Livestock Science ▮ (▮▮▮▮) ▮▮▮–▮▮▮

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Survival analysis of genetic and non-genetic factors influencing ewe longevity and lamb survival of Ethiopian sheep breeds

T. Getachew [a,b], S. Gizaw [c], M. Wurzinger [a], A. Haile [d], B. Rischkowsky [d], A.M. Okeyo [e], J. Sölkner [a,*], G. Mészáros [a]

[a] University of Natural Resources and Life Sciences, Department of Sustainable Agricultural Systems, Division of Livestock Sciences, Gregor Mendel Strasse 33, A-1180 Vienna, Austria
[b] Debre Berhan Agricultural Research Center, P.O. Box 112, Debre Berhan, Ethiopia
[c] International Livestock Research Institute, Addis Ababa, Ethiopia
[d] International Center for Agricultural Research in the Dry Areas, Addis Ababa, Ethiopia
[e] International Livestock Research Institute, Biotechnology Theme, Nairobi, Kenya

ARTICLE INFO

Article history:
Received 4 December 2014
Received in revised form
22 March 2015
Accepted 24 March 2015

Keywords:
Awassi
Menz
Longevity
Survival
Risk ratio
Weibull

ABSTRACT

Survival analysis applying proportional hazards models was used to investigate genetic and non-genetic factors affecting ewe longevity and lamb survival of sheep in Ethiopia. Data were obtained from an on-station closed nucleus breeding program of Menz sheep and an on-farm Awassi × Menz sheep crossbreeding project. A total of 695 ewes and 1890 lambs born from the nucleus population of Menz sheep were used for the analysis of ewe productive life and lamb survival to yearling age respectively. In addition, 5530 lamb records of purebred local and crossbreds with proportions of ~25–50% Awassi, collected from three locations were used for the analysis of lamb survival from birth to weaning age. The effects of year, ewe parity and litter weight at weaning were significant ($p < 0.05$) for ewe productive life. On-station lamb survival to yearling was affected by year and breeding value of yearling weight of the lamb, indicating that faster growing animals had substantially higher survival rates. Animal model heritability estimates for lamb mortality ranged from 0.02 to 0.10. While there was a strong genetic trend for growth rate, as evidenced by estimated breeding values for different birth years, estimated breeding values for lamb survival were variable across years with decreasing trend. These results indicate no antagonism between growth rate and survival under conditions prevailing in the nucleus system. Routine genetic evaluation for survival is suggested. Under farmer conditions, the effects of year, season, sex and location effects were significant ($p < 0.05$) on lamb survival to weaning age whereas breed composition (local versus crossbred) of dam as well as of the lamb were not significant. This seems to indicate that crossbreeding of local animals with Awassi sheep does not have an adverse effect on the survival of lambs under farmer conditions typical for the Ethiopian highland regions included in this study.

* Corresponding author. Tel.: +43 69910442312.
E-mail address: johann.soelkner@boku.ac.at (J. Sölkner).

http://dx.doi.org/10.1016/j.livsci.2015.03.021
1871-1413/

1. Introduction

The Ethiopian sheep population is estimated at 25.5 million animals (CSA, 2012). Corresponding to the diverse agro ecological zones and ethnic communities, the country has a diverse sheep population of about 14 sheep types in four major groups, i.e. sub-alpine short fat-tailed, highland long fat-tailed, lowland fat-rumped/tailed and lowland thin-tailed (Gizaw et al., 2008). The sub-alpine short fat-tailed group consisting of Menz, Tikur, Wollo and Simien sheep types is predominantly found in the central and northern highlands at an altitude of above 2500 m. In this area, sheep are mainly reared for income generation from the sale of lambs at market age although they are also important as source of food, manure and socio cultural benefits (Gizaw, 2008; Getachew et al., 2010).

A closed nucleus breeding program for Menz sheep and an on-farm crossbreeding program using the exotic Awassi sires on the indigenous Menz and Wollo sheep are among the breed improvement programs aimed at improving the productivity of the sub-alpine short-fat-tailed sheep. Increasing the number of lambs available for market is a major concern in sheep production. The number of marketed lambs is influenced by the longevity of the ewe and survival of lambs to market age. Longevity of ewes can be represented as the length of productive life in days from first lambing until culling or death while lamb survival refers the length of time between birth and death. Longevity is important economically as it reduces the cost of rearing of replacement animals. Lamb loss between birth and yearling age is sometimes as high as 20–40% in different sheep farming systems and exerts negative impact on genetic improvement and profitability of sheep production (Mukasa-Mugerwa et al., 2000; Tibbo, 2006; Hatcher et al., 2010; Thomas, 2010). Ewe longevity and lamb survival may be improved through selective breeding and by improving management practices. For appropriate intervention, it is crucial to understand the nature of survival in terms of heritability, genetic correlation with other traits as well as non-genetic factors. Therefore the objectives of this study were to identify factors affecting the on-station ewe productive life both on-station and on-farm lamb survival of indigenous and crossbred sheep and to estimate genetic parameters for the on-station survival of Menz lambs.

2. Material and methods

2.1. Description of breed and study area

2.1.1. On-station ewe productive life and lamb survival to yearling age

Data for the length of ewe productive life and lamb survival to yearling age were obtained from the Menz sheep closed nucleus breeding program carried out at Debre Berhan Agricultural Research Center in Ethiopia (DBARC). The center is located in the central highlands of Ethiopia at latitude of 9°36 N, longitude 39°38 E and altitude of 2780 m. The area characterized by a bi-modal rainfall pattern, receives annual rainfall of about 920 mm with a long rainy season (June to September) and a short rainy season between February and April. The average monthly minimum temperature ranges from 2 °C in November to 8 °C in August, while the average monthly maximum temperature is from 18 °C in Sept to 23 °C in June.

Menz is a sheep breed that is small in body size (the smallest of the 14 Ethiopian breeds described by Gizaw et al., 2007a, 2007b), produces meat and coarse wool, is adapted to the cool Ethiopian highlands, and tolerant to drought, seasonal variation in feed availability, and endo-parasite infection (Haile et al., 2002; Gizaw et al., 2008). The open nucleus breeding program was set up in 1998 with a flock of 300 yearling Menz ewes purchased from Menz area. Details of the breeding program were previously reported (Gizaw et al., 2007a). Sheep mainly depend on natural pasture grazing dominated by *Andropogone,Cynodon, Festuca and pennisetum* grasses, mixed with *Trifolium semense* legume species. Supplementation of about 200 – 300 g day of commercial concentrate feed was practiced for ewes and lambs during the critical dry seasons usually from April to June and at last stage of pregnancy and early lactation periods. The concentrate feed had 21% crude protein and 14 MJ/kg metabolizable energy on dry matter basis.

2.1.2. On-farm lamb survival to weaning age

Lamb survival to weaning age was analyzed from the on-farm Awassi × Local crossbreeding which was started in 1997 by DBARC aiming to evaluate the performance of crossbred sheep under farmer management. The project was carried out in three villages, Serity (loc 1), Negasi-Amba (loc 2), and Chiro (loc 3). Loc 1 and loc 2 are located in North Shewa whereas loc 3 is in the South Wollo administrative zone of the Amhara regional state. The three study areas are located in the highlands with an altitude of about 2800 m (loc 1), 3023 m (loc 2) and 3224 m (loc 3). Indigenous sheep found in loc 1 and loc 2 are Menz sheep breed where as the one of loc 3 is Wollo. Both Menz and Wollo sheep breeds are classified as short fat-tailed breed have similar physical appearances and are reared in sub-alpine and cold highland agro ecological zones of the country (Gizaw et al., 2007b). However, Wollo sheep breed was found to be slightly bigger in body size and weight than Menz sheep breed (Gizaw et al., 2007b). Mixed crop-livestock dominated by sheep-barley is the principal production system in the study areas.

Grazing on natural pasture and crop aftermaths are main feed sources for sheep in all areas. Among grasses *Poa, Festuca, Agrostis* and, to a lesser extent, *Andropogon* and among perennial legumes; the deep-rooted *Trifolium burchellianum* and *Trifolium acaule* are common in the areas (Mengistu, 2006). Supplementation of sheep is rarely practiced by some farmers using available feed sources like crop residues, local brewer by products, weeds, hay and cultivated forage, mainly oat and vetch species. Ethiopian seasons are usually classified into main rainy season from June to August, good pasture after the rainy season from September to November, dry season with short rain from December to February and dry season from March to May. The short rains are unpredictable in time and amount, sometimes fail to come or might delay to April. The breeding scheme was designed to disseminate Awassi × Menz crossbred rams to upgrade the indigenous local sheep breeds through continuous backcrossing. In this crossbreeding scheme, high grade exotic crossbred (75% Awassi – 25% Menz) rams were distributed to farmers. A crossbred ram was disseminated to a group of farmers based

Please cite this article as: Getachew, T., et al., Survival analysis of genetic and non-genetic factors influencing ewe longevity and lamb survival of Ethiopian sheep breeds. Livestock Science (2015), http://dx.doi.org/10.1016/j.livsci.2015.03.021