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Research Article

Reproductive and Productive Performances of Small Ruminants in East Arsi Zone, Oromia Regional State, Ethiopia

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Abstract

The purpose of the study was to examine the reproductive and productive performances of small ruminants in the study area at Dodota Woreda in Ethiopia's Arsi Zone. The results are based on focus group discussion and a survey of 180 sample houses. Based on flock distribution, the Woreda was divided into three groups: mixed flock sites, goat dominating sites, and sheep dominating sites. In the research area, households typically kept 4.15 cattle, 6.91 sheep, 7.61 goats, 1.88 equines, and 5.85 chickens as livestock. From August to December and March to May, there was a lot of intensive lambing and kidding, with November and December appearing to be the peak months. The average litter size, age at first parturition, parturition interval and age of male at first service (months) for sheep had 1.21±0.03, 12.67±0.20, 7.55±0.15, and 6.91±0.14 respectively. For goats, the analogous values were respectively 1.52±0.04, 12.89±0.23, 7.70±0.17, and 7.55±0.21. Sheep were typically slaughtered or sold on average age of 7.43±0.23 months for males and 7.63±0.24 months for females, respectively. Goat comparable values were 8.09±0.25 and 8.30±0.26, respectively. In this study the reproductive and productive performances of small ruminants are extremely low due to different reasons. Credentials of alternative feed sources and strategic feeding management, water development, credentials of disease causes and their control strategies through appropriate policy, and information dissemination are areas of interference that can help farmers build up their flocks and increase productivity.

Keywords

Arsi, Oromia, Productive, Reproductive, Small Ruminants

1. Introduction

Livestock are an integral part of agriculture that contribute to 35 to 49% of the agricultural GDP, 37 to 87% of the household incomes, and 15 to 17% of the foreign exchange earnings of the country [12]. Livestock are playing a vital role in generating income to farmers, creating job opportunities, ensuring food security, providing different services, contributing to the asset, social, cultural, and environmental values, and sustaining livelihood strategies of peoples [4].

There are 42.9 million heads of sheep and 52.5 million heads of goats' population in Ethiopia [10]. They are important components of the livestock subsector and are sources of cash income, milk, meat, wool, manure, and saving or risk mitigation during crop failures, property security,

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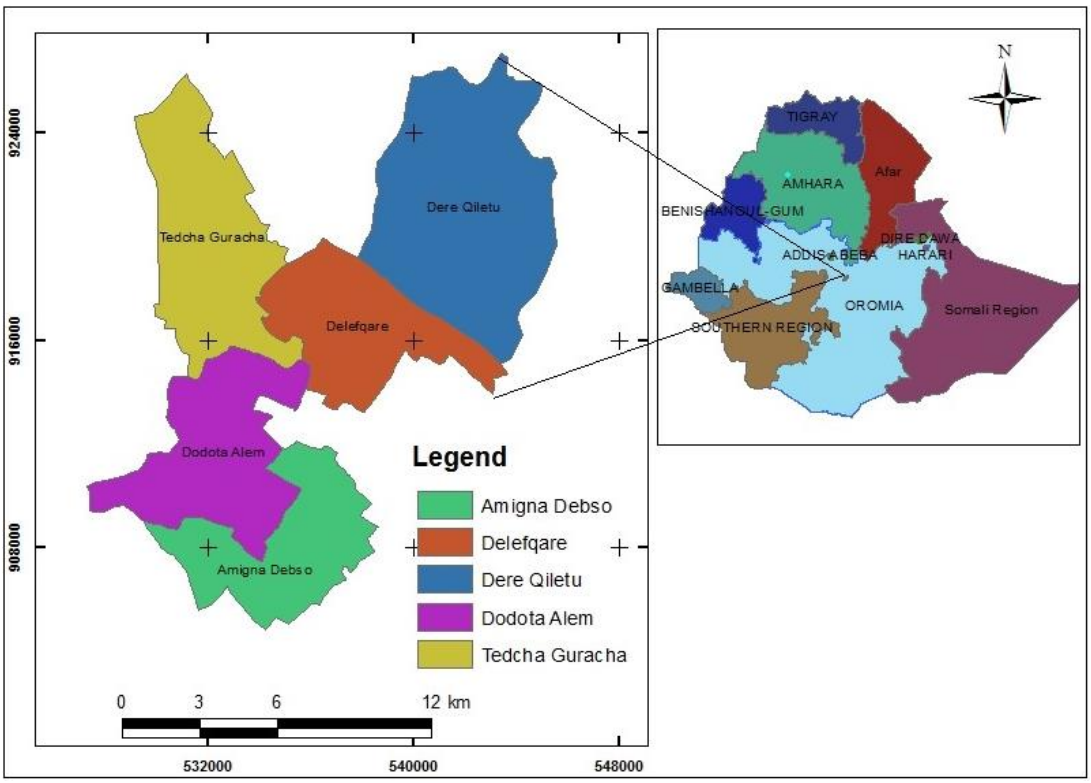
monetary saving and investment in addition to many other socioeconomic and cultural functions [29, 18, 3, 20, 27]. Farmers and pastoralists in Ethiopia depend on small ruminants for much of their livelihood, often to a greater extent than cattle, because small ruminants are generally owned by the poorer sectors of the community as reviewed by Gizaw *et al.* [17].

Despite their large number, the reproductive, as well as productive traits of small ruminant in Ethiopia, are affected by several factors including breed, a season of conception, interval between parturitions, age, sex and health and nutritional status of the individual animal [28, 14, 23, 31]. Additionally, lack of genetic improvement, shortage of water, high prevalence of diseases, parasites, lack of market access and information [1, 2, 13]. Currently, a large number of small ruminant, populations are present in the study area. However, information on reproductive and productive performances of small ruminant in the study area is not documented. In this regard, there exists a paucity of research output. Therefore, the study was conducted to investigate the reproductive and productive performances of small ruminants in the study area.

2. Material and Methods

2.1. Description of the Study Area

Dodota is one of the *Woreda* in Arsi Zone that is located in the Great Rift Valley. It is located 125 km south east of Addis Ababa, 25 km from Adama, and 50 km from the Zonal capital of Asella town. The *Woreda* has a total area of 512 km^2 and is located between 8 °11'- 8 °26' north latitude and 39 °2' - 39 °29' East longitude. The altitude of this *Woreda* ranges from 1343 to 2271 m. a. s. l. The lowest place is found in the Awash Bishola area (1343m) while the highest place is located in Amigna Dabaso, 2271m. There are two major permanent rivers in the *Woreda*. These are the Awash River and Keleta River. According to the CSA [9] a total population of the *Woreda* is 64,310 of whom 32,378 were men and 31,932 were women. The climate of Dodota *woreda* is mainly controlled by the seasonal migration of the Inter-Tropical Convergence Zone (ITCZ), which follows the position of the sun relative to the earth and the associated atmospheric circulation. Regarding the vegetation cover, various species of acacia trees, bushes, woodlands, forests, and shrubs are the major vegetation types in the area. The major types of soil that are found in the study area are Chromic Luvisols, Mollic Andosols, and Vitric Andosols. Also, Dystric Nitosols, Eutric Fluvisols, and Orthic Acrisols are found in pocket areas of the *Woreda* FAO [15].



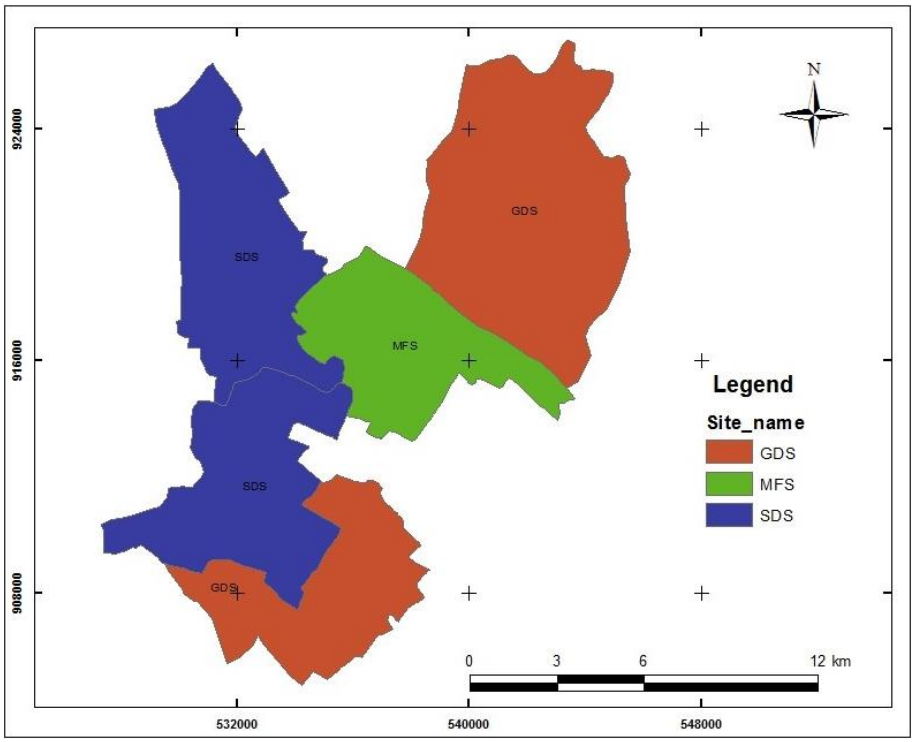


Figure 1. *Map of the five study kebeles in the Dodota Woreda.*

2.2. Sampling and Sample Size Determination

A stratified sampling method was employed in the study area for the selection of *Kebeles (*the smallest administrative unit in Ethiopia*)* by which they can symbolize the density of small ruminants' allocations. Therefore, based on the flock allocations, the study areas were stratified into the sheep dominant site (SDS), goat dominant (GDS), and sheep-goat mixed flock sites (MFS). The sampling of households was done by setting criteria; minimum flock size of the sites (two animals for SDS, three animals for MFS and three animals for GDS), having at least one year practice in small ruminants farming and readiness to partake in the study *kebeles.*

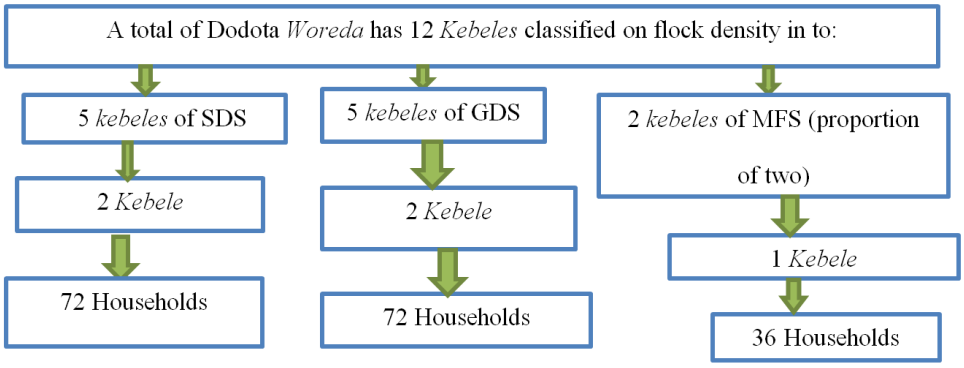


Figure 2. *Stratification and acting of study kebeles and households.*

The sample size was determined according to the formula recommended by Arsham [7] as follows: $N=0.25/SE^2$ Where, N=required sample size, SE=Standard Error (5%), and 95% confidence level. Therefore, a total of 100 respondents were included; however, to increase the precision of the study sample size was increased by 1.8 folds and a total of 180 households from *Woreda* were proportionally selected from five Kebeles. The selected Kebeles were based on the potentiality of the goat, sheep, and mix of two productions and access to roads using secondary information obtained from *Woreda* livestock and fishery office. Accordingly, Direkiltu and Amigna Debeso from GDS, Dodota Alem, and Tedacha Guracha from SDS, and Dilfaker from MFS *kebeles* were selected in the study area are shown in (Figure 1) above.

Those 36 households from each kebeles (a total of 180 households) were randomly selected to partake in the diagnostic survey (Figure 2) above.

2.3. Data Collection

Both primary and secondary data were used. Primary data were collected through personal interviews using a well-defined- structured questionnaire. Secondary data were collected from published theses, journals, books, unpublished theses, Statistical reports and livestock and fishery office. Moreover, the *Woreda* was visited for better understanding of agriculture in broad and small ruminant production in specific. Development agents (DAs) and supervisors who were working in the *Woreda* and who speak the local language were trained to collect the data with the researcher. Focus group discussions (FGD) were held with 7-12 persons guided by trained leaders for 1-2 hours and key informants was also used in the study *kebeles*. Both are used to gain detailed information about the topics covered during the structured interview and to check whether the patterns found in the households were endorsed.

2.4. Data Analysis

The collected data were organized, summarized, and analyzed using SPSS statistical package (SPSS, 2017 Version 25.0). For data involving frequencies and descriptive statistics were employed. Quantitative variables such as livestock holding, age at first parturition, marketing age, lambing/kidding interval, litter size and age of male at first service were analyzed by using analysis of variance procedure and Tukey test was used to separate group means when the F test declared significant differences.

3. Results and Discussion

3.1. Livestock Holding

The average livestock holding of the households across the three studied area was shown in (Table 1). There was no significant difference in three small ruminant density groups of holdings of all species of animals, except cattle at $p<0.05$. In Dodota Woreda a household on average held 4.15 cattle; 6.91 sheep; 7.61 goat; 1.88 equines; and 5.85 chickens from a total land area of 512 km^2. According to the key informants and the group discussions, the trend in holding small ruminants is inclined to goat production than sheep production. This might be due to the ability of goat to resist drought and exist in harsh climatic conditions as compared to sheep. In addition, their dependence on trees and shrubs for as feed sources made them preferable than sheep. The current finding of the average small ruminants holding per household was greater than 0.53 and 0.45, respectively, which was reported by Neme [25] in the Ada Barga and Ejere districts of West Shoa Zone. On the contrary, the current study was lower than Nigussie *et al.* [26] who reported 58.6 and 22.5 per household in eastern Ethiopia and Abraham *et al.* [3] who reported 42.90 and 43.67 per household in western Tigray.

Table 1. *Mean (standard error) number of livestock holding/household in the areas categorized according to small ruminant density.*

Variables	Small Ruminant Density Groups				Test
	MFS	SDS	GDS	Overall	*P*-Value
Cattle	5.41 ±0.56[a]	3.59 ±0.29 [b]	3.97 ±0.30 [b]	4.15 ±0.21	0.004
Sheep	5.76±0.56	8.00 ±1.46	7.68±0.95	6.91±0.53	0.154
Goats	5.67±0.76	7.52±1.51	9.02±1.03	7.61±0.66	0.119
Equines	1.81±0.20	1.91±0.14	1.90±0.24	1.88±0.12	0.939
Chicken	6.03±0.64	5.14±0.63	6.61±0.82	5.85±0.42	0.309

[a, b]: Different Superscripts Denote Significant Differences At P<0.05 Between Means Within Rows, SE= Standard Error, MFS=Mixed Flock Site; SDS=Sheep Dominate Site; GDS=Goats Dominate Site

3.2. Reproductive and Productive Performances of Small Ruminants

3.2.1. The Lambing and Kidding Months

The lambing and kidding seasons of small ruminants in the study area are shown in (Figure 3). There was an increase in kidding/lambing starting from August to December and March to May while, the decrease was observed starting from May to August and December to March. It was also perceived that the months of parturition followed similar trends for both species. This indicated that the majority of

ewes/does give birth during the small rainy season due to feed availability in the study area during rain seasons.

The current finding for the lambing/kidding season was in agreement with Urgessa *et al.* [30] in the Ilu Abba Bora Zone. Alefe [5] in the Shabelle zone also reported that the highest, births occurred during the rainy season and the lowest birth occurred during the long dry season. Unlike the current finding, there is an increase in kidding/lambing starting from December to February while a decrease was perceived starting from March to May months and parturition follows similar trends for both species was reported by Fikru and Gebeyew [16] in the Degehabur Zone.

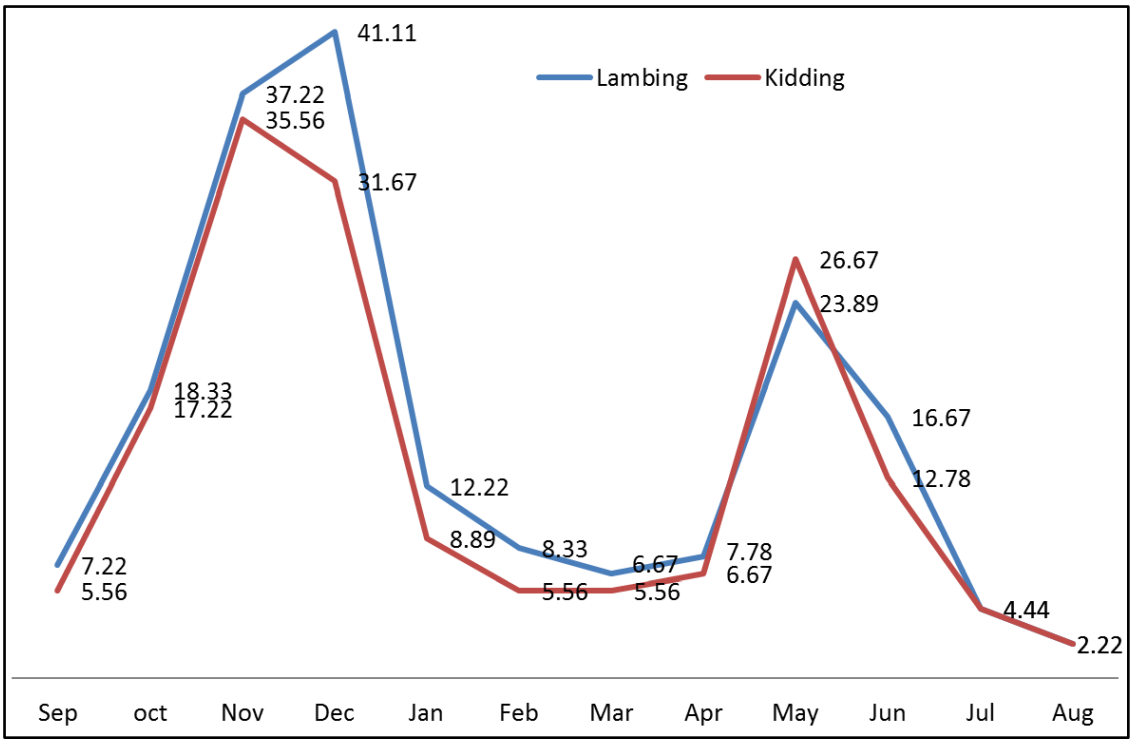


Figure 3. *Kidding and lambing months.*

3.2.2. Age at First Lambing and Kidding

The average reproductive performance of small ruminants in the study area is presented in (Table 2) below. The average age at first lambing and age at first kidding was found to be 12.7 and 12.9 months, respectively. There was no significant difference in age at first lambing and kidding among the three small ruminant density groups at $p>0.05$. The age at first lambing and age at first kidding might be influenced by breed type, feed availability, and habitation. The current finding was an agreement with the report of Alilo *et al.* [6] in the Esera district who reported age at first lambing and age at first kidding were 12.3 and 12.8 months, respectively. On the contrary, the current study AFL was lower than the finding of Hussein [21] who reported 13.6 months in Southern Ethiopia and Hagos *et al.* [19] who reported 14.86 months in the central zone of Tigray. The current study AFL and AFK were lower than the finding of Hussen *et al.* [22] who reported 29.52 and 24.6 months, respectively, in the Jimma Zone and Lakew *et al.* [24] who reported AFL was 13.5 months in the Wolayita Zone.

3.2.3. Lambing and Kidding Interval (LI, KI)

Lambing and kidding are one of the most significant constituents that disturbing the lifetime productivity of the ewe and doe. Lambing and kidding interval of ewes and does were presented in (Table 2) below. The average LI and KI months were found to be 7.55 and 7.70 months, respectively. This showed that the ewes and does are systematic breeders and they may be lambing and kidding three times in two years. There is a significant difference in lambing and kidding interval among the three studied small ruminant density and a comparatively higher figure was recorded for the mixed flock site than the other two sites. This indicated that management problems are high in the mixed flock site. The current findings of LI and KI were in line with Alilo *et al.* [6] who reported 7.71 and 8.22 months, respectively, in the Esera district and in line with Asefa *et al.* [8] who reported 8.00 months kidding interval in Bale Zone. Unlike to current study, Hussen *et al.* [22] in the Jimma Zone reported that the average LI and KI were 15.9 and 15.5 months, respectively, which was twice the present result. On the other hand, Hussein [21] reported that the average LI and KI: 8.97 and 8.99

months, respectively, in southern Ethiopia, which was higher than the current finding. It suggests that due to management considerations, including: feed availability, disease control, genetic component, and geography of the land, lambing and kidding intervals differed from place to place and periodically.

Table 2. Reproductive performance of small ruminants per household across flock density.

Parameter (Month)	Small ruminant density groups (Mean ± SE)				Test
	MFS	SDS	GDS	Overall	p-value
Age at first lambing	12.26±0.2	12.92±0.4	12.66±0.3	12.67±0.2	0.43
Age at first kidding	12.58±0.24	13.00±0.55	13.04±0.35	12.89±0.23	0.69
Lambing interval	8.50±0.39[a]	7.27±0.17[b]	7.20±0.24[b]	7.55±0.15	0.001
Kidding interval	8.58±0.42[a]	7.33±0.24[b]	7.35±0.23[b]	7.70±0.17	0.006
Litter size of sheep	1.03±0.03[b]	1.26±0.06[a]	1.29±0.07[a]	1.21±0.03	0.008
Litter size of goat	1.50±0.08	1.51±0.08	1.52±0.07	1.52±0.04	0.96
Age of male sheep at first service	6.83±0.30	7.14±0.2	6.63±0.2	6.91±0.14	0.30
Age of male goat at first service	7.53±0.33	7.67±0.4	7.49±0.4	7.55±0.21	0.94

[a, b]: Different superscripts denote significant differences at $p<0.05$ between means within rows, SE= standard error, MFS=Mixed flock site; SDS=Sheep dominate site; GDS=Goats dominate site

3.2.4. Litter Size

The average litter size of the households across the three small ruminant densities was shown in (Table 2) above. The average litter size or prolificacy obtained in the present study area was 1.21 lambs and 1.52 kids per head. There is a significant difference in the sheep litter size among the three studied small ruminant density. A comparatively lower figure was recorded for the mixed flock site than the other two sites due to management problems, but there was no significant difference in the goat litter size. The current finding of the average litter size of small ruminants was less than 1.64 and 1.62 that was reported by Alilo *et al.* [6] in the Esera district. On the contrary, the current study of goats litter size was higher than Dereje *et al.* [11] who reported 1.2-1.34 under the traditional management system in Ethiopia.

3.2.5. Age of Males at First Service

The average age of males at the first service of the studied households across the three studied small ruminant density is shown in (Table 2) above. The average age of male small ruminants at first service in the study area was 6.91 and 7.55 months of sheep and goat, respectively. There is no significant difference in the average age of male small ruminants at first service among the three studied small ruminant density. In current finding, the average age of ram at first service was almost similar to 6.65, 6.93 and 7.11 months that was reported by Alilo *et al.* [6] in the Esera district; Hagos *et al.* [19] in the central zone of Tigray and Lakew *et al.* [24] in Wolayita Zone, respectively. Similarly, the average age of buck at the first service was similar to 7.60 months reported by Asefa *et al.* [8] from the Bale zone but lower than 9.88 months reported by Eshetu *et al.* [13] from the Dire Dawa Administration.

3.2.6. Weaning Practices and Slaughter /Market Age of Small Ruminants

According to key informants, the weaning practice of lamb and kid was not known by the farmers, and natural weaning was practiced and it is usually before 2-3 months of the ewe/doe give next birth. There is no significant difference in the marketing age of small ruminants among the three studied small ruminant density (Table 3). The mean slaughtering /marketing age for small ruminants in the study area were 7.43 and 8.09 months for male sheep and goat and 7.63 and 8.30 months for female sheep and goat. The higher and lower mean slaughtering /marketing age for small ruminants in the study area were due to management and breed type. The male small ruminants reached the marketing age prior than females.

The current finding of the average slaughter age of sheep was less than 8.60 months that was reported by Hussein [21] in Southern Ethiopia. Similarly, it was lower than the finding of Asefa *et al.* [8] who reported 11.67 and 12.33 months for male and female goats, respectively, in the Bale Zone. On the contrary, it was higher than the finding of Alilo *et al.* [6] who reported 4.125 and 4.280 months for male and female sheep, respectively, in the Esera district. Some authors re-

ported that 4.228 and 4.326 months for male and female goats, respectively in the Esera district. The current study for male reaching for marketing age prior than females was in line with the report of Asefa *et al.* [8] in the Bale Zone.

Table 3. *Marketing/slaughtering age of small ruminants (months).*

Variables	Small Ruminant Density Groups (Mean ± SE)				Test
	MFS	SDS	GDS	Overall	*P*-Value
Male Sheep	7.63 ±0.4	7.63 ±0.4	7.00 ±0.3	7.43 ±0.2	0.446
Female Sheep	8.20±0.5	7.71±0.4	7.06±0.3	7.63±0.2	0.208
Male Goat	8.28±0.3	8.00±0.5	8.02±0.4	8.09±0.2	0.896
Female Goat	8.69±0.4	8.15±0.5	8.15±0.4	8.30±0.2	0.663

MFS=Mixed flock site; SDS=Sheep dominate site; GDS=Goats dominate site

3.3. Constraint of Small Ruminants Reproductive and Productive Performances

The main limitations on small ruminants in the research area were described in (Table 4). According to the interviewed households; there were numerous limitations that hampered the output of small ruminants. With indexes of 0.330, 0.203, 0.142, and 0.114, respectively, the most significant constraints on small ruminant production were a lack of feed and grazing land, a lack of water, drought, and disease. The research area's climatic conditions may be related to the significant output loss brought on by a lack of feed and grazing land and water. As key informants and focal group discussions the unpredictable nature of the rainfall worsens the availability of food and accelerates the spread of illness and parasites. The current study's findings regarding the scarcity of feed, water, drought and predators were in line with earlier findings that had been reported by other authors, including those in the Bale zone [8], eastern Ethiopia, [26], and western Tigray [3].

Table 4. *Major constraints of small ruminant's production.*

Parameters	Ranked			
	1st	2nd	3rd	Index
Feed and grazing land shortage	70	63	25	0.330
Water shortage	43	33	16	0.203
Drought in the area	33	20	16	0.142
Disease	17	20	33	0.114
Predator	14	22	24	0.101

4. Conclusion and Recommendations

Due to several of reasons, the small ruminant reproductive and productive performances in this study are incredibly low. Low reproductive and productive performances of small ruminants in the research area are mostly caused by changes in feed resource availability and quality throughout the year. Similarly, another factor that limits animal enactments is the occurrence of small ruminant diseases, which tends to occur primarily during periods of serious feed shortage. Longer intervals between lambing and kidding, older ages for first lambing and kidding, and longer ages for small ruminant marketing are reproductive and productive performances that need much more urgent management. Credentials of alternative feed sources and strategic feeding management, water development, credentials of disease causes and their control strategies through appropriate policy, and information dissemination are areas of interference that can help farmers build up their flocks and increase productivity.

Abbreviations

SE	Standard Error
MFS	Mixed Flock Site
SDS	Sheep Dominate Site
GDS	Goats Dominate Site
LI	Lambing
KI	Kidding Interval

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Data Availability Statement

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interests

The authors declare no conflicts of interest.

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