kg Lean), and ratio between fat cover and fat weight (y = 0.0557x + 1.0084, R2 = 0.0831). This resulted in an economic value of -\$0.47/kg of FAT. **EMA** was inferred from calculations based on lean yield, extra loin from EMA increasing by 1 cm^2 (kg/lamb, assuming 8.58% per cm^2 increasing total weight of loin by1.97 kg per carcass (2.46 kg cuts - 20% bone)), the value of loin (\$/kg), and lean energy cost at 40 MJ/kg. The final value was \$2.08/cm^2. **NLB** was based on extra lambs sold after costs, and accounting for the lower profitability per lamb born of twins relative to singles. In addition, prices for store lambs, total feed costs, labour and health, and estimated costs to bring a lamb from store to slaughter were included in the function. The economic value for each extra lamb born (per ewe lambing) was calculated as \$ 13.94. **EMW** was derived by considering feed costs for maintenance and final price of culling ewes, final value was -\$1.28/kg.

Table 1- Economic values, discounted genetic expressions and economic weights for traits in the breeding objective for a ram index and a ewe replacement index.

Trait	Economic Value (\$)	DGE (ram)	DGE (ewe hogget)	EW (ram)	EW (ewe hogget)
Lamb Survival Direct	34.98	0.58	3.50	20.29	122.43
Lamb Survival Maternal	34.98	0.78	7.00	27.28	244.86
Age at 35 kg Direct	-0.71	0.43	2.39	-0.31	-1.70
Age at 35 kg Maternal	-0.71	0.53	4.78	-0.38	-3.39
mm of FAT	-0.47	0.43	2.39	-0.20	-1.12
EMA	2.08	0.43	2.39	0.89	4.97
NLB	13.94	0.52	4.95	7.25	69.00
Replacement EMW	-0.95	0.16	1.53	-0.15	-1.45
Maternal EMW	-0.8	0.52	4.95	-0.42	-3.96
Cull EMW	0.52	0.10	0.93	0.05	0.48
EMW	-	-	-	-0.52	-4.93

Results and discussion

Uptake of the *OviGol*® program for the first 18 months (July 2008 until January 2010) was excellent, with a total of 5,195 performance recorded animals (from 13 breeders) entered onto the database. From these animals 48,348 breeding values were calculated from different recorded traits.

First impressions by the breeders to the breeding value and index results revealed a difference in their perceptions of their best animals compared with evidence from physical characteristics. The introduction of a robust performance recording structure and the subsequent analysis, has highlighted that to make genetic progress, selection cannot be on appearance alone. Of the breeders that went through one *OviGol*® breeding cycle, 90% returned for the next evaluation. In addition to this, there are more breeders who have expressed an interest in entering the *OviGol*® program in the future.

Yield or quality grade is not currently part of the payment system to farmers; hence they are mostly interested in maximizing their income out of higher growth rates and carcass weight. We have included meat and carcass traits in the breeding goal as it is likely that these traits will become of increasing interest in the industry, particularly as there are increasing moves towards supply chain integration for sheep meat production. Reproduction traits (NLB and SUR) have recently been recorded by breeders and will impact index rankings significantly for future sets of evaluated records. Development of this service has involved considerable close work with breeders and farmers in order to support them with implementation of new recording practices. This has been crucial for the success of the overall breeding plan.

Farmers receive complete reports for their flocks or animals involved with OviGol® including Estimated Breeding Values and Selection Indices. These reports help participating pedigree breeders identify superior rams. Productivity reports may also be offered in the future, identifying key performance indicators and crucial improvements required to achieve increased profitability.

Conclusion

The breeding structure of sheep farming until now has been generally based on empirical decisions based on appearance (e.g. conformation, feet position, size) of sires and dams. By implementing a recording and genetic evaluation system, coupled with the breeding objective described here, the *OviGol*® program provides a means for progressive sheep farmers in Brazil to shift their selection emphasis to more direct improvement of key genetic traits linked to the profitability of their farming system.

References

Amer, P. R. (1999). *New Zealand Journal of Agricultural Research*, Vol. 42: 325-336.

Amer, P.R. (2006). *8th World Congress on Genetics Applied to Livestock Production*, 31-01.

Amer, P.R. (2009). *Proc. of the New Zealand Soc. Animal Production.* Vol. 69: 155-157.

Berry, D.P.; Madalena,F.E.; Cromie, A.R.; Amer, P.R. (2006). *8th World Congress on Genetics Applied to Livestock Production*, 31-05.

Food and Agriculture Organization (2007). *The state of the world's animal genetic resources for food and agriculture.* Rome.

Gibson, J. (2009). *Genetic Evaluation and Breeding Program Design,* 13: 1-9.

Simm, G. (2000). *Strategies for genetic improvement.* Genetic Improvement of Cattle and Sheep. 3: 64-106.