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CALCULATING ECONOMIC WEIGHTS FOR GROWTH, REPRODUCTION AND WOOL TRAITS IN MAKUI SHEEP BREED BY ECOWEIGHT SOFTWARE

S. Mohammad Rahimi*, S. A. Rafat, J. Shoja, S. Alijani

Department of Animal Science, University of Tabriz, 29th Bahman Boulevard East Azarbaijan, Tabriz, Iran.
*Corresponding author, E-mail address: San_mohamadrahimi@yahoo.com
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Abstract: Production, reproduction, management and economical parameters obtained from data collected from 1993 to 2012 Makui sheep research station of West Azerbaijan province in Iran were evaluated in the present study. Traits included of fertility, pregnancy rate, lamb weights from birth to the end of period, survival rate of lambs, wool production weight, average daily gain and milk production. The present value of profit computed as the difference between total revenues and total costs per ewe per year. The numeric derivation of each considered trait is calculated by increasing and decreasing the average value of the trait while was kept the other characters in the average. First all costs, revenues, profits and flock structure determined then interned input files and running the software ECOWEIGHT. The results showed that economic values per unit increase in the traits of birth weight, daily gain from birth until weaning, daily gain from weaning until end of period, conception rates ewes, little size, lamb survival, lifetime for ewes, milk yield and wool yield were 0.66, 0.51, 0.03, 0.66, 0.25, 0.85, 0.93, 0.53 and 1, respectively. Breeding objective in Makui sheep breed were productive wool yield, lifetime, lamb survival at weaning, conception rates ewes, birth weight, milk yield, daily gain from birth until weaning, little size, daily gain from weaning until end of period.

Keywords: Ecoweight, breeding, economic weight, lamb, wool

Introduction

The Makuie sheep is a fat-tailed sheep breed which can be found in the Azerbaijan province of Iran. In 1986, a Makuie sheep breeding station was established in the city of Maku in order to breed, protect and purify this breed. Its total population is estimated at approximately 2.7 million (*Abbasi and Ghafouri*,

2011). It has been adapted to cold and highland environments (*Safari, 1986*). They are fat-tailed sheep with a medium-sized body, white in color with black rings around the eyes, nose and feet (*Saadatnoori and Siahmansor, 1986*). They are kept in the Eastern and Western provinces Azerbaijan and their main products are meat, wool and milk (*Saadatnoori and Siahmansoor, 1986*). The rearing system is mostly extensive-migratory from April to September (on natural pastures in spring and summer), and semi-intensive from October to March (on stations and fed in barns during autumn and winter). Alfalfa, barley, corn silage, concentrates and grass are the main feedstuffs used in the semi-intensive rearing period.

The first step in designing a breeding program is definition of the selection object function. In order to do this economic values of traits affecting incomes and costs of production system should be determined. Until now, such a process has not been done for Makui sheep. Need to include the aim of the study. Purpose of the cost adjustment is to provide broad applicability to obtained results in relation to investigated farm (*Okanović et al., 2008*).

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*).

Materials and Methods

The program package ECOWEIGHT is intended for the calculation of economic values of economically important traits in livestock. At the given stage, in its fifth version, two programs for cattle and three programs for sheep are available. The two programs for cattle (EWBC and EWDC) are described in the first part of the manual. Whereas in the present manual (which forms the second part of the documentation) the stand-alone program EWSH1 for sheep with one lambing per year is presented, the third part of the program package which is documented in two manuals is formed by the program EWSH2 which is a modification of EWSH1 and by the program GFSH which models gene flow in sheep. As the programs EWSH2 and GFSH are run together they are in a joint installation package. The program EWSH1 is the implementation of a bio-economic model on the PC to simulate effects on life-cycle efficiency from genetic change in production and functional traits of sheep under alternative management systems with one lambing per year. The flock structure is described in terms of animal categories and probabilities of transitions among them. The Markov chain approach is used to calculate the stationary state of the ewe flock. Up to 47 categories of progeny may be defined whereby pure-bred and cross-bred animals may occur in most categories if cross-breeding is used in the system.

The algorithm includes both deterministic and stochastic components. Performance for most traits is emulated as the population mean, but variation in several traits is taken into account.

Profit estimated as the difference between the total revenues and total costs per ewe per reproductive cycle is used as criterion of the economic efficiency of the production system in the stationary state. The economic importance (economic values) of up to 35 traits (milk production traits, growth traits, carcass traits, functional traits and wool traits) may be estimated. These economic values are intended for developing a breeding objective for sheep.

Table 1. Input files Ecoweight (EWSH1)

Input file	Introduction
1	parameters for calculating the ewe flock structure
2	parameters for calculating the structure of the ram population
3	parameters for calculating the structure of the progeny of the ewe flock
4	parameters for the progeny of the ewe flock reared for breeding for the interval from weaning to mature weight or to selling
5	parameters for surplus progeny
6	parameters for the calculation of milk production on the basis of the Wood function
7	parameters for the calculation of milk production if the lactation curve is unknown
8	parameters for calculating the nutrition costs
9	parameters for the calculation of non-feed costs in the sheep flock and in lamb fattening
10	parameters for calculating revenues except of revenues from slaughter animals and milk
11	parameters for the calculation of the milk price, revenues from milk and cheese
12	parameters for calculating revenues from adult sheep
13	parameters for calculating revenues from lambs slaughtered after weaning or artificial rearing
14	parameters for calculating revenues from lambs in fattening

The marginal economic value is generally defined as the partial derivative of the profit function with respect to the trait considered. It is expressed per given unit of the trait and per time interval (here per ewe entering a reproductive cycle and per year). When using complex bio-economic models instead of simple profit functions (as in the present program) the exact partial derivative must be replaced by an approximate method, by a numeric derivative (difference quotient). The estimation of economic profit based on weight is calculated for a commercial population of sheep of the given breed or breed combination. The methodology

used for the calculation of economic values is different for traits with continuous variation and for categorical traits.

Economic values for traits with continuous variation

The numeric derivative of profit with respect to the considered trait is calculated by increasing and decreasing the average value of the trait TV_{av} by 0.5%. Let TV_h be the higher value of the trait considered which was derived as $TV_h = 1.005TV_{av}$. Similarly, TV_l is calculated by decreasing the average trait value by the same amount: $TV_l = 0.995TV_{av}$. Furthermore, let TP_h and TP_l be the total profit belonging to the first or the second of these values, respectively. The partial derivative is then approximated by the following difference quotient:

$$ev= (TP_h-TP_l) / (TV_h-TV_l)$$

Some traits are complex quantities which are calculated from a series of parameters. For example, average conception rate of ewes is calculated from the conception rates in the individual lactations. For that reason, the conception rate in all lactations is changed in the way described above for calculating the economic value of the average conception rate. Total milk is calculated from the sum of daily milk yield of ewes on different lactations. In this trait a change in parameter (awo in the program) of the lactation curve proved to be useful for the calculation of economic weights.

Table 2. Number of records, means (± s.d.) for considered traits in Makui sheep

Trait	No. of record	Mean± s.d.
Birth weight	18967	4.11± 0.88
Weaning weight	19297	21.50± 3.50
6 month weight	9957	27.18± 3.53
24 month weight for ewe	395	43.88± 6.45
24 month weight for ram	29	44.59± 7.62
Amount of wool per shearing in ewe (kg/animal)	1826	1.19± 0.47
Amount of wool per shearing in ram (kg/animal)	1389	1.40± 0.55

Non-feed costs include veterinary costs, breeding costs, general labour costs, costs for bedding, costs for shearing, fixed costs, costs for removing and rendering dead animals, costs for buying animals, marketing costs, costs for tanning skins, milking costs and costs for cheese production. The latter two cost components accrue only for dairy ewes. Not each single item of the non-feed costs occurs in all categories of animals. All costs are discounted to the birth date of the animals (Table 3).

In all input files the abbreviation MU is used for monetary unit. All values in the distributed version of the program refer to Euros. It is important to note that the currency used in Iran is the Rial (MU1=25000 Rials).

In order to study the effect of environmental factors on growth traits in Makui sheep, we applied information that was collected from 1993 to 2012 in Makui Breeding Station. Records of birth weight, weaning weight, weight at month 6, weight at month 24 for ewe and ram, Amount of wool per shearing in ewe and ram. Characteristics of the data structure are summarized in Table 2. A univariate procedure of SAS was used to check for normality. The SAS software was used for normality test. The data of all traits was normal.

Table 3. Growth data, nutritional management, production, costs and prices in Makui sheep

Title	Mean	Title	Mean
Birth weight (female/male) kg - Singles - Twins	 4.09- 4.36 3.64- 3.73	Weaning age of lambs (months)	5
Weaning weight (female/male) kg - Singles - Twins	 21.24- 21.31 19.84- 20.54	Age at first mating (months)	18
Survival rate of lambs until weaning (%) - Singles - Twins	 99 96	Number of shearing times in per year	1
Mature weight (kg) - Female - Male	 50 60	Number of years keeping ewes in flock	7
Percentage of singles (%)	85	Number of years keeping rams in flock	5
Percentage of twins (%)	15	Days grazing on rangeland	90
Conception rate (%)	95	Days using pastures of residual crop	120
Average daily gain from birth to weaning (g/d) - Female - Male	 190 197	Days using manual feeding	150
Average daily gain from weaning to six- month (g/d) - Female - Male	 65 61	Number of drenchings against worm (endo-parasites)	2

Survival proportion from weaning to the first breeding season - Female /Male	97	Drug and veterinary service (MU/head/year)	0.4
Number of days gestation	150	Cost for milking per kg milk (MU/kg)	0.8
Costs per shearing (MU)	0.4	Price per kg cheese (MU./kg)	6
Labour (MU./100 head/month)	280	Roughage metabolic energy (Mcal/DM)	1.5
Concentrate metabolic energy (Mcal/DM)	2.8	Roughage price (MU./kg DM)	0.108
Concentrate price (MU/kg DM)	0.192	Price per kg live weight of pure-bred lambs to weaning (MU/kg)	6
Price per kg live weight of pure-bred lambs after weaning (MU/kg)	7.2	Price per kg live weight of ewes (MU/kg)	4.6
Price per kg live weight of rams (MU/kg)	4.4	Price per water(MU/lit)	0

Results and Discussion

In Makui sheep production system, variable costs, i.e. feed and non-feed costs included 99% of the total costs. Fixed costs varied widely between flocks, depending on the type of barn used. Traditional barns were cheap, whereas upgraded or newly build barns were relatively expensive. *Kosgey et al., (2003)* estimated the fixed costs at a proportion of 5%, which was more than the evaluated amount in the present study. The difference may have to be attributed to different assumptions of these models. *Kosgey et al., (2003)* considered only roughage cost as feed costs which resulted to relatively lower variable costs and as a result, the proportion of fixed costs to total costs was higher in comparison with present study. Feeding costs and cost of labour contributed most to the variable costs, which coincided with results of *Khodaee, (2005)* and *Vatankhah, (2005).*

The marginal and relative economic values for all evaluated traits are summarized in Table 4. They express the changes in the present value of profit per ewe present in the flock at lambing and per year that would occur when flock average for the trait was increased by one unit.

Table 4. Marginal economic values and relative economic value of the trait in Makui sheep

Trait acronyms	Trait (units)	Marginal Economic value (MU)	Relative Economic value
BW	Birth weight (kg)	1.032	0.66
DGBW	Average daily gain from birth to weaning (g/d)	0.809	0.51
DGWE	Average daily gain from weaning to six-month (g/d)	0.047	0.03
Cr	Conception rate of ewes (%)	1.035	0.66
Ls	Average litter size per ewe lambing (0.01 lambs)	0.394	0.25
Sr	Survival rate of lambs at lambing (%)	1.341	0.85
LE	Length of productive life of ewes (years)	1.461	0.93
MY	Milk yield in the standardized milking period of 150 d (kg)	0.842	0.53
WY	Wool yield (kg)	1.578	1

Highest economic value in base situation was obtained for wool y yield. The economic value of birth weight trait was positive. Results were in agreement with the results obtained for Harki sheep (*Shiru, 2011*), and Gharagol sheep in Iran (*Zahmatkesh, 2010*) in addition to, the system studied by *Kroupva et al., (2009;2011), Wollfova et al., (2009;2011),* but *Musazadeh, (2012), Haghdoost et al., (2008)* obtained negative economic value for these trait.

Economic value was not worked for trait average daily gain in Iran. Software Ecoweight has found average daily gain. Economic value average daily gain birth to weaning and weaning to six- month traits have intermediate and low level. Average daily gain after weaning is high heritability because appropriately important for these trait.

The economic value of another reproductive trait, that is conception rate have a relatively high economic value. Results were in agreement with the results obtained for Lori Bakhtiari sheep in Iran (*Vatankhah, 2005; Kroupva et al., 2009; 2012; 2013*).

Among the reproductive traits, litter size seems to have an intermediate economic value. On the other hand, survival rates of lambs at lambing and until weaning have high economic values. The economic value for milk yield seems to

have an intermediate economic value. Recently, economic values for milk production as well as for growth and functional traits in dairy sheep have been estimated (*Fuerst-Waltl and Baumung, 2009*).

In many countries with developed agricultural practices, economic outcomes of paratubercusosis were investigated in dairy herds (*Vidić et al., 2013*). In Nigeria, goat production plays an important role in the economic improvement of poor farmers and contributes to poverty alleviation *(Yakubu et al., 2014).*

Results of this research showed that in Makui sheep production system, wool yield, length of productive life of ewes and ewe survival were of the most important traits to increase the profit of the flocks. These traits could be recorded under flock conditions and hence should be considered in genetic improvement programs.

Conclusions

Imposing current breeding programs for various sheep breeds in Iran. These programs were supposed to be performed mainly by the flock owners. Redundant need to reword or change sentences construction because very obvious that only copied the end part of the results and discussion.

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Obračun ekonomskih vrednosti za rast, reprodukciju i osobine vune ovaca rase makui korišćenjem „Ecoweight“ softvera

S. Mohammad Rahimi, S. A. Rafat, J. Shoja, S. Alijani

Rezime

Parametri proizvodnje, reprodukcije, upravljanja i ekonomski parametri dobijeni iz podataka prikupljenih od 1993. do 2012. godine, u istraživačkoj stanici za Makui ovace pokrajine Zapadni Azerbejdžani u Iranu, su ocenjenivani u ovoj studiji. Osobine uključene u istraživanje su osobine plodnosti, stopa jagnjenja, težine jagnjadi od rođenja do kraja perioda, stopa preživljavanje jagnjadi,

proizvodnja vune, prosečni dnevni prirast i proizvodnja mleka. Sadašnja vrednost profita izračunava se kao razlika između ukupnih prihoda i ukupnih troškova po ovci godišnje. Numeričko izvođenje svake posmatrane osobine je izračunato povećavanjem i smanjivanjem prosečne vrednosti osobine, dok su ostale osobine zadržane u prosečnoj vrednosti. Prvo su svi troškovi, prihodi, profit i struktura stado utvrđeni, onda internirani ulazni inputi i pokrenut softver ECOWEIGHT. Rezultati su pokazali da se ekonomske vrednosti po jedinici povećavaju u osobinama težina na rođenju, dnevni prirasti od rođenja do odbijanju, dnevni prirasta od odbijanja do kraja perioda, stope koncepcije ovaca, veličina legla, preživljavanje jagnjadi, životni vek ovaca, prinos mleka i vune prinos za 0,66; 0.51; 0,03; 0,66; 0,25; 0,85; 0,93; 0,53 i 1, respektivno. Odgajivački cilj za ovce rase Makui je prinos vune, životni vek, preživaljavanje jagnjadi kod odbijanja, stope koncepcije ovaca, telesna masa, prinos mleka, dnevni prirast od rođenja do odbijanja, veličina legla, dnevni prirasta od odbijanja do kraja perioda.

References

ABBASI M.A., GHAFOURI-KESBI F. (2011): Genetic co(variance) components for body weight and body measurements in Makooei sheep, in Asian-Aust. J Anim Sci, 24, 739-743.

FUERST-WALTL B., BAUMUNG B. R. (2009): Economic values for performance and functional traits in dairy sheep. Ital. J. Anim. Sci.478-486.

JONES H.E., AMER P.R., LEWIS R.M. (2004): Economic values for changes in carcass lean and fat weights at a fixed age for terminal sire breeds of sheep in the Uk. Livest. Prod. Sci. 89, 1–17.

KRUPOVA Z., KRUPA E., WOLFOVA M. (2013): Impact of Economic Parameters on Economic Values in Dairy Sheep. Czech J. Anim. Sci, 58, 21–30.

KRUPOVA Z., WOLFOLVA M., WOLFA J., ORAVCOVA M., MARGETIN M., PESKOVICOVA D., KRUPA E., DANO J. (2009): Economic Values for Dairy Sheep Breeds in Slovakia . Asian-Australasian. Journal of Animal Science, 22(12), 1693 – 1702.

KRUPOVA Z., WOLFOVA M., KRUPA E., ORAVCOVA M., DANO J., HUBA J. a., POLAK P. (2012): Impact of Production Strategies and Animal Performance on Economic Values of Dairy Sheep traits . Animal, 6 (3), 440–448.

KHODAEE M. (2005): Determination of breeding objectives of Guilanian sheep by estimation of economic coefficients of production traits. Msc Thesis. Guilan University, Guilan, Iran.

KOSGEY I.S., VAN ARENDONK J.A.M., BAKER R.L. (2003): Economic values for traits of meat sheep in medium to high production potential areas of the tropics. Small Rum. Res, 90, 187–202.

MUSAZADEH L., SHADPARVAR A., SKANDARNASAB M. (2012): The estimated economic value of productive and reproductive traits in Afshari sheep in the rural system. Research Journal of Anim, 22 (2).
OKANOVIC Đ., PETROVIC Lj., ZEKIC V., ŽIVKOVIC B., DŽINIC N., TOMOVIC V. (2008): Importance of the quality of pig carcass sides for economic efficiency in production and processing of pork. Biotechnology in Animal Husbandry 24 (3-4), p 129-137.
SAADATNOORI M., SIAHMANSOOR S. (1986): Principles of sheep industry. 3rd ed., Ashrafi Publ., Tehran, Iran.
SAFARI E. (1986): Report for identification of Makuie ecotype. Agriculture Ministry of Iran Publ., Tehran, Iran.
SHIRO N. (2011): Determination of breeding objective and economic values for Harki sheep breed. Thesis. M. Sc., Dept. of Ani. Sc., Faculty of Agri., Tabriz University.
VATANKHAH M. (2005): Defining a proper breeding scheme for Lori-Bakhtiari sheep in village system. Ph.D. Thesis, Tehran University, Tehran, Iran.
VIDIC B., SAVIC S., VIDIC V., JOVICIN M., PRICA N. (2013): Economic impact of paratuberculosis on milk production. Biotechnology in Animal Husbandry 29 (2), p 183-191.
WOLFOVA M., WOLF J., KRUPOVA Z., KICA J. (2009): Estimation of economic values for traits of dairy sheep: I. Model development. Journal of Dairy Science, 92, 2183-2194.
WOLFOVA M., WOLF J., KRUPOVA Z., MARGETIN M. (2009): Estimation of economic values for traits of dairy sheep: II. Journal of Dairy Science., 92, 2183-2194.
WOLFOVA M., WOLF J., MILERSKI M. (2011): Economic weights of production and functional traits for Merino Landschaf, Romney, Romanov and Sumavska sheep in the Czech Republic. Small Ruminant Research, 99, 25-33.
YAKUBU A., MUHAMMED M.M., MUSA-AZARA I.S. (2014): Application of multivariate logistic regression model to assess factors of importance influencing prevalence of abortion and stillbirth in Nigerian goat breeds. Biotechnology in Animal Husbandry 30 (1), p 79-88.
ZAHMATKESH R., HAFEZIIAN H. (2010): Estimation of economic values of some important characteristics of Gharagol in the Fars. Sari, University of Natural Resources. Animal Production Research, 42-52.

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