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# Determination of economic values for some important traits in Moghani sheep

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ABSTRACT

Determination of economic values for important traits is one of the most important priorities in animal breeding. Therefore, a deterministic bio-economic model was used to estimate economic values for litter size, pre-weaning survival, post-weaning survival, ewe survival, birth weight, weaning weight, yearling weight, mature ewe live weight, dressing percentage, conception rate and wool weight in Moghani sheep breeding station herd located in Jafarabad-Moghan, including 432 ewe and 52 rams. Sensitivity analysis of economic values to price levels of input and output was also carried out. Sensitivity of EVs for traits was proportional to ±20% changes in prices of meat, wool, roughage and concentrate, because they are the most affective factors in system profit under the studied condition. Results of sensitivity analysis showed that relative economic values of traits except for birth weight and wool weight had the highest sensitivity to change in meat price, which was the most important component of profit. The most important trait in this study was litter size with relative economic value to wool weight of 76.36 followed by dressing percentage and ewe survival with relative economic values of 2.43 and 1.54, respectively. The lowest relative economic value was found for birth weight (−0.08). In this system, the economic values of all traits were positive except for birth weight, indicating positive effects of these traits on system profitability. Generally, traits which increased income and decreased costs through increase in extra lamb selling had higher economic values.



## 1. Introduction

A well-defined breeding objective is the first requirement of any genetic improvement program. Breeding objectives comprise those traits, which one attempts to improve genetically because they influence returns and costs to the producer (Kahi and Nitter, 2003). Definition of the breeding objective is generally regarded as the primary step in the development of structured breeding programs (Harris, 1970; Danell, 1980; Ponzoni, 1986). Animal breeding, generally, aims to obtain a successive generation of animals that will produce desired products more efficiently under future farm economic and social circumstances than the present generation of animals (Groen, 2000). The selection index theory established the basis for optimal combination of traits when selecting for more than one trait. Within this theory, the aggregate genotype may be defined as a linear function of additive genetic values of traits multiplied by their economic value (Fuerst-Waltl and Baumung, 2009). Economic values are defined by the value of one unit superiority of a trait keeping all other traits in the aggregate genotype constant (Hazel, 1943; Kosgey et al., 2004; Fuerst-Waltl and Baumung, 2009). 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

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(Amer et al., 2001; Fuerst-Waltl and Baumung, 2009). Economic weights can be derived as marginal economic values, e.g. the marginal returns minus marginal costs obtained by increasing the level of a trait by one unit (Wolfova and Nitter, 2004). Formal breeding objectives for subsistence production systems are scarce in the tropics (Amer et al., 1998). Defining objectives in economic terms is difficult enough in temperate agriculture and becomes even more different in the tropics because of the greater environmental and managerial complexity (Franklin, 1986). Breeding objectives should account for inputs, such as feed, husbandry and marketing costs, as well as for outputs, such as income from sale of products and surplus animals, which are difficult to quantify under most tropical conditions (Kahi and Nitter, 2003). This has forced animal breeders in the past to define breeding objectives in purely biological terms. In the biological definition, costs ($C$) and revenues ($R$) are expressed in energy and/or protein terms, and in the economic definition the expression is usually in terms of money. The biological definition is not ideal because not all $C$ and $R$ can be expressed in terms of energy and/or protein (Groen, 1989; Kosgey et al., 2003; Kahi and Nitter, 2003). One of the useful tools for estimating economic values for traits is a bio-economic model which provides a very powerful tool to estimate the economic value of genetic changes in various traits, and also to investigate the robustness of these values to changes in nutrition, management and market prices (Jones et al., 2004; Kosgey et al., 2003; Haghdoost et al., 2008). The present investigation focuses on the development of a breeding objective of sheep by the bio-economic model comprising revenues and feeding criteria and another production costs as production system of Moghani sheep coinciding with tropical regions system. The economic values of traits in Moghani sheep are not previously reported. Therefore, the present investigation was carried out in order to obtain economic values of some important traits in Moghani sheep.

## 2. Materials and methods

In this study, a deterministic simulation static model which assumes no variation in characteristics among animals was used for calculation of economic values (EVs) for important traits of Moghani sheep. The model describes quantitative relationships between the levels of genetic merit for the traits considered and levels of output of the farm. The total annual profit of the flock was derived as the difference between costs and revenues of the system as shown in Eqs. (1)–(3). The average prices in 2009 were used and all costs and prices were expressed in US$. The productive unit was the ewe, and the time unit was one year. The inputs for the production system were roughage feed, management (i.e. labor, spraying or dipping, veterinary services and mineral supplements), marketing (i.e. transporting live animal and carcass, and levies for auction, slaughter and meat inspection) and fixed costs. The outputs were the revenues from sale of cull-for-age ewes and rams, surplus yearlings, and manure from all the categories of animals. Table 1 describes the assumptions made for the input variables of the model. The input parameters were derived from the Moghani sheep breeding station herd located in Jafarabad-Moghan, the market, farmers and expert opinions. The flock structure was close to reality and adapted to Moghani sheep breeding station. All assumptions in the study of Kosgey et al. (2003) were used. Seasonal variations in animal's performance and prices were not included in the model. For example, to simplify the situation, all the carcasses were assumed to have the same grade and different cuts of the carcass to have the same price. The amount of manure was derived for each category of animals based on the assumed amount of fed roughage and its digestibility. In the calculation, a linear relationship between manure and feed intake was assumed. As animals were kept in penned enclosures everyday (Gatenby, 1986; Jaitner et al., 2001) farm-gate price was assumed for manure sold and therefore no transport or marketing costs were incurred. The number of animals slaughtered for official guest's consumption was considered to be negligible, although this may not always be true. Therefore, receipts from skin sales were considered to accrue to the butcher and were excluded from revenue calculations. Fresh grass consumed by the sheep was produced on the farm and no commercial concentrate feed was provided to the animals. Supply of labor by the farmer was set to be fixed per animal per year but varied with the size of the flock. It was considered to be equal for all animal categories except for replacement stock that were considered to require half the amount of labor per animal. Replacement stock was less cared than the young stock and breeding animals. Opportunity cost for the farmer's labor for other farm tasks in smallholder farming systems was used to arrive at the cost of labor. Veterinary care was assumed to be optimal and therefore, reasonable average costs have been used. Eqs. (4)–(6) show details on derivation of the variable costs. Other costs not related to flock size were included in the fixed costs.

### 2.1. Animal flows and events

Fig. 1 shows diagram of animal flows and events of a flock consisting of 432 ewes. This represents the number of ewes present over the entire period. Six animal categories were distinguished according to age: (1) lambs (0–3 months old); (2) yearlings (4–11 months old); (3) replacement females (12–18 months old); (4) replacement males (12 months old); (5) breeding ewes (>18 months old); (6) breeding rams (>12 months old). It was assumed that 50% of lambs born were males. All males not required for breeding have been castrated before weaning while all breeding males have been culled after four productive years. Breeding season for Moghani sheep begins from end of July and continues until the end of September.

In this flock twinning rate was 25% with conception rate of 98%. These figures were on 12-month basis and production system was based on single bearing at one year. In this system, milk has been given to lambs for 4 months and pre-weaning lamb mortality rate ($m1$) was 4%. Post-weaning lamb mortality ($m2$) was 2% which was set to occur equally between 5 and 11 months after weaning. The mortality rate of replacement stock for female ($m3$) and male ($m4$) was 4% and 3%, respectively up to 18 months of age. Breeding ewe ($m5$) and ram ($m6$) annual mortality rate was calculated as 2% and 4%, respectively and it was assumed to be distributed equally for the entire period.

### 2.2. Profit equations

Total annual profitability of the sheep flock ($Tf$) was described by the following equation (Kosgey et al., 2003):

$$Tf = [N_e \times (R_e - C_e)] - \text{CFCF} \tag{1}$$

where $N_e$ is the number of ewes in the flock per year, $R_e$ the average revenue, per ewe per year, $C_e$ the average variable costs, per ewe per year, excluding CFCF and CFCF is the fixed costs, per flock per year.

The revenue ($R_e$) was calculated from Eq. (2) as the sum of four revenues (Kosgey et al., 2003):

$$R_e = \text{surplus yearlings and lambs at weaning meat} + \text{cull-for-age ewes and rams meat} + \text{wool} + \text{manure}$$

$$R_e = \left[\sum_{i=1}^{6} N_i \times f_i \times (1-m_i) \times \left(\text{LW}_i \times \frac{\text{CM}_i}{100}\right) \times P_m\right] + \sum_{i=2}^{6}[N_i \times f_i \times W_i \times P_w] + \sum_{i=1}^{6}[N_i \times f_i \times O_i \times P_o] \tag{2}$$

where $i$ is the animal category (1 – lambs; 2 – yearlings; 3 – replacement females; 4 – replacement males; 5 – breeding ewes and 6 – breeding rams), $N$ in this and the following equations refers to number of animals present relative to number of ewes present, $f$ the fraction of animals that are slaughtered in case of meat or producing manure in case of manure, $m$ the mortality rate of animals (%), LW the live weight at slaughter of an animal (kg), CM is the consumable meat, including 20% offal at half price