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Estimation of economic values for traits of dairy sheep: II. Model application to a production system with one lambing per year

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ABSTRACT

A bioeconomic model for dairy sheep was applied to a production system with one lambing per year. The classical extensive Carpathian system with indoor winter lambing, traditional weaning, sale of surplus lambs before Easter, and a summer milking period with ewes on pasture was modeled. The economic values of 15 performance and functional traits were calculated for the Slovakian Improved Walachian multi-purpose breed. The economic values per unit increase in the traits were 0.32 €/kg of milk yield during the standardized milking period of 150 d, 0.29 €/0.1% milk fat, 0.42 €/0.1% milk protein, 0.28 €/% and 0.56 €/% for conception rates of female lambs and ewes, respectively, 0.20 €/0.01 lamb born, 0.0036 €/% and 0.0040 €/% for lamb survival at birth and until weaning, respectively, 0.65 €/kg of birth weight, 0.032 €/g per d daily gain from birth until weaning, −0.030 €/kg of mature weight, −0.38 €/0.1 and −0.21 €/0.1 conformation quality grade for weaned lambs and adult sheep, respectively, 0.42 €/kg of fleece weight and 11.10 €/year of productive lifetime for ewes.

Key words: dairy sheep, bioeconomic model, economic value

INTRODUCTION

About 35% of the world's sheep milk is produced in the European Union. Products from sheep such as milk, cheese, and lamb meat are in high demand on the national and international markets. To keep dairy sheep farming competitive in the European market, it is imperative that management, husbandry systems, and genetic merit of dairy sheep be improved. In Slovak agriculture, dairy sheep farming has an important role. The breeding program for dairy sheep in Slovakia and in other countries has focused mainly on improving milk yield (Oravcová et al., 2005; Smulders et al., 2007). Recently, functional traits have become important for efficient breeding schemes in the dairy sheep industries, because of increased costs of production relative to milk prices, consumer demand for safe, quality food, and greater awareness of animal welfare (Barillet, 2007). Next in importance to milk production, lamb production accounts for a substantial part (e.g., 35 to 45% in Slovakia or Austria) of the income for dairy sheep farmers. Improving ewe reproductive performance, lamb survival, and lamb growth is therefore important for modern breeding programs in dairy sheep (Legarra et al., 2007a; Fuerst-Waltl and Baumung, 2009).

Current dairy sheep breeding programs in Slovakia are based upon a performance test for reproduction, lamb growth, and milk production, and breeding values are estimated for milk yield, fat and protein content (Oravcová, 2007), and litter size (Margetín et al., 2006). A breeding value estimation program for weaning weight is in preparation.

Economic values for traits in dairy breeds of sheep have been published only recently. Legarra et al. (2007a, b) reported economic values for the Spanish breeds Latxa and Manchega, and Fuerst-Waltl and Baumung (2009) published economic values for Austrian dairy sheep. No economic values for Slovakian dairy breeds have been available until now.

The objective of this paper was, therefore, to apply and validate a previously described bioeconomic model (Wolfová et al., 2009) and the corresponding computer program (Wolf et al., 2008) to the calculation of economic values for the most important traits in dairy or multi-purpose sheep. The most widespread multi-purpose sheep breed in Slovakia, Improved Walachian, was chosen for the example calculations.

MATERIALS AND METHODS

Description of the Production System for Improved Walachian Sheep

The Improved Walachian sheep breed was developed in 1982 as a multi-purpose breed with emphasis on satisfactory milk, meat, and wool production. It is a

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Table 1. Characteristics specific to reproductive cycles (parities)

	Ewes died or culled as percentage of ewes entering the reproductive cycle					
Parity	Ewes died	Ewes culled for health problems	Ewes culled for low milk production	Conception rate (%)	Percentage of singles[1]	Coefficients for milk yield[2]
1	6.0	8	12.1	95.4	89	1.00
2	3.6	7	10.1	95.6	69	1.31
3	2.4	2	5.5	95.8	65	1.15
4	2.4	2	4.4	93.2	66	1.08
5	2.4	9	5.5	91.9	71	0.99
6	3.6	14	10.0	91.0	74	0.90
7	4.5	18	12.1	90.4	71	0.86
8	5.6	20	13.8	87.8	75	0.80
9	5.9	25	16.2	85.9	76	0.77
10	6.4	37	21.0	—	78	0.72

[1]The percentage of twins is 100 minus the percentage of singles.

[2]The coefficients relate milk yield in higher parities to predicted milk yield (calculated from the lactation curve) in the first lactation.

mountain sheep belonging to the Zackel group. Recently, the breeding goal for this breed has been to improve milk production and fertility. Improved Walachian is the most widespread breed in Slovakia, with 27,700 ewes and 800 rams in 2006 (PSSR, 2009). It is found mostly in mountain and foothill conditions, more than 800 m above sea level and in both extensive or semi-extensive production systems. For the economic value calculations, the extensive so-called Carpathian production system for Improved Walachian in Slovakia was assumed, with winter lambing indoor and summer grazing on extensive mountain and hill pastures.

As inputs to the model, the average lambing date was February 8, and the milking period started after weaning on April 5 and lasted until November 30. Natural mating of females was performed between September 1 and November 30, during the milking period. Ewes that did not conceive were culled 60 d after the end of the breeding season. As an exception, however, 80% of the ewes that did not conceive following their first lambing and 50% of ewes that did not conceive after their second lambing were retained to be mated in the next breeding season in the following year. All remaining ewes were culled at the end of their tenth reproductive cycle.

All female replacements and 16% of required male replacements were reared on farm, and 84% of required male replacements were purchased. Seventy-two percent of weaned surplus female lambs and 10% of surplus male lambs were sold as breeding animals at about 14 mo of age and therefore were reared with the lambs retained as flock replacements. All remaining surplus female and male lambs were sold for slaughter at weaning.

Female lambs that reached the required proportion of mature weight (75%) were mated at approximately 7 to 8 mo of age in the breeding season following their weaning. Conception rate of female lambs in this breeding season was 70%. The remaining replacements plus those females that did not conceive during their first breeding season were mated the following year in the second breeding season following their weaning, where an 85% conception rate was achieved. Female lambs that failed to conceive were culled 60 d after this breeding season. Male replacements that reached 75% of breed average mature weight at the start of the breeding season following their weaning were used for breeding at 7 to 8 mo of age. For young rams, the ewe-to-ram ratio was 35:1. Remaining replacement male lambs entered the flock in the second breeding season following their weaning. For these and for adult rams, the ewe-to-ram ratio was 40:1.

The stationary state of the ewe flock was calculated as described by Wolfová et al. (2009) using the parameters given in Table 1. The maximum number of lambings per ewe was set to 10, and the maximum number of breeding seasons for each ram was set to 2. The structure of progeny born in the flock per reproductive cycle and their growth patterns were calculated on the basis of breed average litter size at each lambing, survival and growth rates of lambs within each litter size (see Tables 1 and 2), and growth rates of breeding lambs during rearing (Table 3).

Milk production of Improved Walachian sheep is not high, because the breed was selected not only for milk but for wool and meat production as well. The base lactation curve (first parity lactation with single suckled lamb) is characterized by the equation (Oravcová et al., 2006)

$$y(t) = 0.4t^{0.18}\mathrm{e}^{-0.005t}$$

where t is time (days in milk) and $y(t)$ is the milk yield at time t. This lactation curve reaches its maximum (0.68 L) at $t = 35$ d.