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(RESEARCH ARTICLE)

Assessment of productive and reproductive performance of disseminated Abera sheep to different districts of Sidama Region, Ethiopia

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Abstract

Small ruminant production such as sheep production is an important activity for smallholders, particularly for resource poor farmers in many parts of the country. The aim of this study is to assess productive and reproductive performance and to identify constraints affecting sheep productivity in selected districts of Sidama region, Ethiopia. Two stage purposive sampling strategies was employed to select study area. In the first stage, four districts such as Bursa, Arbegona, Gorche and Melga were selected based on information indication of place that Abera ram distribution taken place. Then, in the second stage two kebeles from each district were purposively selected to carry out research work. Thirty individuals have been selected and improved Abera ram was selected from each study woreda. Selection of individual was based better experience in animal husbandry and modality in the kebele. A total of 120 individuals were selected for this study based on criteria. Data were collected through semi-structured formal questionnaires and focus group discussions. The mean age at first service for male Abera cross sheep in Arbegona, Bursa, Melga and Gorche districts were 7.23 ± 1.33, 7.43 ± 0.85, 7.0 ± 1.61 and 7.24 ± 1.24, respectively. The mean age at first service for female Abera cross sheep in Arbegona, Bursa, Melga and Gorche districts were 7.5 ± 1.33, 7.63 ± 1.27, 7.2 ± 1.27and 7.5 ± 1.47, respectively. The mean age at first lambing for Abera crossbred ewes were 14.3 ± 2.5, 13.68 ± 2.12, 14.45 ± 2.7 and 14.78 ± 2.55 months for Arbegona, Bursa, Melga and Gorche, respectively. The current mean lambing interval for Abera crossbred ewes were 9.6 ± 1.32, 9.83 ± 1.48, 9.6 ± 1.42 and 9.7 ± 1.36 months for Arbegona, Bursa, Malga and Gorche, respectively. The improvements in reproductive performance of sheep after Abera sheep crossbreeding were observed in all districts when compared to their local counterparts. The Abera rams and its crossbred progeny showed high adaptation to locally available feeds and waters and tolerance to disease and parasite load in the areas. Moreover, crossbreds from the ram were better preferred by the farmers for their overall merit of both adaptation and productivity. Disease prevalence and shortage of feed are the most important sheep production constraints and therefore efforts should be made on improving veterinary service and the feed availability.

Keywords: Productive; Reproductive; Performance; Disseminated; Sidama

1. Introduction

Ethiopia is believed to be one of the major gateways for domestic sheep migration from Asia into Africa [1]. With 42.9 million sheep among this 99.72% indigenous, 0.22% crossbred and 0.06% exotic [2] and there are highly diversified indigenous sheep types (14 traditional populations according to Gizaw et al [3] which are parallel to the diverse agro-ecology, ethnic communities and production systems. These sheep types are highly adaptable to a broad range of environments [4]. They support regular income in both tangible and/or intangible manners to a large human population through the sale of live animals and skins [5] and provide their owners with a vast range of products and services such as immediate cash income, meat, milk, skin, manure [6]. They are also considered as living bank

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against the various environmental calamities (crop failure, drought and flooding) and have socio-cultural values for diverse traditional communities [1].

Central Statistical Agency report indicated that Southern Region is endowed with 4.5 million sheep head that found in different parts of region and different agro ecology as well as land topography [2]. In addition to Bonga sheep breed, there are sheep types that have been under work for breed registration. Among those sheep breed Abera sheep type is one of sheep resource found in southern region. In spite of such a wide range of genetic diversity and vast number of sheep in the country, the average productivity is generally below optimum. Thus, sheep improvement efforts were started as far back as in 1944 in Ethiopia; through crossbreeding indigenous sheep types with sheep breeds imported from various countries. But, most crossbred sheep were neglected by farmers as they did not meet the preference of the farmers [7]. This is mainly because of the inadequate participation of sheep rearers in the implementation of the breeding program. The productivity of sheep in the country is largely constrained by feed shortage, disease, poor infrastructure, lack of market information and technical capacity, besides lack of planned breeding programs and breeding policies [8].

Abera sheep has been under improvement since 2005 E.C under Southern Agricultural Research Institute. Paternal line selection is strategies used for improvement. Over past five years many best ram were being selected and used among famers and cooperatives. In addition to this improved ram has been distributed to different districts of Sidama region. Aleta Wondo, Wonsho, Arbegona, Gorche, Wondo Genet, Dara, Hula, Aroresa are some of districts that Abera ram has been distributed. Performance assessment of distributed ram is most important work that helps for designing future improvement and intervention work. It also helps to identify constraints that are hampering sheep productivity. On the other hand, there has no information on distributed Abera ram on their performance and adaptability. Therefore, this work was initiated to assess reproductive performance, adaptability, their economic importance and to identify constraints affecting sheep productivity as general.

2. Material and methods

The study was conducted in selected districts of Sidama region namely, Arbegona, Bursa, Melga and Gorche where improved Abera ram has been disseminated.

2.1 Introduction of Abera Ram in the Study Areas

The year of introduction and number of Abera ram introduced, year wise, up to study time is presented in table 1. The dissemination of improved Abera ram was started in 2018 onward. The improved Abera ram were introduced over the years in order to improve both productive and reproductive performance of local sheep type through crossbreeding with Abera sheep. The Abera rams were purchased from Abera sheep community based breeding cooperative, which is under Hawassa Agricultural Research Center, by either government agencies or NGOs.

Table 1 Number of disseminated Abera rams in the study areas

Location	Year of Abera ram introduction			
	2017	2018	2019	Total
Arbegona	6	8	6	20
Bursa	8	7	8	23
Melga	7	10	5	22
Gorche	8	8	9	25
Total	29	33	28	90

Source: Districts Livestock and Fishery Development Office

2.2 Sampling procedure

Two stage purposive sampling strategies was employed to selected study area. In the first stage, four districts such as Bursa, Arbegona, Gorche and Melga was selected based on information indication of place that Abera ram distribution taken place. Then, in the second stage two kebele from each districts was purposively selected to carry out actually research work. Thirty individuals have been received and using improved Abera ram was selected from each study woreda. Selection of individual was based better experience in animal husbandry and modality in the kebele. Hence,

120 individuals was selected for this particular research work based on criteria. Information for farmer's selection was obtained from woreda bureau of Livestock and Fishery. Group discussions and key informant interviews were the source of data. Individual interview (questionnaire) was also be used to generate socio-economic information and management practices. The data to be collected include reproductive data include, age at first lambing, lambing interval, age of sexual maturity etc.

2.3 Data management and analysis

The collected survey data was analyzed using Statistical Procedure for Social Sciences (SPSS, version 20.).

3. Results and discussion

3.1 General characteristics of households

Table 2 shows the demographic and socioeconomic characteristics of the selected respondents considered for the survey study. The total (overall) proportion of male and female respondents in all districts was 68.3% and 21.7%, respectively. This shows that males participate more in the field work with their livestock and play a dominant role in livestock production practices compared to females who spend most of their time at home. This contradicts with Agedie Yesma [9], where females cover half of the total respondents in the north Shewa zone on poultry production. It may be related to the type of livestock species. The current study revealed that most of the sheep keepers (40%) were able to read and write, followed by the respondents who had no formal education and had attended primary school. The overall average age group showed that a major proportion (46.7%) of respondent households were 41–50 years of age, followed by 31–40 years of age (25%) and (c) > 50 years of age (21.6%) in the current study. The current result of the age of the respondents aged between 41 and 50 years was within the range and in line with the 46 years reported for the Debre Berhan areas [10]. The proportion of respondents aged between 41-50 years in the study area may have good experience in sheep production.

Table 2 General characteristics of respondents of the districts

Household Characteristics		N	%
Sex	Male	82	68.3
	Female	38	21.7
Education level	Illiterate	31	25.8
	Read and Write	48	40
	Primary (Grade 1-8)	29	24.2
	Secondary (Grade 9-12)	12	10
Age group (years)	<30	8	6.7
	30-40	30	25
	41-50	56	46.7
	>50	26	21.6
Marital Status	Married	118	98.3
	Single	2	1.7

N = number of respondents

3.2 Family and Land Holding Sizes

The landholding and average family size per HHs in the study area are presented in Table 3. The average family size of respondents in the study area was 4.98, which is closer to the value reported by Melaku Tareke [11] than the overall mean family size of 5.4 and 5.41 in the Northwest Amhara Region in Wogdi and Borena districts of the South Wollo zones, respectively. This figure is also similar to the national average of 5.14 reported by CSA [12]. However, a slightly lower family size than Fisseha Moges *et al*. [13], who reported that Bure and Dale districts had 6.2 and 6.9 people per HH, respectively. The total average landholding size per HHs in the area was 2.34 ha, which is higher than the 1.5 ha

reported by Deribe Gemiyu [14] in Alaba, Southern Ethiopia but similar to the 2.3 ha reported by Agedie Yisma [9] in Kowet district, North Shewa zone. The average landholding size for grazing land was 0.54 ha. The average grazing landholding size in the study area (0.54 ha) is similar to the 0.52 ha reported by Mekete Bekele [10] in the central highlands of Ethiopia. This indicated that farmers plough some of the grazing land for cropping purposes. It may be due to food insecurity.

Table 3 Average family and landholding sizes of household in the study area

Location	Total family size Mean ± SD	Total land holdings (ha) Mean ± SD	Grazing land (ha) Mean ± SD
Arbegona	5.3 ± 1.73[a]	2.2±1.9[b]	0.8 ± 0.13[a]
Bursa	4.7 ± 1.18[b]	2.53 ±1.4[a]	0.53 ± 0.16[b]
Melga	5 ± 1.8[a]	2.07±1.5[b]	0.35 ± 0.12[c]
Gorche	4.9 ±1.18[a]	2.58±1.9[a]	0.48 ± 0.13[bc]
Overall	4.98 ± 1.51[a]	2.34 ± 1.8[ab]	0.54 ± 0.15[b]

3.3 Sheep flock size and structures

Table 4 Average flock size and structures per household in the study area

Sheep type	Arbegona Mean ± SD	Bursa Mean ± SD	Melga Mean ± SD	Gorche Mean ± SD	Overall Mean ± SD
Ewe	5.67 ± 1.76	5.9 ± 1.21	5.2 ± 1.24	4.9 ± 1.90	5.41 ± 1.59
Ram	1.5 ± 0.62	1.0 ± 0.9	0.9 ± 0.14	1.3 ± 0.31	4.7 ± 1.98
Ram lamb	1.8 ± 0.80	1.96 ± 0.66	1.66 ± 0.75	2.67 ± 0.6	2.02 ± 0.71
Ewe lamb	2.1 ± 0.73	3.87 ± 0.73	3.2 ± 0.75	2.86 ± 0.81	3.0 ± 0.76
Lamb	2.9 ± 0.96	2.83 ± 0.87	2.76 ± 1.04	2.53 ± 0.93	2.77 ± 0.95

SD = standard deviation

Flock composition is an indicator of the production objectives and breeding practices of the smallholders (Solomon G et al [15]. In the present study, the overall mean number of ewes was 5.67 ± 1.59, 5.9 ± 1.21, 5.2 ± 1.24 and 4.9 ± 1.90 were found in the Arbegona, Bursa, Melga and Gorche districts, respectively. The overall average number of ewes was 5.41. The current result is in line with the 5.45 reported for the East Gojam zone [16]. The higher proportion of breeding ewes in the sheep flock, followed by the suckling age (lambs) group, is consistent with the findings of other Ethiopian researchers (4, 17].

3.4 Purpose of keeping sheep

Table 5 Purpose of keeping sheep in the study area

Purpose of keeping sheep	Frequency	Percent
Income generation	70	58.3
Meat	15	12.5
Savings	6	5.0
Income, Meat and Saving	29	24.2
Total	120	100.0

The reasons for keeping sheep in the study area are shown in Table 5. The major proportion (58.3%) of respondents keep sheep for the purpose of income generation through the sale of live animals, and the cash obtained might be used to buy fertilizer, clothing, and food items; pay taxes; as well as cover school costs for their children. As reported by the respondents in the study area, sheep were primarily kept for income generation, followed by meat and saving. This is in agreement with the results of Zewedu Wuletaw [18], who reported income generation was the primary purpose of sheep production in Horro. The reasons for keeping sheep were rational and correlated with the farmer's needs in the long or short term.

3.5 Feeds and feeding systems

Feed resources commonly used by farmers in the study area across the different seasons are presented in Table 6. The major feed resources for sheep during the wet season were natural pasture from grazing land followed by crop residues across four districts. The findings of the current study (wet season feed availability) in the study area were similar to those of Tesfaye [19], Grum [20], and Amelmal [21], who reported for Metema district of the Amhara region, around Dire Dawa, Dawuro Zone, and Konta Special Woreda of SNNPR, respectively. However, the major feed resources during the dry season across the two agro ecologies were crop residues followed by natural pasture. Enset leaf and stem, and bamboo leaf are also important feed resources used to complement feed supply, particularly during the dry season when the availability of forage is low. Crop residues include barely, wheat, bean, and pea straws in Arbegona and Gorche districts, and maize, wheat, and haricot bean in Bursa and Melga districts. The difference in the availability of crop residues between the districts is due to the difference in agro-climatic requirements of the different crops. Similarly, Addis [22] carried out a review of feed resources for sheep in Ethiopia, and his findings were also comparable with the present report. The details of grazing land are as under:

3.6 Type of grazing land and grazing system

Table 6 Grazing land of respondents

Parameters		Bursa N	Arbegona N	Melga N	Gorche N	Overall (%)
Grazing land	Private	20	22	25	20	72.5
	Communal	4	4	3	4	12.5
	Both	6	4	2	6	15
Grazing system	Free grazing	9	7	6	8	25
	Tethered grazing	5	6	10	4	20.8
	Both	16	17	14	18	54.2
Total		30	30	30	30	100

N = number of respondents

The result of the type of grazing land is presented in Table 6. Almost all respondents interviewed in the study area had similar feeding and management systems. The majority (72.5%) of respondents in all study sites use private grazing land for sheep. Moreover, 12.5% and 15% of respondents use communal and both communal and private grazing land for their sheep, respectively. The grazing system used by respondents in four districts for their sheep, Abera rams, and crossbreds revealed that 54.2, 25.8, and 20.8 percent of farmers, respectively, practice mixed tethered grazing and free grazing, free grazing alone, and tethered grazing. During the present study, it was observed that farmers tether their sheep on the road and between the borders, and they consider this as supplementary grazing land (both communal and private) in the districts. The studies of Edea [23] and Metsafe [24] in the Bonga area also showed that the majority of farmers were using private grazing land for the grazing of sheep in the Adiyo kaka area. They also reported that the area used for communal grazing is shrinking due to its use for cultivation for crops.

3.7 Selection of Ewes for crossing with Abera Rams

The result of the selection of local ewes for crossing with Abera rams in the four study districts is presented in figure 1. The farmers in the study were also asked whether they practiced selection of their ewes for breeding or mating with Abera rams. However, the majority (62.7%) of the respondent farmers practice selection of ewes for crossing with Abera ram, while 37.3% of the farmers do not practice the selection of ewes in four districts. Farmers select breeding ewes with large body size and good body condition. This finding is in agreement with the report of Haile et al [25] wherein

large body size was used as selection criteria for Afar, Menz, Bonga, and Horro ewes in Ethiopia. The possible reason for the large body size of the ewe as a selection criteria may be attributed to the assumption of farmers that lambs born from good body condition and large body-sized ewes have higher body weight.

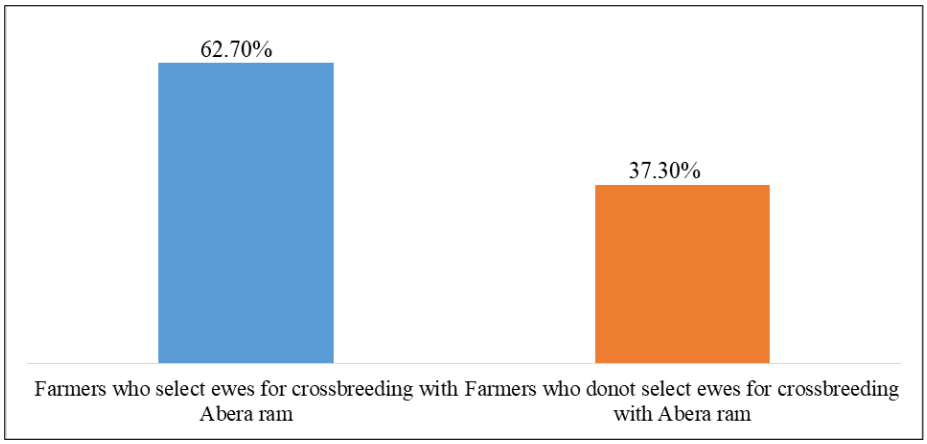

Figure 1 Selection of Ewes for Cross Breeding with Abera ram

3.8 Abera ram using trends

The Abera rams were introduced in these areas by the AGP-II program for sheep improvement from 2-3 years ago up to the time of this study. This introduction of Abera rams facilitated the availability of breeding rams in the study areas. The FGD revealed different patterns of use of Abera rams in the study areas. The responding farmers do not own Abera rams due to the low number of rams distributed in the area. The farmers obtained the Abera breeding rams from FTC and/or other community members. None of the farmers in the Arbegona and Melga districts had their own Abera rams; instead, they used Abera rams from FTC or "Limat Budin" (local sub-group). Bursa and Gorche districts, the Abera rams were first maintained by model farmers, and then other farmers used these rams for mating. The model farmer continues to maintain the Abera ram and can dispose of it at the prescribed age. These rams were used by community members for mating in their flocks free of charge. Haile et al [26] reported that, the community decides how rams are managed and how they are shared in the community-based breeding sites. However, the lack of ram mating pedigree records might make it difficult to manage inbreeding problems in the study areas.

3.9 Culling of local rams after introduction of Abera rams

The result of culling practices is presented in the table below. The overall results showed that 87.5 and 12.5 percent of respondents culled local rams through sale and castration, respectively. The district-wise results showed that farmers in Arbegona, Bursa, Melga, and Gorche districts (80, 86.7, 90, and 93.3%), respectively, culled local rams by sale. Similar trends were reported by Haile et al [26] and Metsafe [24], who reported that farmers culled inferior breeding rams.

Table 7 Culling practices of local ram after introduction of Abera ram

Location										
Culling practice	**Arbegona**		**Bursa**		**Melga**		**Gorche**		**Overall**	
	N	%	N	%	N	%	N	%	N	%
Castration	6	20	4	13.3	3	10	2	6.7	15	12.5
By sale	24	80	26	86.7	27	90	28	93.3	105	87.5

N = number of respondent farmers possessing local breeding rams at the time of introduction of Abera rams.

3.10 Mating systems

During FGD in all sites, it was revealed that before the introduction of Abera ram in their flocks, the famers were using breeding rams randomly (from rams existing in their own flocks) or from neighboring flocks (from a ram sold at the market). The results of the mating systems followed by the respondent farmers before the introduction of Abera rams are presented in the table. Broadly, the mating system followed was either controlled (selected rams were used for

mating by the farmers) or uncontrolled (rams used for mating were not selected but depended (on the rams available at mating time). The results (overall) showed 22.5 and 77.5 percent of Abera ram user respondents were exercising controlled and uncontrolled mating, respectively, before introduction of Abera rams in their area.

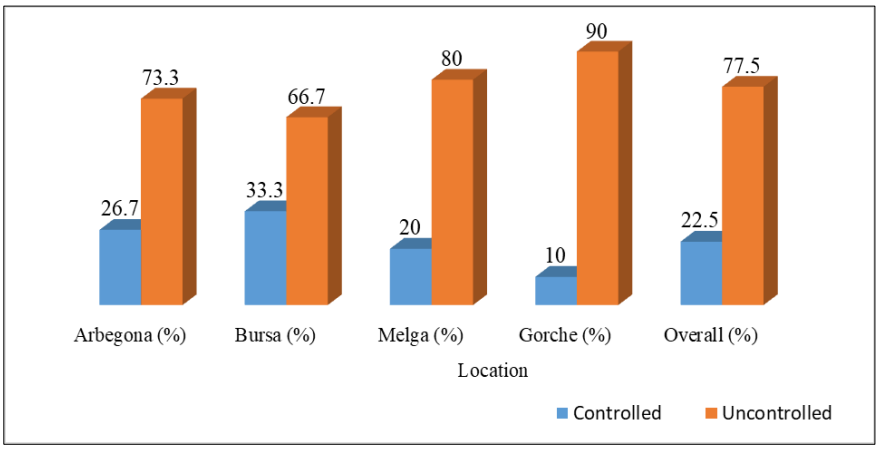

Figure 2 Mating system of sheep in the study area

3.11 Reproductive performance of Abera crossbred and local lambs

The results of reproductive performance of sheep, based on interviews of Abera ram user respondents are presented in table below.

Table 8 Comparison of reproductive performance of local sheep breed and Abera ram crossbreed

		Parameters			
Location	**Breed**	**Age at first service for males (months) Mean ± SD**	**Age at first service for females (months) Mean ± SD**	**Age at first lambing (months) Mean ± SD**	**Lambing interval (months) Mean ± SD**
Arbegona	Local	8.2 ± 1.18	8.73 ± 1.36	14.93 ± 1.98	10.43 ± 1.25
	Abera cross	7.23 ± 1.33	7.5 ± 1.33	14.32 ± 2.5	9.6 ± 1.32
Bursa	Local	8.03 ± 0.85	9.6 ± 1.37	14.66 ± 1.44	10.73 ± 1.25
	Abera cross	7.43 ± 0.85	7.63 ± 1.27	13.68 ± 2.12	9.83 ± 1.48
Melga	Local	7.73 ± 1.22	8.26 ± 1.33	15.26 ± 1.94	10.30 ± 1.18
	Abera cross	7.0 ± 1.61	7.2 ± 1.27	14.45 ± 2.7	9.6 ± 1.42
Gorche	Local	7.5 ± 1.13	8.7 ± 1.11	15.37 ± 1.98	10.36 ± 1.27
	Abera cross	7.03 ± 0.99	7.5 ± 1.47	14.78 ± 2.55	9.7 ± 1.36
Overall	Local	7.86 ± 1.12	8.84 ± 1.38	15.05 ± 1.26	10.45 ± 1.22
	Abera cross	7.24 ± 1.24	7.39 ± 1.33	14.31 ± 1.57	9.7 ± 1.38

3.12 Age at first service (AFS)

The mean age at first service for local male sheep in Arbegona, Bursa, Melga and Golche districts was 8.2 ± 1.18, 8.03 ± 0.85, 7.73 ± 1.22 and 7.86 ± 1.12 months, respectively. The mean age at first service for male Abera cross sheep in Arbegona, Bursa, Melga and Golche districts was 7.23 ± 1.33, 7.43 ± 0.85, 7.0 ± 1.61 and 7.24 ± 1.24, respectively. The mean age at first service for local female sheep in Arbegona, Bursa, Melga and Golche districts was 8.73 ± 1.36, 9.6 ± 1.37, 8.26 ± 1.33 and 8.7 ± 1.11 months, respectively. The mean age at first service for female Abera cross sheep in Arbegona, Bursa, Melga and Golche districts was 7.5 ± 1.33, 7.63 ± 1.27, 7.2 ± 1.27and 7.5 ± 1.47, respectively. The survey results showed that the average age at sexual maturity of male sheep was earlier than that of their female counterparts. Most of the findings revealed that the age at first mating for both sexes is not fixed and sheep are left to nature to reproduce.

Different scholars agree that, genetic as well as environmental factors, and the interaction between these, clearly affect sexual development, i.e. earlier attainment of puberty. Besides, Younis et al. [25] reported that, body weight has more influence on puberty than age. Farmers also reported that the age at first service in single-born male lambs was lower than in multiple birth lambs. This may be attributed to the higher body weight of single birth lambs. The location difference may be attributed to the management practices of farmers in the respective areas. In general, respondent farmers reported that, after the introduction of Abera rams in the area, the age at first service for both sexes was reduced.

3.13 Age at first lambing

Age at first lambing is positively correlated with AFS (puberty). The mean age at first lambing for Abera crossbred ewes was 14.3 ± 2.5, 13.68 ± 2.12, 14.45 ± 2.7 and 14.78 ± 2.55 months for Arbegona, Bursa, Melga and Gorche, respectively. The mean age at first lambing for local ewes was 14.93 ± 1.98, 14.66 ± 1.44, 15.26 ± 1.94 and 15.37 ± 1.98 months for Arbegona, Bursa, Malga and Gorche, respectively. The current overall results of age at first lambing of Abera cross and local sheep breeds are 15.05 ± 1.26 and 14.31 ± 1.57, respectively. The current survey result is in agreement with the report of Getahun [26] for Adilo sheep (14.6 months) and 470.10 days for Menz sheep [19]. The result is higher than 12.43 months [14], Zewdu [18], Solomon [27], and 12.88 months of Dawuro sheep [21]. This is due to the wide difference in age at first lambing in African sheep, mainly due to differences in genotype and management practices [27].

3.14 Lambing Interval

The shorter lambing interval gives a better opportunity to increase the lifetime productivity of ewes by increasing the number of lambs per crop. The current mean lambing interval for Abera crossbred ewes was 9.6 ± 1.32, 9.83 ± 1.48, 9.6 ± 1.42 and 9.7 ± 1.36 months for Arbegona, Bursa, Malga and Gorche, respectively. The current mean lambing interval for local ewes was 10.43 ± 1.25, 10.73 ± 1.25, 10.30 ± 1.18 and 10.36 ± 1.27 months for Arbegona, Bursa, Melga and Gorche, respectively. The result shows that crossbreds have a shorter lambing interval, indicating three lambs in two years could be harvested in an efficient way. However, shorter lambing intervals for Abera crosses were reported by Abera ram user farmers in all districts. The overall lambing interval of local and Abera cross ewes found in this study was 10.45 ± 1.22 and 9.7 ± 1.38 months. The result was comparable with Getachew [28], Edea [23], Metsafe [24], and Marufa et al [29] for Menz, Bonga, and Abera sheep, respectively.

3.15 Opportunities and Constraints of Sheep Production in the Study areas

3.15.1 Possible opportunity to expand sheep production

The availability of high market demand and easy to manage was reported as an opportunity for sheep production as a shortage of land coupled with population pressure is forcing farmers to shift from large ruminant to small ruminant production. The growing demand for meat from small ruminants, the improving transportation infrastructure, and the experience of farmers in small ruminant keeping are providing opportunities to enhance the contribution of the sector (Legesse et al. 2008).

3.15.2 Constraints of sheep production in study areas

The constraints related to sheep production are presented as pairwise ranked in Table 12. Diseases, feed shortages, improved ram shortages, and technical support shortages were ranked as the first, second, third, and fourth constraints in all study districts, according to the FGD results. According to Ermias (2014), the marketing was reported as a major problem for Dorper crosses in the Wolayta zone, but no such response was reported in the present study. Besides, he

also reported that feed shortage was a major constraint in Silte zone and this observation was in agreement with the present study.

Table 9 Pairwise ranking of constraints of sheep production in study areas

Constraints	D	FS	IRS	LTS	Score	Rank
Diseases (D)	---	D, FS	D	D	3	1
Feed shortage (FS)		----	FS	LTS	2	2
Shortage of improved ram (IRS)			----	IRS	1	3
Lack of technical support (LTS)				---	1	4

4. Conclusion

The improved Abera rams were distributed from Abera sheep community-based breeding communities for genetic improvement in different districts of the Sidama region. Promising results were seen in productive performances, feed and disease adaptability of Abera rams and their progenies in all study sites. The improvements in the productive performance of local sheep after Abera sheep crossbreeding were observed in all districts. The survey results showed that age at first service for males and females, age at first lambing and lambing interval for Abera crosses were improved. Abera ram and its F1 have been preferred by the farmers for their ability to resist disease and parasites, their easy adaptability, fast growth, and attractive coat color. Moreover, crossbred F1 from the ram was preferred by the farmers for its overall merit of both adaptation and productivity. Disease prevalence and shortage of feed are the most important sheep production constraints, and therefore efforts should be made to improve veterinary service and feed availability.

Recommendations

Based on the above views, the following recommendations were forwarded;

- To sustain current cross breeding efforts in the study areas and increase the net income of farmers, complementary interventions (improved forages, periodic vaccinating/deworming, and other management aspects) should be incorporated into the program;
- Farmers must be trained in breeding management (inbreeding, the benefits and drawbacks of crossbreeding, cross lamb breeding lines, and culling) as well as other aspects of improved feeding management on a long-term basis.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

None of the authors have any conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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