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I. Introduction

Sheep play an important role in the rural economy of Ethiopia (Kosgey, 2007), but productivity of the breeds in the country is among the poorest in sub-Saharan Africa. Thus, attempts have been made to improve the productivity of local breeds through crossbreeding with imported genotypes (Tibbo, 2006), however, there have been little efforts to select indigenous breeds for improved productivity, including reproduction.

Hence, a community-based breeding program was established for four sheep breeds representing different agro-ecologies and production systems in Ethiopia to improve native breeds through within breed selection. Bonga sheep is one of the sheep breeds which have been considered for community-based production in Ethiopia. The breed has got priority as it was known for its high growth rate and prolificacy. Bonga sheep reared in the areas where mixed crop-livestock production system practiced is characterized by the long fat tail and highly preferred for meat production. The breed is classified as a large size breed and can thrive in places where disease and internal parasites are obstacles to production (Zewdu, 2008). Thus, emphasis was given to explore the genetic potential of the sheep breed concerning mutton production through undertaking performance testing of the breed.

Thus, on-farm recording of traits of economic importance that encompasses reproduction and production attributes has been taking place since 2009. Major attributes measured were body weight (at birth, weaning, and six months), the number of lambs weaned and the number of lambs born, birth date, birth type (single/twin), neonatal deaths and sex. However, the collected data regarding the phenotype of reproductive traits of ewes were not analyzed.

Reproductive performance is a trait of outstanding importance in sheep production enterprises. Reproductive performances of sheep together with survival and growth traits, are determinants of productivity of sheep in meat livestock farming systems (Wilson et al., 1985). Reproductive efficiency in a prime lamb producing ewe flock is a key driver of profitability (Cottle, 2010), and lamb survival is known to be a key component of reproductive efficiency. (Hinch & Brien, 2014).

Reproductive performance is measured by several parameters. The most commonly used ones are the proportion of lambs born (alive and dead) per ewe lambing (also called drop rate and a measure of prolificacy), and age at first lambing. Also lambing percentage (number of lambs born per ewe exposed to the ram); and weaning percentage (percentage of lambs weaned per ewe exposed to the ram) although the latter is more of an economic measure. To measure lamb losses, it is preferable to calculate stillbirth rates and pre-weaning mortality rates as a proportion of lambs born and lambs born alive, respectively. Therefore, the aim of this paper is to point up some reproductive parameters of Bonga sheep under farmer's management.

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II. Materials and Methods

a) Description of the study area

The study was conducted in Adiyo-Kaka district of Kaffa zone, particularly in Boka kebele, where farmers are organized into cooperatives with the objective of improving Bonga sheep breed through participatory selection. The area is placed to the Southwestern part of the country in Kafa zone. Natural forest covers large area of the district, and the area is known by growing bamboo tree (*Yushania alpina*) (Metsafe et al., 2017). The district is situated within a longitude of 36° 47"E and a latitude of 7° 26"N with an altitude ranging from 500 to 3500 meters. The temperature in the area can be as high as 36°C and can also reach the lowest value of 3°C (SUDCA, 2007). The known farming system of the area is mixed crop-livestock production. It has a livestock population of 107657, 30819, 28825, 47176, and 7699 cattle, sheep, goat, chicken, and equines, respectively (report of Agricultural and rural development office of Kafa zone, 2012).

b) Sampling procedure and source of data

We selected the study area purposely due to the existence of a community-based breeding program (CBBP) for Bonga sheep in the area. The source of data for this particular study was secondary data from the record book of enumerators. We used the performance data of 3270 lambs born over five years (2009-2013) to evaluate the reproductive performance of the sheep breed. Data for the study were different reproductive parameters gathered by the purposely recruited enumerators since 2009 G.C.

c) Data management and analysis

Outliers were screened and removed from the data before conducting the main data analysis. Descriptive analysis was employed to determine the overall performance of the sheep breed concerning some traits. These stands for reproductive characters like lambing interval, age at first lambing and lifetime lambing. Other parameters like pre-weaning mortality, twinning rate, litter size, annual reproductive rate, and survivability/mortality rate were computed on a percentage basis using their respective formulas below.

ARR= LS (1-M)/LI ---------- (1)

Where

ARR- Annual Reproductive Rate

LS - Litter size

M- Pre weaning mortality rate

LI - Lambing interval (Ibrahim, 1998)

Litter size= number of lambs born/number of ewes lambing X100% ---------- (2)

Pre-weaning mortality rate = no. of lambs died/total number of lambs born X100% ---------- (3)

Weaning rate = no. of lambs weaned/total number of ewes lambing X100% ---------- (4)

Pre-weaning survival rate = no. of lambs weaned/total no. of lambs born X100% ---------- (5)

III. Result

a) Reproductive performance of Bonga sheep

The Boka-shuta farmers' cooperative recorded a total of 3270 newborn lambs between 2009 and 2013 GC. The reproductive performance of the sheep breed is summarized in Table 1. The results indicated that the number of ram lambs born was higher than the ewe lambs in the study area. The proportion of ram lambs is 53.49% out of 3270 lambs. Accordingly, female to male ratio of the lambs was 1:1.15, which varies from the expected ratio (1:1). The weaning rate, twinning rate, and mortality rate of the sheep breed were 118.8%, 34.9%, and 13%, respectively. In contrast, the litter size/prolificacy (LS) and annual reproductive rate (ARR) of Bonga sheep were 3.7 and 1.9 heads, respectively. Bonga ewes give birth to about 11.4 lambs on average in their lifetime with the average age at first lambing and lambing interval 14.6 (438 days) and 8.5 (255 days) months, respectively.

Table 1: Frequency and descriptive statistics of reproductive traits for Bonga sheep

Parameters	Mean± SE
Lambing interval (LI)**	8.5±1.6
Age at 1st lambing (AFL)**	14.6±2.5
Number of lambs born/ewes lifetime*	11.4±0.1
Pre-weaning mortality rate (%)	13
Weaning rate (%)	118.8
Twinning rate (%)	34.9
Sex ratio (F:M)*	1:1.15
Litter size (LS)*	1.37
Annual reproductive rate*	1.9

**-in heads, **-in months, %-percent, SE-Standard Error*

IV. Discussion

a) Reproductive performance

The lambing interval (LI) obtained in the present study (8.5±1.6) was comparable with the value reported by Fikirte (2008) for sheep in Damot-Gale woreda. However, it is slightly longer than the value reported by Belete (2009) to the same breed (Bonga sheep). The differences observed may be attributed to changes in management of the sheep in the study area. It is highly accredited to the shortage of grazing areas due to increased demand of land for crop cultivation. Solomon (2007), and Fisehatsion (2013) also reported shorter lambing intervals for Gumuz sheep and sheep in Gamogofa zone, respectively. However, longer LI than the current finding was reported by Samuel (2005) for sheep breed in Ada‟‟a woreda.

Both genetic and environmental factors (nutrition, post-weaning growth, and disease and parasite infestation) influence the age at first lambing (AFL); thus, the trait can have wide variation both within a breed and production systems (Getahun, 2008; Girma, 2008). Age at first lambing found in this study was presented in Table 1. The values are in agreement with the values reported by Niftalem (2000) for Menz sheep. However, it was longer than the values reported by Tsedeke (2007), Getahun (2008), Belete (2009), and Fisehatsion (2013). In contrary, it is shorter than reports by Adugna (1998), and Samuel (2005) for sheep raised in Kochere and Ada''a woredas respectively. Following a better nutritional plan for earlier maturity and thus for earlier age at puberty could help to shorten the AFL.

Both genetic and environmental factors influence the LS of various sheep breeds in tropics such as Garole breed from West Bengal in India (Banerjee et al., 2011). Many tropical and temperate breeds (Davies et al., 2002) carry several fecundity genes and they result variation in prolificacy. Embryonic mortality and reabsorption during different stages of pregnancy (due to intrauterine competition of the fetus for nutrients and space) are some of the non-genetic factors influencing the trait (Hammond et al., 1984). The average litter size of Bonga sheep mentioned in Table 1 was within the range (1.08 and 1.75) reported for tropical breeds (Girma (2008). It is also in agreement with previous reports of Solomon (2000) and Zewdu (2008) for Horro and Bonga sheep, respectively. Tsedeke (2007), Zewdu (2008), and Belete (2009) reported higher LS than the present result for Arsi-Bale, Horro, and Bonga sheep breeds kept in village conditions, respectively. However, Armbruster and Peters (1993), Niftalem (2000), Asmamaw and van Arendonk (2006), and Mengistie (2009) reported lower LS than the current finding for Djallonke, Menz, Horro, and Washera sheep breeds, respectively.

The annual reproductive rate (ARR) best estimates the impact of reproduction on sheep and goat productivity. The average ARR of African sheep breeds was 1.2 (Mukasa and Lahlou 1995), while Gaten by (1986) and Wilson (1989) reported the value to be 1.4 for Menz sheep reared in highlands of Ethiopia. The ARR value of 1.9 lambs per head (Table 1) in the current study, is much higher than values reported by the mentioned authors. The observations might be the fallout of lower mortality rate and high level of prolificacy in the breed. The value reported in the present study is also much higher than the ARR of 0.89 for Alaba sheep described by Tsedeke (2007). The current result is within the range of 0.89-1.97 heads reported elsewhere in the tropics (Wilson, 1989). The same author reported 0.82 heads of the traitfor Yatenga sheep in Sub Saharan Africa, which is lower than the present result. The higher ARR indicates that there may be specific genes influencing prolificacy, and fecundity in the breed. Hence, it is important to identify the genetic factors (if any for the high ARR). A study by Davis (2004) identified that the presence of FecB gene in heterozygous form increases the ovulation in Booroola Merino by 1.5, while it improves the ovulation by about 3.0 times if the gene is homozygous.

The average mortality rate found in the present study (13%) was lower than 13.9% reported by Deribe (2010) for Adilo sheep. It is also much lower than the mortality rate (20.9%) reported by Belete (2009) in Southwest Ethiopia. Berhanu (2006) reported the pre-weaning mortality rate of 15% for Menz sheep, which is higher than the present result. Decline of the pre-weaning mortality rate presently might be due to better management. Metsafe (2015) stated that, restriction of lambs to run with their mothers at an earlier stages, better health management, and frequent vaccination all contributed to the lower death of lambs. The low mortality rate observed might also be attributed to the tolerance of the breed to some commonly occurring ovine diseases.

The twinning percentage of Bonga sheep breed obtained in the study was 34.9%, which is lower than those of Horro (39.9%) and Bonga (36.0%) sheep breeds previously reported by Zewdu (2008). Unintentional selection against twin bearers as practiced by the producers might be the reason for the lower twinning rate currently in the area. Table 1 summarizes the female to male ratio of lambs in the study area. It is slightly lower than the female to male ratio (1:0.91) of Adilo sheep (Deribe, 2010). According to the resource allocation theories (Cheryl and Michael, 2004), the higher percentage of ram lambs than ewe lambs indicates better nutrition and care of the ewes, especially during the gestation period.

Long-term reproductive performance (longevity, high fertility, ability to produce more lambs) under harsh environment is one of the adaptation traits of tropical livestock (Kosgey et al., 2007). The average lifetime lamb production found in the study is lower than 13.5

lambs reported by Solomon (2008) for Gumuz sheep. It is also lower than 12.2 and 15.3 lambs per head for Bonga and Horro sheep reported by Zewdu (2008). However, the low number of lambs in ewe's lifetime (10.3 and 7.9) than the current result is described by Dejen (2010) in Kafa and Bench Maji zones, respectively.

V. Conclusion and Recommendation

From the study, it is concluded that the overall performance of the sheep breed was legitimately promising in general. However, traits like AFL and LI were longer and still need to be shortened for reproductive efficiency and the subsequent productivity. Specifically, the higher annual reproductive rate (ARR) obtained in the study is an indication that there may be specific genes influencing prolificacy, and fecundity in the breed and hence it is important to identify the genetic features (if any). Generally, it is suggested that further selection among the flock for desired reproductive traits to achieve higher volume of lamb with superior performance is essential.

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