Economic values for production traits for different sheep breeds in Kosovo

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Abstract

Generally, all traits of economic importance should be included in the breeding goal of live-stock breeding programmes. The main aim of this study was to examine economic values for a combination of dairy and meat traits of the dual purpose Bardhoka (BAR), Balusha (BAL), Sharri (SHA) and Kosova (KOS) sheep breeds in Kosovo. The underlying herd model is based on a deterministic approach considering a sheep flock with milk production, lamb fattening and replacement stock. In order to examine the economic impact for different sheep breeds, the production traits considered were milk (milk yield) and fattening (daily gain). For each lactation cycle among the breeds the milk yield (milk yield) and daily gain for BAR/BAL/SHA/KOS, respectively. For BAR and BAL the economic value per average ewe place and year was € 37.7 for both breeds, while for SHA and KOS it was € 35.1 and € 32.5, respectively. For lamb fattening, daily gain was found to have the highest economic value at € 7.00 for BAL, SHA and KOS, while for BAR it was € 6.67. The relative economic values for milk yield and daily gain for BAR, BAL, SHA and KOS were 84.96:15.04, 84.42:15.58, 83.45:16.55, and 82.36:17.64, respectively.

Introduction

Currently, approximately 126,592 sheep of about 4 different breeds are kept in Kosovo (Ministry of Agriculture Forestry and Rural Development, 2011). The vast majority of sheep in Kosovo are indigenous types managed under a traditional system of management. Traditional breeding objectives for sheep farms are continuing to be the same for many years (Bytyqi et al., 2014). The decreasing economic value of wool for local breeds and increased importance of ewe milk and lamb meat production implies that breeding should be more focused on traits contributing to the overall profit of sheep farmers in Kosovo.

The main goal of successful sheep farming is to combine breeding and selection, health, nutrition, management, and marketing with an economic perspective and, thus, to produce a quantity of quality products with maximum efficiency. Although the genetic gain for traits of economic interest is largely dependent on their heritabilities and genetic relationships, some selection drive may be applied. Information on heritability is essential for planning efficient breeding programmes, and for prediction of response to selection ( Falconer, 1989).

Estimates of genetic parameters and economic values are lacking for all traits for different sheep breeds in Kosovo. To date, only limited published information estimates on some productive (Mehmeti, 2000) and morphological traits (Bytyqi, 2009; Bytyqi and Mehmeti, 2006) of Kosovo sheep have been accomplished.

Even though some developments have been made in Kosovo sheep production with regard to nutrition and breeding using traditional population genetics, their drawbacks are obvious (lack of product diversification, planned lambing, hygienic aspects, risk of inbreeding, etc.).

The introduction of economic factors in defining selection goals is not new (Hazel and Lush, 1942). However, only recently a few studies were devoted to derive economic values for selected traits by different approaches (profit functions, herd model) in dairy sheep (Tolone et al., 2011; Fuerst-Waltl and Baumung, 2009; Wolfova et al., 2009; Legarra et al., 2007a, 2007b). Amer et al. (2001) suggested that while the terms economic value and economic weight are often used synonymously, they may also be defined as the absolute and the relative benefit of improving a trait, respectively. In breeding objectives, traits should be included according to their economic importance. Some authors (Groen et al., 1997; Dempfle, 1992) point out that in addition to economic reasons for including functional traits in the breeding programmes, there are several other reasons, for example ethical reasons and consumer concerns, which become more and more important.

In this study, the introduction of a new approach for analyzing systems of sheep production has been initiated because of the need to include economic considerations when defining future breeding programmes. The knowledge of each trait’s contribution in the breeding objective is essential in order to design appropriate breeding schemes for sheep. Apart from examining the economic impact of different traits (milk production, growth rate, stillbirth, etc), many other important aspects should however be taken into account in order to assist Kosovar sheep farmers. These include, for instance, support in selection decisions of breeding rams, knowledge building with regard to the principles of production based on breeding decisions and on proper nutrition and body conditioning (i.e., prevention of underfeeding/imbalanced feeding) according to the genotypes; but also to increase the awareness of sheep farmers about culling of non-producing animals or reasons for culling.

Hence, the objective of this study was to derive economic values for a combination of dairy and meat traits in Kosovo dual purpose sheep enabling the set up of a breeding program based on well-defined breeding goals.

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Materials and methods

Model

A computer programme, based on a bio-economic model and originally designed to optimize management-related decisions in cattle farms (Amer et al. 1996), was adapted by Miesenberger et al. (1998), and later by Fuerst-Waltl and Baumung (2009) to enable the derivation of economic values for cattle and sheep, respectively.

As in the study of Fuerst-Waltl and Baumung (2009), the underlying herd model is based on a deterministic approach where a sheep flock with milk production and lamb fattening was simulated in a steady state over an infinite planning term according to Miesenberger (1997) and Reinsch (1993). The economic value for each trait was derived by calculating the difference in herd profit between the reference scenario and after a genetic change. In order to meet this objective, daily results weighted by the proportion of the respective ewe class (ewes in different lactations) were summarized over the lambing interval or until culling (Fuerst-Waltl and Baumung, 2009). Within each scenario, the herd distribution stayed constant over time. All relevant revenues and costs were calculated per day. In general, the farm revenues resulted from selling milk, fattened lambs and animals for replacement. To avoid double counting (Dempfle, 1992), economic values were derived separately for each trait keeping all other traits constant. For milk yield and daily gain for fattening lambs, the results were expressed as marginal utility in € referring to an improvement by one unit (1 kg milk, 1 g daily gain) and as the economic value in € per genetic standard deviation ($S_g$). Generally, all results were expressed per average ewe place and year.

Assumptions

For levels of production, the assumptions made in this study are based on the characterization of Kosovar sheep breeds (Bytyqi et al. 2014). Apart from utilizing information on 2448 sheep of the four breeds (BAR, BAL, SHA and KOS), results of questionnaires distributed among farmers established the basis for various input parameters. Input parameters include animal specific (e.g. age structure, birth types, milk yield; Tables 1-3) and management parameters (e.g. working time needed for different activities; Table 2) as well as costs and revenues (Tables 4 and 5). The sheep farmers showed detailed knowledge of the situation regarding animals, management and actual prices and costs. Therefore, the prerequisites for collecting reliable data are considered to be very good.

The assumed herd distributions are shown in Table 1. The proportions of ewes in different lactations depended on the percentage of culling for infertility, for involuntary or voluntary reasons and are based on the survey in 20 Kosovar sheep farms (Bytyqi et al., 2014). Culling for voluntary reasons is equivalent to culling for insufficient production while involuntary culling reflects health problems. As no information on time of culling was available, culling for voluntary, involuntary, or infertility reasons were set to occur at lactation days 150, 150 and 490, respectively, according to Fuerst-Waltl and Baumung (2009).

In Table 2, an assortment of assumptions and in Table 4, a fraction of prices and revenues considered for traits covered in this study are presented. All relevant revenues and costs were calculated per day, and all costs were treated as variable. Revenues are the result of selling milk, fattened lambs and animals for herd replacement, respectively.

Available feedstuffs for summer and winter feeding and cost per kg dry matter (€/kg DM) and protein, energy (MJ ME) and fibre contents for available feedstuffs are stated in Table 5. A linear planning algorithm was used to select a least-cost ration that meets the protein and energy requirements (Press et al., 1986) for each day.

As in the study Fuerst-Waltl and Baumung (2009), the functions of Wood (1967) and Gompertz (Fitzhugh, 1976) were used to esti-
mate the daily milk and live mass (LM) and daily gain, respectively. 

Average daily milk yields were calculated by the exponential function as below:

\[ y_t = a \cdot e^{bt} \]  \hspace{1cm} \text{Wood (1967)}

with \( y_t \), being milk on day \( t \), where \( a \), \( b \), and \( c \) are constants that specify the shape of the lactation curve. The parameter \( a \) is calculated by the given milk production potential (MP) and the shape of the lactation curve:

\[ a = \frac{MP}{\sum e^{-ct}} \]

For MP, the results of Bytyqi et al. (2014) were used while parameters \( b \) and \( c \) were adopted from Fuerst-Waltl and Baumung (2009). For higher lactations, aging factors based on the study of Bytyqi et al. (2014) were multiplied by the average milk yield of the first lactation (Table 3), while the shapes of the lactation curves were assumed to be the same as in the first lactation.

For fattening animals LM on day \( t \) was defined according to the function

\[ LM_t = a \cdot e^{-bc-t} \]  \hspace{1cm} \text{(Fitzhugh, 1976)}

with a being the asymptote, while \( b \) and \( k \) denote slope and point of inflexion, respectively. Parameters used for the Gompertz function are shown in Table 6.

Daily energy and protein requirements, maximum daily dry matter intake and the factors multiplied by the metabolic live mass were calculated as in the study of Fuerst-Waltl and Baumung (2009).

As artificial insemination is not practiced in Kosovo, all costs for natural service rams (i.e., price of rams, costs per barn unit, labour, veterinary costs and feed) were considered for each breed. The costs per insemination were calculated assuming a one-year period of ram use and a theoretical number of 40 ewes per ram. Insemination costs per ewe thus were approximately 1.6 € for all breeds (Table 4).

Costs for housing, feeding, veterinary care, labour and other expenses were taken into account for ewes, replacement and fattened animals within all breeds (Table 4). Depending on breed, working time for a ewe during the whole lambing cycle, time spent independently from milk yield, and for lamb fattening ranged between 3.2-4.9, 1.6-1.8 and 0.6-0.7 days, respectively. Labour costs were assumed to be 0.7 € per hour.

Based on questionnaires, the breeds’ conception rates were 88.3-88.4%. Further, the proportion of single, twins and triplets born were 77.0-84.5%, 15.0-21.0% and 0.5-3.0%, respectively. Stillbirth rate (considered for lambs died at born and 48 hours after) ranged from 1.8 to 2.5 between breeds (Bytyqi et al., 2014).

Birth weight of single/twins/triples ranged between 3.8-4.0/3.0-3.2/2.5-2.8 kg per lamb. The fattening period for lambs lasts for about 150 days. For all breeds, 10% of male lambs were considered as breeding rams.

Traits
As a first step, the traits considered for the derivation of economic values were production traits only. As stated by the farmers, the most

Table 2. Assortment of assumption.

| Trait                          | BAR   | BAL   | SHA   | KOS   |
|-------------------------------|-------|-------|-------|-------|
| Standard lactation length, d  | 280   | 250   | 190   | 190   |
| Age at first lambing, d       | 365   | 365   | 365   | 365   |
| Minimum days open, d          | 150   | 150   | 150   | 150   |
| 1st lactation yield, kg       | 174   | 135   | 80    | 87    |
| Fat 1/2/3/higher lactation, % | 4.75/5.75/6.41 | 4.67/5.33/7.33 | 5.65/6.38/7.65 | 4.67/5.33/7.33 |
| Prot. 1/2/3/higher lactation, %| 4.00/4.75/5.35 | 4.17/4.67/5.39 | 4.50/4.90/5.90 | 4.16/4.42/4.88 |
| Average conception rate, %    | 88.4  | 88.3  | 88.3  | 88.4  |
| Proportion of single/twins/triples, % | 78.5/21/0.5 | 77.0/20/0.5 | 84.5/15/0.5 | 82.6/16/4.0 |
| Birth weight of single/twins/triples, kg | 4.0/3/2.6 | 4.0/3/2.8 | 4.0/3/2.6 | 3.8/3/2.5 |
| Stillbirth rate, %             | 2.5   | 2.3   | 2.2   | 1.8   |
| Male lambs for fattening, %   | 90.0  | 90.0  | 90.0  | 90.0  |
| Working time ewes lambing cycle, d | 4.9     | 4.1   | 3.2   | 3.5   |
| Working time/d independent from milk yield | 1.8     | 1.7   | 1.6   | 1.7   |
| Working time/d lambs reared/fattened | 0.70    | 0.63  | 0.72  | 0.64  |
| Fattening period, d           | 150   | 150   | 150   | 150   |

BAR, Bardhoka; BAL, Balusha; SHA, Sharri; KOS, Kosova.

Table 3. Assumed average first lactation milk yield as well as ageing factors for higher lactations.

| Breed | First lactation milk yield, kg | Age factor for lactation yield |
|-------|--------------------------------|--------------------------------|
|       | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
| BAR   | 174   | 1.00  | 1.11  | 1.16  | 0.98  | 0.82  | 0.66  | 0.60  | 0.60  | 0.60  |
| BAL   | 135   | 1.00  | 1.13  | 1.20  | 0.83  | 0.76  | 0.67  | 0.67  | 0.61  | 0.61  | 0.61  |
| SHA   | 80    | 1.00  | 1.12  | 1.21  | 0.93  | 0.81  | 0.69  | 0.69  | 0.69  | 0.69  | 0.69  |
| KOS   | 97    | 1.00  | 1.02  | 1.05  | 0.82  | 0.68  | 0.67  | 0.66  | 0.66  | 0.66  | 0.66  |

BAR, Bardhoka; BAL, Balusha; SHA, Sharri; KOS, Kosova.
important traits are milk yield followed by fattening performance.

When deriving economic values for milk yield, the daily milk yield was increased by the same value throughout the lactation with the shape of the lactation curve remaining constant. Milk is usually directly sold at the farm as no commercial dairies exist for sheep milk processing. Thus, at present no economic values were derived for milk contents.

For the derivation of economic values for daily gain, the parameters of the Gompertz function (Fitzugh, 1976) were changed in lambs (Table 5) without altering adult ewe size. Hence, for both traits marginal utilities could be calculated from the profit difference at two different performance levels.

As no genetic parameters were available for either breed, values were adopted from Fuerst-Waltl and Baumung (2009) (Table 7). With regard to the derivation of economic values, both traits’ marginal utilities refer to an improvement in the trait mean by one unit. They are expressed per average ewe place and year. Economic values are calculated by multiplying the marginal utilities with the assumed genetic standard deviations of the traits.

Table 5. Cost (€) per kg dry matter, protein energy and fibre content for available feedstuffs.

| Feedstuff                  | DM, kg | Crude protein, g | Energy, MJ ME | Fibre, % |
|----------------------------|--------|------------------|---------------|----------|
| Hay                        | 0.13   | 148              | 9.39          | 23.6     |
| Grass (summer)             | 0.09   | 169              | 10.97         | 24.0     |
| Grass silage               | 0.12   | 169              | 10.04         | 23.2     |
| Corn silage                | 0.11   | 85               | 10.8          | 19.9     |
| Concentrate (mixture wheat+maize grain) | 0.12 | 120 | 12.93 | 3.3 |

DM, dry matter; ME, metabolisable energy. The following feed restrictions were applied: concentrate max 40%; fibre min 10%; corn silage max 10%; grass silage max 50%.

Discussion

This study shows that milk production has been found to be more economically important than meat production for all sheep breeds raised in Kosovo. Producers who sell replacement stock for other farmers may find that body type may be important, as well. However, deriving economic values for conformation traits is less straightforward than for production or functional traits (e.g. Fuerst-Waltl and Baumung, 2006) and could not be considered in the present study.

Milk yield trait revenues were different among sheep breeds. The highest revenue rate was achieved by higher yielding BAR sheep with about 25.6%, 56.0%, 57.4% higher com-

Results

An overview of the reference situation for all breeds included in the study is presented in Table 8. A profit of 55.19, 55.46, 38.86, and 31.33 € per average ewe place and year was achieved for BAR, BAL, SHA and KOS, respectively.

Per standard lactation cycle of 280 days for BAR, 250 days for BAL, 190 days for SHA and KOS, ewes yielded 175.6/69.68/8.90, 135.6/8.20/7.17, 84.8/5.83/4.65 and 94.8/5.89/4.30 kg milk, fat and protein per average ewe place and year, respectively (Table 8).

Main revenues resulted from selling milk (61.82/46.03/26.37/27.22 € per lambing cycle) and lamb fattening (34.06/39.88/35.42/33.92 €) for BAR/BAL/SHA/KOS. Main costs derived from feedstuff with 62.43/64.41/58.37/57.22 € and labour with 39.10/28.37/22.70/21.71 € for BAR/BAL/SHA/KOS, respectively (Table 8).

In Table 7, means in the reference situation, assumed heritabilities, additive genetic standard deviations as well as marginal utilities, economic values and relative economic weights for traits considered in the four Kosovar sheep breeds are shown.

Marginal utilities for milk yield ranged from € 0.50 (KOS) to € 0.58 per kg (BAL, BAR) (Table 7). Presuming an additive genetic standard deviation of 65 kg, economic values of € 37.7 per average ewe place and year were estimated for the breeds BAR and BAL. With a marginal utility of € 0.54, the calculated economic value for milk yield was € 35.1 per average ewe place and year in SHA. The lowest marginal and economic value of € 0.50 and € 32.5, respectively, were found for KOS.

For daily gain, economic values of € 7.00 were derived for the breeds BAL, SHA and KOS, while for BAR it was somewhat lower with € 6.67 (Table 7). These economic values were calculated from an average marginal utility originating from the changes of the Gompertz parameters derived of € 0.240 g per g for the breeds BAL, SHA and KOS and 0.230 for BAR.
pared to BAL, KOS and SHA, respectively. With regard to fat and protein content, SHA sheep milk contains a higher percentage per kg of milk produced (6.8% for BAL, 6.0% for KOS and 5.2% for BAR), respectively (Kominakis et al., 2014). However, due to the longer lactation period, farmers of BAR and BAL produce about 3.08 kg fat and 3.56 kg protein per lactation in addition to farmers keeping SHA and KOS sheep. Despite the fact that the milk content traits are of theoretical economic impact on profitable Kosovo sheep farming, they are currently not considered in the milk payment system due to solely direct marketing. Should milk be processed in commercial dairies in future, economic values for content traits will most likely be needed. However, in the present study fat and protein content were only considered in order to calculate energy and protein requirements of ewes.

Regarding the marginal utilities for milk yield, results in our study were close to earlier works dealing with Latxa and Manchega sheep (Legarra et al., 2007a; Kominakis et al., 1997), where marginal utilities of 0.69 and 0.57 per kg milk yield were reported.

For the trait daily gain, the relative economic weight for different breeds shows some variation ranging from 15.04-17.64%. Marginal utilities were 0.23 to 0.24 per g daily gain resulting in economic values of 6.7-7.0. The results presented were close to the work presented by Carta and Ugarte (2003) who mention that approximately 25% of the income derives from lambs’ meat in dairy sheep. Kominakis et al. (1997) reported a marginal utility of 0.066 per g daily gain.

Also due to predominant direct marketing and consequently lack of consideration in the payment system, carcass traits such as dressing percentage and EUROP grading score were not considered in the present study. However, in future scenarios of food supply chains this might change.

For some traits, i.e., lactation length or yield at 1st lactation, huge differences between breeds living in Dukagjini valley (BAR and BAL) compared with SHA and KOS breeds bred in other regions in Kosovo were observed. In general, stillbirth rate and veterinary costs were low, both having a positive economic impact in sheep farms in Kosovo. For traits like birth type (single/twins/multiples), the results show that there is a need for improvements considering factors that have an effect on these traits (e.g., inbreeding, feeding, etc.). Some other traits (i.e., days open, seasonal lambing, lamb fattening period, a proportion of male lambs sold for breeding, etc.) are set mainly due to traditional management characteristics in Kosovo.

At present, no artificial insemination is used in Kosovo sheep breeding. As a consequence, the breeding ram prices were noticeably high for all breeds. However, due to small populations per breed and narrow breeding replacement stock cycle (exchange of rams between a small number of flocks usually grazing together for many years), inbreeding could be one area of concern. Returns to rams sold for breeding, ranging from 150 to 230 €/ram, can provide relatively good profit for farmers. This could also be an alternative for some farmers emphasizing their efforts on raising breeding stock for other farmers. Due to low wool quality for all Kosovo sheep breeds, the current study did not consider wool for the derivation of economic values.

The current study indicates that revenues from sheep farms might be greatly improved when farmers could concentrate on traits of economic impact (i.e., milk yield and daily yield, results in our study were close to earlier works dealing with Latxa and Manchega sheep (Legarra et al., 2007a; Kominakis et al., 1997), where marginal utilities of 0.69 and 0.57 per kg milk yield were reported.

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### Table 6. Gompertz parameters for fattening lambs: reference situation (italics) and derived economic weights.

| Breed |参数 | A   | b   | k   |
|-------|-----|-----|-----|-----|
| BAR/SHA/KOS | | 56.14 | 2.84 | 0.0135 |
| BAL   | | 56.14 | 2.99 | 0.0120 |

| Breed | Milk yield, kg/year | Daily gain, g | Marginal utility, €/unit | Economic value, €/sa | Relative economic weight, % |
|-------|---------------------|---------------|--------------------------|----------------------|-----------------------------|
| BAR   | 174.7               | 251           | 0.27                     | 65.0                 | 0.58                        | 37.7                       | 84.96                       | 15.04                       |
| BAL   | 135.6               | 251           | 0.30                     | 29                   | 0.23                        | 37.7                       | 84.42                       | 15.38                       |
| SHA   | 84.8                | 251           | 0.30                     | 29                   | 0.58                        | 35.1                       | 83.45                       | 16.55                       |
| KOS   | 94.8                | 251           | 0.30                     | 29                   | 0.50                        | 32.5                       | 82.36                       | 17.64                       |

b²; heritability; sa; additive genetic standard deviations; BAR, Bardhoka; BAL, Balusha; SHA, Sharri; KOS, Kosova.

### Table 7. Means in the reference situation, heritability and additive genetic standard deviations as well as marginal utilities, economic weights and relative economic weights for traits considered in four sheep breeds.

| Breed and traits | Mean   | h²   | sa   | Marginal utility, €/unit | Economic value, €/sa | Relative economic weight, % |
|------------------|--------|------|------|--------------------------|----------------------|-----------------------------|
| BAR              | Milk yield, kg/year | 174.7 | 0.27 | 65.0 | 0.58 | 37.7 | 84.96 | 15.04 |
|                 | Daily gain, g | 251   | 0.30 | 29   | 0.23 | 37.7 | 84.42 | 15.38 |
| BAL              | Milk yield, kg/year | 135.6 | 0.27 | 65.0 | 0.58 | 35.1 | 83.45 | 16.55 |
|                 | Daily gain, g | 251   | 0.30 | 29   | 0.24 | 7.0  | 17.64 |             |
| SHA              | Milk yield, kg/year | 84.8  | 0.30 | 29   | 0.50 | 32.5 | 82.36 |             |
|                 | Daily gain, g | 251   | 0.30 | 29   | 0.24 | 7.0  |              |                 |
| KOS              | Milk yield, kg/year | 94.8  | 0.30 | 29   | 0.50 | 32.5 | 82.36 |             |
|                 | Daily gain, g | 251   | 0.30 | 29   | 0.24 | 7.0  |              |                 |
gain). The model used is deterministic and describes quantitative relationships between average performance levels for the traits considered and levels of output of the farm.

In other sheep breeds (e.g. Gebre et al., 2012) it was stated that functional traits need to be considered in breeding programmes. The same model calculation procedures could be applied for the inclusion of functional traits. However, taking into account the current lack of a breeding programme in Kosovo dairy sheep, those traits are rather unlikely to be included in routine performance testing in near future. In any case, as soon as data on functional traits are routinely available, they should be utilized. However, the sheep farm profit function might slightly vary with inclusion of different marginal utilities in the milk production traits (milk composition content), carcass traits (EURO standards), functional traits, etc.

Even though there have been some movements in improving overall management in recent years, the efficiency of Kosovar sheep industry remains unknown. However, it should be pointed out that among all four breeds, definition of clear breeding objectives of the traits considered will be a need for the direct economic importance. The future sheep production ultimately requires farmers to determine which traits to focus on in their herd but milk production and daily gain seem to be the ones that create the highest returns.

Apart from the economic values derived, results point at room for improvement with regard to managerial conditions. However, the efficiency of sheep industry relative to environment, food and other animal industries could be an important factor for the future sustainable economic approach on sheep production.

### Conclusions

For each trait in the breeding goal, economic values are needed to ensure that selection emphasis is proportional to the economic importance of these traits (Amer et al., 1996). Currently, only production traits are in the focus of Kosovar sheep breeders. Routine performance testing, which has been non-existent so far, will most likely only be implemented for dairy and fattening traits in the first step. However, routine recording of functional traits should follow, as breeding goals should generally include both, production and functional traits. Apart from breeding goals and selection schemes, it might be necessary to use a better overall management practice to develop acceptable levels of desirable traits having a direct economic impact. Firstly, an intensive focus must enable to increase milk

### Table 8. Results for the reference situation (per average ewe place).

| Trait                                | BAR   | BAL   | SHA   | KOS   |
|--------------------------------------|-------|-------|-------|-------|
| Cycle length*, d                     | 328.1 | 327.8 | 323.7 | 322.2 |
| Milk yield, kg                       | 175.6 | 135.6 | 84.8  | 94.8  |
| Fat yield, kg                        | 9.68  | 8.20  | 5.83  | 5.89  |
| Protein yield, kg                    | 8.90  | 7.17  | 4.65  | 4.30  |
| Fat/protein content, %               | 5.51  | 5.29  | 5.88  | 6.23  |
| Milk revenue, €                      | 61.82 | 45.03 | 28.37 | 27.22 |
| Revenues from ewes sold, €           | 34.06 | 28.88 | 35.42 | 33.92 |
| Feed costs, €                        | 62.43 | 64.14 | 58.37 | 57.22 |
| Concentrate, kg DM                   | 40.29 | 21.97 | 8.73  | 8.07  |
| Replacement costs, €                 | 25.40 | 26.19 | 31.06 | 29.32 |
| Barns costs, €                       | 3.0   | 3.0   | 3.0   | 3.0   |
| Labor costs, €                       | 39.10 | 28.37 | 22.70 | 21.71 |
| Insemination costs, €                | 1.74  | 1.76  | 1.79  | 1.79  |
| Costs for lambing, €                 | 1.13  | 1.61  | 1.00  | 1.08  |
| Proportionate costs (sales), €       |       |       |       |       |
| Lamb fattened                        | 4.94  | 5.43  | 7.36  | 6.93  |
| Ewe                                 | 5.63  | 7.34  | 7.81  | 7.31  |
| Ram                                 | 1.17  | 1.30  | 1.50  | 1.43  |
| Proportionate revenues (sales), €    |       |       |       |       |
| Lamb fattened                       | 51.17 | 49.80 | 52.10 | 52.95 |
| Ewe                                 | 34.06 | 39.88 | 35.42 | 33.92 |
| Ram                                 | 8.09  | 13.62 | 12.63 | 8.37  |
| Revenue total, €                     | 162.68| 157.64| 134.35| 130.33|
| Cost total                          | 113.07| 107.84| 99.98 | 102.67|
| Profit                              | 49.61 | 49.80 | 34.37 | 27.66 |
| Results per year, €                  |       |       |       |       |
| Revenue total                       | 180.98| 175.55| 151.47| 147.63|
| Cost total                          | 125.79| 120.00| 112.61| 116.30|
| Profit                              | 55.19 | 55.46 | 38.86 | 31.33 |

BAR, Bardhoka; BAL, Balusha; SHA, Sharri; KOS, Kosova; DM, dry matter. *Shorter than lambing interval as culling is considered; + labor costs for feeding included in costs for feedstuff.
production as a main profitable trait. Secondly, since seasonal lamb meat price fluctuations were reported, an option for lambing out of the current season practice (December-January) and rapid fattening of lambs should be taken into consideration.

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