

## Characterization of Goat and Sheep Production System in Oromia Zone of Amhara Region, Ethiopia

<sup>1</sup>Teshome Mulualem, <sup>2</sup>Ahmed Seid and <sup>3</sup>Solomon Gizaw

<sup>1</sup>Department of Animal Science, Debark University, P.O. Box: 90, Debark, Ethiopia

<sup>2</sup>Jimma University, College of Agriculture and Veterinary Medicine, P.O. Box: 307, Jimma, Ethiopia

<sup>3</sup>International Livestock Research Institute (ILRI), P.O. Box: 5689, Addis Ababa, Ethiopia

**Abstract:** The objectives of this study were to describe sheep and goats production systems comparatively in three districts of Oromia zone (ArtumaFursi, Dewachefa and JileTimuga). The study was performed based on household survey and field measurements. About 162 households (54 from each district) were involved. Data collected through questionnaire (survey) were statistically analyzed using SPSS. In the study area, the overall average number of sheep and goats per household were  $7.19 \pm 4.34$  and  $11.90 \pm 6.70$ , respectively. Agro-pastoral (84.6%) and pastoral (15.4%) were the main production system in the study area. The primary reason of keeping sheep and goats in all districts was for cash income. Goat milk is consumed by respondents particularly in Artuma Fursi and Jile Timuga districts with index value of 0.019 and 0.078, respectively. On the other hand, all respondents in the study area reported that using sheep milk for home consumption is forbidden by their culture. Natural pasture and river water were the major sources of sheep and goats feed and water in both dry and wet seasons in the three districts. The majority (88.3%) of farmers in the study area practiced uncontrolled mating system. Appearance/body size, growth rate and color were the first, second and third selection criteria, respectively, to select breeding ram and buck in the study area. The overall liter size of sheep and goats were  $1.27 \pm 0.49$  and  $1.73 \pm 0.82$  in the study area, respectively. Diseases and feed scarcity were the main production constraints in all of the study districts. Health services should be delivered in all the study districts to improve reproductive and productivity of sheep and goats. There is the invention natural pasture land with parthenium weeds species, so that the farmers should remove this weed from the grazing land in order to improve the natural feed resource and enhance productivity of sheep and goats.

**Key words:** Characterization • Goats • Oromia Zone • Artuma Fursi • Dewachefa • Jile Timuga

### INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa [1]. Small ruminants are preferred by the small holder farmers from the fact that they require small investments; have shorter production cycles, faster growth rates and greater environmental adaptability as compared to large ruminants [2, 3].

Sheep and goats are among the major economically important livestock species in Ethiopia. They are considered most prolific ruminant among all domesticated ruminant species especially under harsh climatic conditions [4, 5]. According to [1], Ethiopia has about

30.70 million sheep and 30.20 million goat population. Out of total sheep, about 72.14 percent are females and about 27.86 percent are males. Similarly, out of the total goats, 70.61 percent are females and about 29.39 percent are males. Majority of the national goat population is found in the lowland areas of the country. Nearly all (99.99%) of the goats are indigenous types [1] which have become adapted to a wide agro-ecological zones of the country [6] due to natural selection.

Sheep and goats are reared under diverse agro-ecological zones from very arid to very humid and over a wide range of production systems. Sheep and goats are relatively cheap and are often the first asset acquired,

through purchase or customary means, by a young family or by a poor family recovering from a disaster such as drought or war. Sheep and goats, once acquired, become a valuable asset providing security to the family as well as milk and dairy products [7]. According to [1] the purpose of both sheep and goats kept for mutton and meat are higher for males. On the other hand, the same report revealed that female sheep and female goats are primarily kept for breeding purposes. Rearing of small ruminants play important socio economic role in many rural areas where they are reared for generating income and as bank on hooves [8]. The purpose of keeping goats in highland systems is mainly meat production for sale. Whereas in the lowland areas, utilization of goat milk is common and meat production is also one of the main purposes for rearing the goat populations [9-11]. On other hand sheep also play a major role in the food security and social well-being of rural populations living under conditions of extreme poverty [12]. Generally, small ruminants account for about 40% of the cash income earned by farm households, 19% of the total value of subsistence food derived from all livestock production and 25% of total domestic meat consumption [13]. However, sheep and goat production constrained by different factors such as poor nutrition, prevalence of diseases, lack of appropriate breeding strategies and poor understanding of the production system [10, 14].

In Oromia administrative zones of Amhara region, the studies of [15] and [16] characterized only goats in Bati district. However, these studies did not include the whole zone goat population. In addition, any casual observer can understand that physical appearance difference between goat population in Bati and the rest districts of Oromia administrative zones goat population. However, there is no empirical evidence to substantiate this hypothesis. Oromia administrative zone of Amhara region is found in lowland parts of the country, where indigenous sheep and goats are found in all districts of the zone. Comparatively describing rearing environment of sheep and goats is very essential to design management and utilization strategies. The comparative characterization of sheep and goat is very crucial for which type of small ruminant species is more important economically and their performance in the area. Characterization of production system work is also important to improve the management of sheep and goats. Therefore, the objectives of the study were to assess sheep and goat production systems and to assess sheep and goat reproductive performance.

## MATERIALS AND METHODS

**Study Areas:** The study was conducted in three districts namely, *ArtumaFursi*, *Dewachgefa* and *JileTimuga* districts of Oromia zone which is located in Amhara Regional state in north eastern Ethiopia. *ArtumaFursi* is one of the districts in the Oromia Zone the area is located at 10° 18' 45"N, latitude and 5°18' 44'' E longitude. The total land area of the district is about 1,078.09 km<sup>2</sup> and the climatic condition of Artuma Furs district 80% lowland (Kola) and 20% midland (WeynaDega). *DawaChefa* is one of the district in the Oromia Zone the area is located at 10°43'N, latitude and 39°52'E longitude and the total land area of the district is about 568.92 km<sup>2</sup>. Dawa Chefadistrictfalls within 89% Kolla (lowland), 10% Weyna Dega (midland) and 1% Dega Highland) agro-climatic condition.*JileTimuga* is one of the districts in the Oromia Zone the area is located at 10° 02' -10° 25' N, latitude and 39°55' -40° 24' E longitude and the total land area is about 882.56 km<sup>2</sup> with 94.07% kola (lowland) and 5.93% weynadega (midland) agro-ecological zones [17].

**Data Collection:** The survey was conducted in three sample districts (Artuma Fursi, Dawa Chefa and Jile Timuga) which were selected based on the presence of a relatively large proportion of sheep and goats. From three districts totally nine kebeles (three from each) namely Chereti, Chaka and Kechecho from ArtumaFursiDodo, Teref and Tucha from Dawachefa and Fugnadenbi, Beta and Werelencha from JileTimuga were purposively selected again based on relatively large sheep and goat population. From each kebele, households which had at least two sheep and two goats were randomly selected and interviewed.

The questionnaire covered various aspects of livestock species with more details on sheep and goats production and marketing systems. A semi-structured questionnaire was used in designing the questionnaire prepared by International Livestock Research Institute (ILRI) [18]. Based on the questionnaire, socio economic characters like sex, age, education level, marital status, household size, composition of livestock species, flock size, flock structure, economic importance, management practices like feed and water resource utilization and availability, breeding practices, health conditions, reproductive performance and problems and production constraints of sheep and goats were collected.

In addition, information was collected from group discussions and the group included extension workers, DAs, model farmers, village leaders, elders, women and socially respected individuals. The focus of the discussions was reason of keeping sheep and goats, major selection criteria of male and female animals (sheep and goats), major constraints and economic importance of sheep and goats, special distinguishing features of the indigenous sheep and goat production system.

**Secondary Data Like:** Climatic data (temperature and rainfall), geographical location and livestock population demography was collected from Zone administrative office, the district, office of agriculture Rural Development and other written documents.

**Data Management and Statistical Analysis:** Preliminary data analysis like homogeneity test, normality test was employed for quantitative data before conducting the main data analysis. Different types of statistical analysis were used depending upon the nature of the data. All data was analyzed by SPSS Version 20. Data generated from questioners was described and summarized using descriptive statistics. Chi-square ( $\chi^2$ ) test was carried out to assess the statistical significance among categorical

variables using district as fixed effect. Index was calculated for data that needs ranking like reasons for keeping sheep and goats, feed resources during the dry and wet seasons, selection criteria associated with breeding females and males, reproductive problem of sheep and goats, disease observed and production constraints of sheep and goats.

$$I = \frac{3 \times I_{st} + 2 \times I_{nd} + 1 \times I_{rd} \text{ given for an individual reason}}{3 \times I_{st} + 3 \times I_{nd} + 1 \times I_{rd} \text{ for all reasons}}$$

## RESULT AND DISCUSSION

**General Household Information:** The characteristics of households in the study area are presented in Table 1. The majority (80.2%) of households in the study area were male headed while the remaining proportion was headed by females. There was no significant difference ( $P>0.05$ ) in sex of the household heads among districts. The occurrence of less percentage of women respondents in the study areas could be due to the culture of the community that females do not lead the family.

Half (50.0%) of the respondents in the study area were within the age class of 31-40 years while 22.2% of households were found in the age class of 41-50 years.

Table 1: General household information in the study area

Variables	District								X <sup>2</sup> value
	Artuma Fursi		Dewachefa		Jiletimuga		Overall		
	N	%	N	%	N	%	N	%	
<b>Sex structure of household</b>									
Male	42	77.8	43	79.6	45	83.3	130	80.2	0.545 <sup>ns</sup>
Female	12	22.2	11	20.4	9	16.7	32	19.8	
<b>Age structure</b>									
20-30	4	7.4	3	5.6	8	14.8	15	9.3	12.096 <sup>ns</sup>
31-40	32	59.3	28	51.9	21	38.9	81	50	
41-50	7	13	12	22.2	17	31.5	36	22.2	
51-60	8	14.8	7	13	3	5.6	18	11.1	
>60	3	5.6	4	7.4	5	9.3	12	7.4	
<b>Marital status</b>									
Married	47	87	46	85.2	51	94.4	144	88.9	4.655 <sup>ns</sup>
Divorced	3	5.6	6	11.1	2	3.7	11	6.8	
Widowed	4	7.4	2	3.7	1	1.9	7	4.3	
<b>Educational status</b>									
Illiterate	27	50.0	28	51.9	31	57.4	86	53.1	12.690 <sup>ns</sup>
Read and write	26	48.1	20	37.1	18	33.4	64	39.5	
Primary	0	0	4	7.4	5	9.3	9	5.6	
Secondary high school	1	1.9	2	3.7	0	0	3	1.9	
Household size Mean ±SD	6.6±1.46		5.7±2.1		6.5±2.0		6.3±1.9		

SD=Standard deviation

Table 2: Mean  $\pm$  SD of Livestock of species holding per house hold

Livestock	ArtumaFursi	Dewacheffa	Jiletimuga	Overall
Goat	10.29 $\pm$ 4.49 <sup>b</sup>	10.96 $\pm$ 4.59 <sup>b</sup>	14.44 $\pm$ 9.23 <sup>a</sup>	11.90 $\pm$ 6.70
Sheep	6.87 $\pm$ 3.70 <sup>a</sup>	9.79 $\pm$ 4.60 <sup>a</sup>	4.92 $\pm$ 3.19 <sup>b</sup>	7.19 $\pm$ 4.34
Cattle	13.16 $\pm$ 4.9 <sup>a</sup>	8.72 $\pm$ 3.84 <sup>b</sup>	9.12 $\pm$ 5.26 <sup>ab</sup>	10.30 $\pm$ 5.11
Chicken	6.28 $\pm$ 4.00 <sup>a</sup>	3.94 $\pm$ 2.17 <sup>ab</sup>	3.21 $\pm$ 1.47 <sup>b</sup>	4.61 $\pm$ 3.15
Donkey	1.17 $\pm$ 0.39	1.04 $\pm$ 0.20	1.45 $\pm$ 0.88	1.22 $\pm$ 0.57

Means with different superscript (a,b,c) in the same row are significantly different ( $P < 0.05$ ).

This revealed that most farmers in the study area are found within productive age class. There was no significant difference ( $P > 0.05$ ) across districts in household age structures. With regard to marital status, majority (88.9%) of the respondents were married while 6.8 and 4.3 % of respondents were, divorced and widowed, respectively.

In the study area, the small ruminant owners had different educational background. Above half (53.1%) of the respondents were illiterate. This could be difficult to improve and expand small ruminant production. This result was relatively higher as compared to the result of [16] who reported that 43.88% of respondents in Bati district were illiterate. The remaining 46.9% of the respondents in the study area were literate in different educational category. This would be a good chance for adoption of new technologies and to implement control breeding and management practice improvement strategies. The overall average family size of the respondents in the study area was 6.3.

**Livestock Holding per Household:** Average numbers of various livestock species per household in the study area are summarized in Table 2. The overall average number of goats per household (11.9) in the study area was higher than all livestock species and followed by cattle (10.3). There was significant difference between districts in sheep, goat, cattle and chicken population per household ( $P < 0.05$ ). The average number of goats per household in JileTimuga district (14.44) was significantly ( $P < 0.05$ ) higher than the two districts (10.29 in Artuma Fursi and 10.96 in Dewacheffa). This was due to farmers in this district depends on livestock rearing and use goat production as source of income generation. However, there was no significant difference between Artuma Fursi and Dewacheffa districts. The overall flock size of goats per house hold (11.90) in the study area was comparable with the result of [19] who reported that the average flock size per household in Lay Armachiho district of North Gondar zone was 10.5. On the contrary, the present result was higher than the report of [16] who reported that the average flock size of goats per house hold in Bati districts was 8.99.

On the other hand, the average flock size of sheep in Dewacheffa (9.79) and in Artuma Fursi (6.87) was significantly higher than average flock size of sheep (4.92) in JileTimuga district. This could be due to high available wet grazing land in Dewacheffa and ArtumaFursi districts as observed during data collection and group discussion. The overall mean number of sheep per households in the study area (7.19) was comparable with the report of [16] who reported that the average flock size of sheep per house hold in Borena district was 7.82. The average number of cattle per household in ArtumaFursi (13.16) was significantly ( $P < 0.05$ ) higher than the average number of cattle per household in Dewacheffa district (8.72). Respondents in ArtumaFursi districts had significantly higher number of chicken (6.28) than respondents in Jile-Timuga district (3.21). This could be due to female respondents in ArtumaFursi districts relatively higher (22.2%) and chicken is easily managed by females.

**Flock Size and Structure of Sheep and Goats in the Study Area:** Flock size and structure of sheep and goats in the study area presented in Table 3. The mean number of ewes, male kids < 6 month and bucks had significant differences ( $P < 0.05$ ) between districts. The mean number of ewes was 2.89, 3.21 and 2.22 for ArtumaFursi, Dewacheffa and JileTimuga districts. The mean number of ewes in ArtumaFursi and Dewacheffa was higher than that of JileTimuga district. Whereas the overall mean number of does (>1 year) was 4.18 in the study area. The mean number of does was higher than the overall mean of ewes; this could be due to higher flock size of goat as presented in Table 2. The current study areas showed lower breeding ewes but higher does compared to the previous report in west Shewa zone reported 3.12 and 1.98 for breeding ewes and does respectively [20]. In addition, the current result is comparable with the report of [16] who reported 3.51 breeding doe in Bati district. On the other hand, the overall mean number of rams (>1 year) and bucks have almost similar size 1.62 for sheep and 1.63 for goats. However, the number of castrated males goats was higher (2.53) than castrated sheep (1.56). The overall mean of lambs in male aged 6 months to 1 year per household

Table 3: Flock structure over sexes and ages in the study area

Sheep Flock structure	ArtumaFursi	Dewachefa	JileTimuga	Overall
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Male lamb<6 month	1.44±0.50	1.69±0.94	1.25±0.44	1.51±0.76
Female lamb<6 month	1.64±0.59	1.76±0.82	1.30±0.47	1.62±0.69
Weaned Male lamb 6-12 month	1.23±0.43	1.36±0.56	1.30±0.47	1.30±0.49
Weaned female lamb 6-12 month	1.40±0.59	1.54±0.72	1.27±0.46	1.43±0.62
Ram(>1 year)	1.47±0.56	1.84±1.00	1.53±0.67	1.62±0.79
Ewes(>1 year)	2.89±1.73 <sup>a</sup>	3.21±1.77 <sup>a</sup>	2.22±1.14 <sup>b</sup>	2.82±1.64
Castrated	1.45±0.72	1.62±0.70	1.55±0.98	1.56±0.77
Goat flock structure				
Male kids<6 month	1.57±0.87 <sup>b</sup>	1.76±0.78 <sup>b</sup>	2.31±1.50 <sup>a</sup>	1.90±1.16
Female kids<6 month	1.72±0.78	1.71±0.98	2.08±1.70	1.85±1.26
Weaned Male kids 6-12 month	1.57±0.56	1.82±0.61	1.69±0.98	1.70±0.77
Weaned female kids 6-12 month	2.00±0.97	1.76±0.90	1.97±1.08	1.91±0.99
Buck (>1 year)	1.63±0.65 <sup>ab</sup>	1.78±0.69 <sup>a</sup>	1.47±0.66 <sup>b</sup>	1.63±0.67
Does (>1 year)	3.86±1.56	3.75±1.41	4.90±2.85	4.18±2.11
Castrated	2.31±1.13	2.09±1.10	3.03±1.53	2.53±1.35

Table 4: Sheep and Goats and Production System in the Study area

Production System	Artuma Fursi		Dewachefa		JileTimuga		Overall		X <sup>2</sup> value
	N	%	N	%	N	%	N	%	
Agro-pastoralist (Mixed)	45	83.3	52	96.3	40	74.1	137	84.6	10.311 <sup>a</sup>
Pastoralists	9	16.7	2	3.7	14	25.9	25	15.4	

SD = standard deviation

were lower (1.30) than female aged 6 months to 1 year (1.43) compared to other groups. Similarly overall mean of goats in male aged 6 months to 1 year were lower (1.70) than female aged 6 months to 1 year (1.91) as compared to other groups. This lower mean may be due to sale of these animals at age 6 month to 1 year. The present result was higher as compare to [21] in all age groups numbers of both species. In the study area the mean of kids (< 6 month) were relatively higher than mean of lambs (< 6 month) this is because of high number of does as compare to ewes across all the districts. Based on total number of breeding rams and total number of breeding ewes the breeding ratio of sheep were 1.62 to 2.82 (Ram: Ewes). On other hand the breeding ratio of goats was 1.63: 4.18 for buck and does, respectively.

**Sheep and Goats and Production System in the Study Area:** Production Systems of sheep and goats in the study area is presented in (Table 4). Sheep and goats production in all study districts was characterized by low input subsistence, multiple production objectives in marginal environments. The Agro-pastoralist (mixed) production system is the predominant system (83.3%, 96.3% and 74.1%) for ArtumaFursi, Dewachefa and JileTimuga districts respectively. Similar to current study [16] reported that mixed crop-livestock production system

was the predominant system (96.94%) in Bati area. While the remaining 16.7%, 3.7% and 25.9% household in ArtumaFursi, Dewachefa and JileTimuga districts respectively were involved in livestock rearing. The proportion of pastoralist was relatively higher in ArtumaFursi and JileTimuga districts of the respondents which were relying on livestock production as source of cash income and food for home consumption. The major crops such as sorghum, maize, teff, *masho*, onion, cabbage and tomatoes were the main cultivating crop and vegetables in the study area.

**Purpose of Keeping Sheep and Goats in the Study Area:** The purpose of keeping sheep and goats in the study area is presented in Table 5. The primary reason for sheep and goats rearing in all three districts was income generations with an index value of 0.468, 0.39 and 0.435 for sheep and 0.404, 0.443 and 0.431 for goats in ArtumaFursi, Dewachefa and JileTimuga districts, respectively. The money earned from sheep and goat sale is used to buy cloth and food items, pay taxes, purchase fertilizers and other household goods. This finding was in agreement with reports of earlier workers [20, 22]. The other reasons of keeping sheep mentioned by the respondents were saving (0.198), meat consumption (0.207), ceremony (0.073), breeding (0.053),

Table 5: The purpose of keeping sheep and goat in the study areas

	Artuma Fursi				Dewachefa				Jile Timuga				Overall index
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	
-----Purpose of keeping Sheep-----													
Meat	10	4	12	0.169	20	6	7	0.271	4	18	8	0.182	0.207
Income	30	21	6	0.468	22	23	2	0.390	40	6	2	0.435	0.431
Saving	14	7	6	0.210	3	14	10	0.161	8	12	21	0.224	0.198
Milk	0	0	0	0.000	0	0	0	0.000	0	0	0	0.000	0.000
Skin	0	3	4	0.034	0	1	1	0.010	0	0	2	0.006	0.017
Breeding	0	4	6	0.047	1	5	2	0.051	0	3	13	0.062	0.053
Gift	0	1	2	0.014	2	0	2	0.027	0	3	0	0.019	0.020
Ceremony	0	8	1	0.058	6	3	2	0.089	2	5	6	0.071	0.073
-----Purpose of keeping Goats-----													
Meat	8	6	12	0.151	16	8	7	0.246	4	12	44	0.144	0.180
Income	34	6	14	0.404	28	21	2	0.443	40	4	132	0.431	0.426
Saving	12	16	6	0.233	4	14	10	0.173	8	12	69	0.225	0.210
Milk	0	0	6	0.019	0	0	0	0.000	2	6	24	0.078	0.032
Skin	0	3	4	0.032	0	1	1	0.010	0	0	2	0.007	0.016
Breeding	0	9	2	0.063	1	5	2	0.052	0	8	27	0.088	0.068
Gift	0	0	2	0.006	2	0	2	0.028	0	3	6	0.020	0.018
Ceremony	0	14	1	0.091	2	3	2	0.048	0	0	2	0.007	0.046

R1=first rank, R2=second rank, R3=third rank, I=index

Table 6: Ranking of available feed resources during the dry and wet seasons in the study area

Feed resources	ArtumaFursi				Dewachefa				JileTimuga				Overall Index
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	
Wet season													
Natural pasture	42	4	1	0.43	48	2	4	0.47	36	4	14	0.46	0.45
Established pasture	2	12	14	0.14	0	6	10	0.07	6	14	11	0.21	0.14
Hay	0	0	2	0.01	1	2	0	0.02	0	2	6	0.04	0.02
Crop residues	4	16	21	0.21	2	12	24	0.17	8	12	4	0.19	0.19
Fallow land	4	18	6	0.17	0	18	20	0.17	2	2	7	0.06	0.13
Concentrates	2	1	4	0.04	3	12	2	0.11	1	3	4	0.05	0.07
Dry season													
Natural pasture	44	2	4	0.49	46	0	0	0.50	40	3	4	0.41	0.47
Established pasture	1	15	12	0.16	2	4	16	0.11	4	8	11	0.12	0.13
Hay	0	0	2	0.01	0	0	6	0.02	0	4	2	0.03	0.02
Crop residues	9	21	6	0.26	2	16	15	0.19	6	21	14	0.23	0.23
Fallow land	0	0	4	0.01	0	0	12	0.04	0	15	9	0.12	0.06
Concentrates	0	2	14	0.06	2	15	0	0.13	4	3	5	0.07	0.09

R1=first rank, R2=second rank, R3=third rank, I=index

gift (0.020) and skin (0.017), respectively. Similarly, saving (0.210), meat consumption (0.180), breeding (0.068), milk (0.032), gift (0.018) and skin, (0.016) were the other reasons of keeping goats in the study area. Goat milk was consumed by respondents particularly in ArtumaFursi and JileTimuga districts. Similarly, [16] reported that goat owners in Borena, Bati and Siti districts used goat milk for home consumption. On the other hand, all respondents in the study area reported that using sheep milk for home consumption is forbidden by their culture. The study was in agreement with the result of [10] who reported that farmers in Menz district was not utilized sheep milk for home consumption.

**Source of Feed for Sheep and Goats During Dry and Wet Season in the Study Area:** Sources of feed for sheep and goat during dry and wet season in the study area are presented in Table 6. The different feed resources reported in all study districts were natural pasture, established pasture, hay, crop residues, fallow land and concentrates. In the study area, availability of feed resources of sheep and goats in the study area depends on season. However, natural pasture was the major feed resources of sheep and goats both in wet and dry seasons in all study districts. The current result was in agreement with [23] in North Gondar district, [20] in west Shoa zone of Oromia Regional State, [24] in Wolaita

Table 7: Grazing/ browsing practices reported on households in the study area

Grazing/ browsing method	Artuma Fursi				Dewachefa				Jile Timuga			
	DS		WS		DS		WS		DS		WS	
	N	%	N	%	N	%	N	%	N	%	N	%
Free grazing	30	55.6	12	22.2	17	31.5	11	20.4	26	48.1	26	48.1
Herding	19	35.2	39	72.2	36	66.7	39	72.2	28	51.9	23	42.6
Rotational grazing	5	9.3	3	5.6	1	1.9	4	7.4	0	0.0	5	9.3

DS= Dry Season, WS= Wet Season

zone of southern region, [19] around Amhara and Tigray National Regional States and [16] in Bati districts. They reported that natural pasture was the major feed resources of sheep and goats both in wet and dry seasons.

Even if sheep are grazer and goats are browser, the feed resources available in the study area mostly natural pasture. Sheep mostly graze different grass types and foliage on pastureland whereas; goats browse on plant sharps like: *Acacia spp.*, *Sesbania*, *Lantana camara* and other shrubs within the same pasture. The feed resource of sheep and goats hadn't big difference in the study area. The natural pasture was ranked as first feed source for sheep and goats in both wet (with index value 0.43, 0.47 and 0.46) and dry season (with index value of 0.49, 0.50 and 0.41) for ArtumaFursi, Dewachefa and JileTimuga districts, respectively. However, respondents ranked established pasture, fallow land, hay, crop residue and concentrates as the other feed resource of sheep and goats in study area in both wet and dry season.

The availability of feed resources in the study area was different in wet and dry season especially in ArtumaFursi and JileTimuga districts there was the scarcity of feed occurred in dry season. The coping mechanisms of farmers as respond during group discussion was providing different supplements such as: leaves of trees, bushes, crop residues, sorghum and maize stover and some farmers feed wheat bran "furushika" during feed shortage in all districts of study area. The major crop residues used in the study area were: sorghum and maize stover and "mashogebeba".

**Grazing Method Practiced in the Study Area:** The grazing/ browsing practices reported on households in the study areas are summarized in Table 7. The grazing managements of the respondents were different for dry and wet seasons in the study area. Nearly half (55.6% and 48.1%) of sheep and goat owners in ArtumaFursi and JileTimuga districts practiced free grazing /browsing method whereas the remaining percentage of sheep and

goat owners practiced herding and rotational grazing method during the dry season. The majority of sheep and goat owners in Dewachefa district practiced herding in both in dry season (66.7%) and wet season (72.2%). The reason was due to most of the land covered by crop or vegetable in both dry and wet season. The current result was in agreement with report of [25] who reported that in west Gojjam zone most farmers herding their animals due to cultivation of grazing land for crops production.

**Common Source of Water, Frequency and Distances to Watering Point**

**Common Source of Water in the Study Area:** Different water sources in both seasons in the study area are presented in Table 8. The common water sources for livestock include rivers, pipe water, spring and deep well as well as rain water harvest. Majority (66.7%, 64.8% and 75.9%) of respondents in dry season and almost similar proportion of respondents (70.4%, 64.8% and 63.0%) in wet season in ArtumaFursi, Dewachefa and JileTimuga districts, respectively, watered their sheep and goats from river. The current finding was similar with the report of [16], Dhaba *et al.* [21] and Ahmed [26] who indicated that 61.8%, 42.3% and 76.5% in Illu Abba Bora zone, HorroGudruWollega zone and Bati districts; rivers are the most important sources of water for goats in wet and dry season.

**Watering Frequency and Distance to Watering Point During Dry and Wet Season:**

Watering frequency and distance of water during dry and wet season in the study area are presented in Table 9. Majority (66.7% in dry season and 61.1% in wet seasons) of respondents watered their sheep and goats once a day. The rest (33.3% in dry and 38.9% in wet season) of respondents watered their sheep and goats freely. In addition, water shortage was not a problem of sheep and goat in the study area. The current finding is in agreement with [19] who reported that 65.3% of respondents in Lay

Table 8: Common source of water for Sheep and Goats in the study area

Source of water		Artuma Fursi		Dewachefa		Jile Timuga		Overall	
		N	%	N	%	N	%	N	%
Dry season	River	36	66.7	35	64.8	41	75.9	112	69.3
	Pipe water	4	7.4	2	3.7	1	1.9	7	4.3
	Deep well	8	14.8	3	5.6	12	22.2	23	14.1
	Spring	6	11.1	14	25.9	0	0.0	20	12.3
Wet season	River	38	70.4	35	64.8	34	63.0	107	66.0
	Pipe water	5	9.3	5	9.3	2	3.7	12	7.4
	Rain water	10	18.5	2	3.7	6	11.1	18	11.1
	Spring	1	1.9	12	22.2	0	0.0	13	8.1
	Deep well	0	0.0	0	0.0	12	22.2	9	7.4

Table 4: Watering frequency and distance of watering point during dry and wet season in the study area

Watering frequency		Artuma Fursi		Dewa Chefa		Jile Timuga		Overall	
		N	%	N	%	N	%	N	%
Dry season	Freely available	28	51.9	26	48.1	0	0.0	54	33.3
	Once a day	26	48.1	28	51.9	54	100.0	108	66.7
Wet season	Freely available	17	31.5	24	44.4	22	40.7	63	38.9
	Once a day	37	68.5	30	55.6	32	59.3	99	61.1
Distance of watering point									
Dry season	Watered at home	9	16.7	10	18.5	9	16.7	28	17.3
	Less than 1 km.	15	27.8	13	24.1	8	14.8	36	22.2
	1km to 5 km	30	55.6	31	57.4	37	68.5	98	60.5
Wet season	Watered at home	24	44.4	31	57.4	19	35.2	74	45.7
	<1km	19	35.2	20	37.0	30	55.6	69	42.6
	1km-5km	11	20.4	3	5.6	3	9.3	19	11.7

Armachiho district watered their sheep and goats once a day while 34.7% of respondents watered their goats freely in dry season. Majority (60.5%) of respondents in dry season watered their sheep and goat between one and five kilometers distance. On the other hand, less than half (45.7%) of respondents in wet season watered their sheep and goats at home in the study area. About 22.2% of respondents in the study districts watered their sheep and goats less than one kilometers distance during dry seasons whereas during wet season 42.6% of respondents in the study districts watered their sheep and goats less than one kilometers distance.

**Housing of Sheep and Goat in the Study Area:** Type of house and materials used by the respondents to construct sheep and goats house is presented in Table 10. House protects animals from extreme temperature, rain, wind, predators and theft. Different types of houses, housing materials and housing systems were identified in the study area. However, housing systems of sheep and goats were similar across districts. Nearly half (52.5%) of respondents in all districts housed their sheep and goats in separate house with roof. This result is comparable with

the result of [16] who reported that all of the respondents in Bati area used roofed house for their goats in both dry and wet seasons. However, 13.0%, 16.7% and 20.4% of respondents in ArtumaFursi, Dewachefa and JileTimuga districts respectively used kraal (fenced) sheep and goat house without roof. This type of house did not protect sheep and goats from rain during wet season, so poor housing system should be improved to roof type of house for better productivity.

The survey result indicated that, 70.4% of respondents in the study area used grasses or bushes for construction of roof while the remaining 20.34% and 9.4% of respondents used corrugated iron sheet and plastic canvas for construction of roof, respectively. This study was comparable with [27] who reported that, 88.2% of households used grasses or bushes for construction of roof while the remaining 11.75% used corrugated iron sheet in Bensa district of southern Region. About 94.4% of respondents in the study area reported that sheep and goats were housed together. This result was similar with the result of [28] who reported that majority (94.7%) of respondents in Bale Zone housed their goats with sheep. Almost all (98.1%) of in ArtumaFursi, 96.3% in Dewachefa

Table 5: Type of house and housing material in the study area

Districts	Type of house	Artumafursi		Dewacheffa		Jile Timuga		Overall	
		N	%	N	%	N	%	N	%
	Family house with roof	6	11.1	8	14.4	6	11.1	20	12.3
	Separate house with roof	28	51.9	29	53.7	28	51.9	85	52.5
	Verenda	8	14.8	4	7.4	6	11.1	18	11.1
	Kraal	7	13.0	9	16.7	11	20.4	27	16.7
	Gatta	5	9.3	4	7.4	3	5.6	12	7.4
Type of housing material									
	Iron sheet	12	22.2	11	20.35	10	18.5	33	20.34
	Grass /bushs	38	70.4	37	68.55	39	72.2	114	70.4
	Plastic canvas	4	7.4	6	11.1	5	9.3	15	9.3
Sheep and Goats are housed									
	With together	51	94.4	52	96.3	50	92.6	153	94.4
	With Cattle	3	5.6	2	3.7	4	7.4	9	5.6
Kids With adults									
	Yes	53	98.1	52	96.3	43	79.6	148	91.4
	No	1	1.9	2	3.7	11	20.4	14	8.6

Table 6: The sources of breeding ram and buck, mating system and its selection practices in the study area

Parameter		Artuma Fursi		Dewacheffa		Jile Timuga		Overall	
		N	%	N	%	N	%	N	%
Do you have breeding ram	Yes	46	85.2	48	88.9	38	70.4	132	81.5
	No	8	14.8	6	11.1	16	29.6	30	18.5
Do you have breeding buck	Yes	40	74.1	42	77.8	48	88.9	130	80.2
	No	14	25.9	12	22.2	16	11.1	32	19.8
Source of breeding ram	Own born	46	85.2	48	88.9	38	70.4	132	81.5
	Neighbors	8	14.8	6	11.1	16	29.6	30	18.5
Source of breeding buck	Own born	40	74.1	42	77.8	48	88.9	130	80.2
	Neighbors	14	25.9	12	22.2	16	11.1	32	19.8
Breeding/mating system	Control led	4	7.4	7	13.0	8	14.8	19	11.7
	Uncontrolled	50	92.6	47	87.0	46	85.2	143	88.3
Reason of uncontrolled mating	Graze/browse together	20	37.0	15	27.8	19	35.2	54	33.3
	Lack of awareness	27	50.0	31	57.4	25	46.3	83	51.2
	Insufficient no of ram/buck	7	13.0	8	14.8	10	18.5	25	15.4
Do you select breeding male and female	Yes	49	90.7	48	88.9	50	92.6	147	90.7
	No	5	9.3	6	11.1	4	7.4	15	9.3

and 79.6% in JileTimuga) of the respondents housed kids together with the adult flock except newly born lambs or kids. The report was in agreement with the result of [26] who reported that all sex and age groups of goats in Horro Guduru Wollega zone were housed together at night except new born kids.

### Breeding Practices in the Study Area

**Ram and Buck Ownership, Sources, its Selection Practices and Mating System:** The sources of breeding ram and buck, mating system and its selection practices of farmers in the study area are summarized in Table 11. About 81.5% and 80.2% of respondents in the study area had their own ram and their own buck, respectively. The current results were in disagreement with [20] who

reported that only 23.9% and 21.1% of farmers had their own breeding ram and buck, respectively. However, most farmers did not use their breeding ram or buck for mating purpose due to the fact that most of ram and buck sale or castrated at early age. This finding was in agreement with the report of [2] who reported that 98%, 89% and 71% of respondents in Jijiga and Shinile and in Eastern Harerghe zone kept their own indigenous breeding rams and [19] who reported that 97.1% of respondents in Ziquala, 98.7% of respondents in TanquaAbergelle had their own indigenous breeding buck. In the study area, 88.3% of respondents practiced uncontrolled mating system. From them, 50.0% of respondents in ArtumaFursi, 57.4% in Dewacheffa and 46.3% in JileTimuga districts didn't know the effect of uncontrolled mating on the future

Table 7: Selection criteria for selecting breeding ram and buck in the study area

Selection Criteria	Artuma Fursi				Dewachefa				Jile Timuga				Overall Index
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	
<b>Selection Criteria Ram</b>													
Color	8	12	9	0.19	12	11	4	0.21	7	12	5	0.17	0.19
Body Size	21	11	9	0.31	19	15	7	0.33	24	11	7	0.35	0.33
Tail Size	10	5	7	0.16	9	8	5	0.17	7	8	4	0.14	0.15
Family History	2	3	4	0.05	2	6	4	0.08	3	4	6	0.08	0.07
Growth Rate	11	12	8	0.22	10	7	4	0.17	11	7	10	0.20	0.19
Adaptability	1	4	3	0.04	1	0	7	0.03	1	2	5	0.04	0.04
Libido	0	2	4	0.03	1	0	2	0.02	0	1	2	0.01	0.02
<b>Selection Criteria of Buck</b>													
Color	11	9	3	0.21	15	13	6	0.28	7	14	9	0.20	0.23
Body Size	20	14	12	0.40	21	15	8	0.35	25	15	10	0.41	0.39
Family History	5	4	4	0.11	1	4	12	0.08	0	6	8	0.07	0.09
Growth Rate	13	8	7	0.24	10	6	14	0.20	16	10	6	0.25	0.23
Adaptability	0	2	2	0.02	1	4	7	0.06	2	3	4	0.05	0.04
Libido	0	0	3	0.01	0	3	2	0.03	0	1	4	0.02	0.02

R1=first rank, R2=second rank, R3=third rank, I=index

generation of the flock. This finding was in agreement with the report of [16] who reported that 88.78% of respondents in Bati district practiced uncontrolled mating system. The remaining overall percentage of respondents (33.3% and 15.4%) in the study area reported that, grazing/browsing together with opposite sexes and insufficient number of ram and buck in their flock respectively were the main reasons to practice uncontrolled mating.

About 90.7%, 88.9% and 92.6% of respondents in ArtumaFursi, Dewachefa and JileTimuga districts, respectively, practiced selection of their breeding male and female for the future production purpose. The current results were in agreement with [28] who reported that 85% of respondents in Bale zone practice selection of males and females goats.

**Selection Criteria for Breeding Ram and Buck in the Study Area:** The selection criteria of breeding rams and bucks in the study area are summarized in Table 12. Selection of parents of the next generation in both the rams and bucks was based on the performance and preference of farmers. Appearance/Body size, growth rate and color were the first, second and third (index value 0.33, 0.19 and 0.19) selection criteria of breeding ram, respectively, in all of the study areas. Similarly, appearance/body size, growth rate and color were the first, second and third (index value 0.39, 0.23 and 0.23) selection criteria for breeding buck in all of the study area. This finding was in agreement with the report of [16, 20] who reported that body size/conformation was the primary selection criteria of farmers to select both ram and buck as parents of next generation.

On the other hand, tail size was 4<sup>th</sup> selection criteria for ram while family history was the 4<sup>th</sup> selection criteria for buck. Fawn coat color was the most preferred color of breeding rams while red, fawn and white were most preferred color of bucks in all study areas.

**Selection Criterion for Breeding Ewes and Does in the Study Area:** The selection criteria for breeding ewes and does in the study area are presented in Table 13. Appearance/body size was the first criteria to select breeding ewes with the overall index value of 0.41 across study districts. Color was the second criteria for selection of breeding ewes in ArtumaFursi and Jiletimuga districts, whereas lambing interval the second criteria for selection of breeding ewes in Dewachefa. Likewise appearance/body size, color and litter size were the first, second and third selection criteria, respectively, for breeding does in all the study area. Lambing interval was the 3<sup>rd</sup> selection criteria for breeding ewes especially in Dewachefa and JileTimuga districts while litter size was the 3<sup>rd</sup> selection criteria for breeding does in all the study area. Lamb/kid survival, family history and age at sexual maturity were also mentioned as selection criteria with lower proportion for both species. The current finding was in agreement with [20] who reported that body size and coat color were ranked first and second selection criteria of breeding ewes and does in west Shewa zone.

**Major Sheep and Goat Diseases in the Study Area:** The major common sheep and goat diseases in the study area are presented in Table 14. Diseases have numerous negative impacts on productivity of herds i.e. death of animals, loss of weight, slow down growth, poor fertility

Table 8: The selection criteria for breeding ewes and does in the study area

Selection Criteria ewes	Artuma Fursi				Dewacheffa				Jile Timuga				Overall index
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	
Color	10	12	5	0.21	6	14	0	0.16	8	15	0	0.20	0.19
Body Size	22	19	8	0.41	29	8	11	0.43	26	14	0	0.39	0.41
Lamb Survival	2	2	4	0.06	0	0	1	0.00	0	6	4	0.06	0.04
Family History	2	6	5	0.08	3	12	0	0.12	0	3	4	0.04	0.08
Lambing Interval	6	3	7	0.10	7	14	5	0.20	9	5	11	0.18	0.16
Litter Size	7	5	6	0.13	3	2	4	0.06	7	2	6	0.11	0.10
Age of Sexual maturity	0	0	5	0.02	0	0	8	0.03	0	1	4	0.02	0.02
Selection Criteria for of does													
Color	12	12	8	0.23	14	9	6	0.26	11	12	4	0.22	0.24
Body Size	26	18	4	0.41	19	12	5	0.34	30	15	5	0.45	0.40
Kid survival	0	0	5	0.02	0	0	1	0.00	0	0	4	0.01	0.01
Family History	0	4	4	0.04	1	4	0	0.05	0	8	4	0.07	0.05
Kidding Interval	3	7	3	0.09	5	1	0	0.08	4	4	6	0.10	0.09
Litter Size	8	12	6	0.19	8	11	6	0.21	5	7	2	0.12	0.17
Age of Sexual Maturity	0	0	8	0.03	1	4	3	0.06	0	1	6	0.03	0.04
R1=firstrank, R2=secondrank, R3=thirdrank, I=index													

performance, decrease in physical power etc. (1). Pasteurellosis, sheep/goat pox, fascioliasis, PPR (Peste des Petits Ruminants), diarrhea, anthrax and mange mite and foot and mouth diseases were reported as major diseases affecting sheep production in the study area. This study was comparable with the report of [22]. Paste des petites ruminants (PPR), foot and mouth disease, pasteurellosis and anthrax are the most important diseases prevalent in Ethiopia. Among those diseases, pasteurellosis and sheep pox (index value 0.33 and 0.23) were the most common disease in sheep across the study districts. Similarly, pasteurellosis and goat pox (index value 0.35 and 0.21) were common disease by affecting production of goats in the study area whereas fascioliasis was the common disease (index value 0.15 and 0.26) of sheep especially in Artumafursi and Dewacheffa district, respectively. This could be due to relatively the grazing land of this district was wet land so favorable for liver fluke prevalence which is important for cause of fascioliasis. On the other hand PPR (index value 0.17) was more serious disease in goats than sheep in the study area.

There was great production loss of sheep and goats caused by disease problems due to inadequate health management by farmers and inefficient veterinary service in the study area. Most of the farmers were using modern drugs for treating the sick animals and also some of the farmers treat their animal with locally available medicine. Government animal health centers are the major source of veterinary services in all the study districts however, there was limitation of delivery of health center in all districts.

**Veterinary Service in the Study Area:** The distance and type of veterinary service in the study area is presented in Table 15. All of the farmers in ArtumaFursi and Dewacheffa and 96.3% Jile Timuga district of farmers have access to only government veterinary clinics. Nearly half (54.9%) of sheep and goats owners in the study area had access to veterinary services by traveling up to 1 km whereas, 30.9% of them had access to veterinary services from 1 -5 km. The remaining (14.2%) of the sheep and goats owners travelled 5-10 km to get veterinary services. However there was the limitation of veterinary service to address vaccination for all kebeles of the study area due to this there is production loss of sheep and goats. The government should establish more animal health infrastructure not addressed kebeles especially in Dewacheffa and ArtumaFursi districts.

**Castration Practices of Sheep and Goats in the Study Area:** Castration practices, reason of castration and age of castration of sheep and goats in the study area are presented in Table 16. Majority (93.8%) of the respondents' said that they practice castration of their sheep and goats. The current result was comparable with the report of [29] who reported that 96.7% and 97.2% sheep owners practiced castration in Menz and Afar districts, respectively. The result indicated that 40.0% of sheep owners and 51% of goat owners in the study area mainly practiced castration for reason of improve the fattening potential. The remaining percentage of respondents reason of castration of their ram and buck were to get higher price, make the buck docile or and to control mating to some extent. Inbreeding was probably

Table 9: The major sheep and goat diseases in Oromia zone of Amhara region

Local name	Common name	Artuma Fursi				Dewachefa				Jile Timuga				Overall Index
		R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	
<i>Fentata</i>	Sheep pox	6	10	8	0.21	8	11	8	0.24	13	6	8	0.25	0.23
<i>Kentir</i>	PPR	3	8	0	0.11	0	1	3	0.02	6	8	4	0.16	0.10
<i>Neft</i>	Pasteurellosis	19	6	0	0.32	17	10	0	0.31	20	12	4	0.37	0.33
<i>Tekimati</i>	Diarrhea	2	4	4	0.08	0	5	4	0.06	4	6	4	0.12	0.09
<i>Afemeyaz</i>	FMD	0	1	3	0.01	0	1	2	0.02	0	0	3	0.01	0.01
<i>Yegubettill</i>	Fascioliasis	8	2	4	0.15	12	9	6	0.26	0	1	3	0.02	0.14
<i>Dingetegna</i>	Anthrax	1	3	5	0.06	1	0	8	0.05	1	1	2	0.03	0.05
<i>Ekeki</i>	Mange Mites	0	2	4	0.04	1	0	4	0.03	2	1	2	0.04	0.04

  

Local name	Common name	Artuma Fursi				Dewachefa				Jile Timuga				Overall Index
		R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	
<i>Fentata</i>	Goat pox	16	4	2	0.25	7	4	8	0.14	10	8	11	0.25	0.21
<i>Kentir</i>	PPR	4	8	6	0.15	10	9	5	0.20	4	7	12	0.17	0.17
<i>Neft</i>	Pasteurellosis	21	12	0	0.37	25	9	0	0.36	20	6	0	0.31	0.35
<i>Tekimati</i>	Diarrhea	2	4	1	0.06	0	5	2	0.05	2	4	2	0.07	0.06
<i>Afemeyaz</i>	FMD	0	2	5	0.04	4	2	5	0.08	0	2	3	0.03	0.05
<i>Yegubettill</i>	Fascioliasis	0	1	3	0.02	0	2	4	0.03	0	2	1	0.02	0.02
<i>Dingetegna</i>	Anthrax	0	3	4	0.04	1	3	8	0.06	1	4	8	0.08	0.06
<i>Ekeki</i>	Mange Mites	0	5	6	0.07	2	6	2	0.08	2	3	4	0.07	0.07

R1=first rank, R2=second rank, R3=third rank, I=index

Table 10: Percent of farmers accessing public and private veterinary services and distance to veterinary services in Oromia zone of Amhara region

Parameters		Artuma Fursi		Dewachefa		Jile Timuga		Overall	
		N	%	N	%	N	%	N	%
Type of veterinary services	Government	54	100.0	54	100.0	52	96.3	160	98.8
	Private	0	0.0	0	0.0	2	3.7	2	1.2
Distance	<1 km	28	51.9	32	59.3	29	53.7	89	54.9
	1-5 km	17	31.5	12	22.2	21	38.9	50	30.9
	5-10 km	9	16.7	10	18.5	4	7.4	23	14.2

common as active rams or bucks are often the main source of replacement males due to this breeding in both species was uncontrolled.

Majority (72.2%) of farmers in the study area practiced castration by modern method and the remaining (27.8.6%) of farmers used traditional castration method. All sheep and goats were castrated by selected farmers that use traditional material “*alolo*” and modern by burdizo in all districts of the study area. About 66.7% and 33.3% of the respondents in the study area reported that they castrate their sheep at the age of 1.5-2 years and 1-1.5 years respectively. On the other hand, majority (69.1%) of the respondents in the study area reported that they castrate their goats at the age of 2-3 years, while the remaining 30.9% of the respondents in the study area reported that they castrate their goats at the age of 1-2 years. The current result was comparable with [29] who reported that rams were castrated at age of 1.7 and 1.5 years, respectively for Menz and Afar sheep whereas; [16]

reported that average castration age of buck was 1.72±0.11 years in Bati area. According to the focus group discussion of the respondents the main castration season were September and October while some respondents castrate their ram and buck at any time that the animals perform age of castration across all the study districts.

**Mean Marketing and Culling Age of Sheep and Goat in the Study Area:** Average marketing and culling age of sheep and goats in the study area are presented in Table 17. The mean marketing and culling age of sheep and goats were had significant difference across the districts except market age of male sheep, market age of female goat and culling age of male sheep. The mean marketing age for sheep in the study area was 11.68±1.53 month for male and 11.75±1.02 month for female sheep while, the mean marketing age for goats in the study area was 11.76±1.01 month for male and 11.66±1.06 month for female goats. This indicates that male sheep reach

Table 11: Castration practices of sheep and goats in the study area

Parameters		Artuma Fursi		Dewachefa		Jile Timuga		Overall		X <sup>2</sup> -value
		N	%	N	%	N	%	N	%	
Do you castrate Sheep and Goats?	Yes	52	96.3	51	94.4	49	90.5	152	93.8	1.492 <sup>a</sup>
	No	2	3.7	3	5.6	5	9.5	10	6.2	
Reason Castration for sheep	Control breeding	6	12.2	3	6.1	5	10.6	14	9.7	3.835 <sup>a</sup>
	Better fattening	15	30.6	23	46.9	20	42.6	58	40.0	
	Better income	22	44.9	17	34.7	18	38.3	57	39.3	
	Better temperament	6	12.2	6	12.2	4	8.5	16	11.0	
Reason Castration for goats	Control breeding	3	6.1	3	6.1	6	12.8	12	8.3	2.119 <sup>a</sup>
	Better fattening	25	51.0	27	55.1	22	46.8	74	51.0	
	Better income	10	20.4	9	18.4	9	19.1	28	19.3	
	Better temperament	11	22.4	10	20.4	10	21.3	31	21.4	
Castration method for both species	Traditional	16	29.6	15	27.8	14	25.9	45	27.8	0.185 <sup>a</sup>
	Modern	38	70.4	39	72.2	40	74.1	117	72.2	
Age of castration for sheep	1-1.5 years	17	31.5	18	33.3	19	35.2	54	33.3	0.167 <sup>a</sup>
	1.5-2 years	37	68.5	36	66.7	35	64.8	108	66.7	
Age of castration for goats	1-2 years	22	40.7	18	33.3	10	18.5	50	30.9	6.480 <sup>a</sup>
	2-3 years	32	59.3	36	66.7	44	81.5	112	69.1	

Table 12: Average marketing and culling age of sheep and goats in the study area

Parameter		ArtumaFursi	Dewachefa	JileTimuga	Overall
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Market age of sheep in month	Male	11.87±0.91	11.74±1.03	11.44±2.27	11.68±1.53
	Female	11.48±1.14 <sup>b</sup>	11.74±1.02 <sup>ab</sup>	12.05±0.68 <sup>a</sup>	11.75±1.02
Market age of Goats in month	Male	11.55±1.17 <sup>b</sup>	11.72±1.08 <sup>ab</sup>	12.01±0.68 <sup>a</sup>	11.76±1.01
	Female	11.79±0.93	11.50±1.17	11.68±1.06	11.66±1.06
Culling age in Sheep years	Male	5.24±0.95	4.90±0.99	5.12±0.75	5.09±0.91
	Female	7.27±0.83 <sup>a</sup>	6.87±0.97 <sup>b</sup>	7.42±0.74 <sup>a</sup>	7.19±0.88
Culling age in Goats years	Male	5.16±0.81 <sup>a</sup>	5.01±0.81 <sup>a</sup>	4.62±0.87 <sup>b</sup>	4.93±0.86
	Female	7.57±1.10 <sup>a</sup>	7.07±1.02 <sup>b</sup>	7.20±0.91 <sup>ab</sup>	7.28±1.03

SD=Standard deviation;<sup>abc</sup>: means with different superscript in the same row are significantly different ( $P<0.05$ ).

marketing age earlier than female sheep; however, female goats reach marketing age earlier than male goats. The current finding was comparable with [30] who reported that the overall, the mean market age of goats in Shebelle Zone was 11.01 and 11.69 month for male and female goats, respectively.

Culling was used to improve the overall productivity of the flock. Farmers in the study area cull their sheep at mean age of 5.09 years for males and 7.19 years for female sheep. On the other hand the mean culling age of goats 4.93 years for male and 7.28 years for female goats. The culling age of male sheep and goats was lower than female sheep and goats the possible reason of this male sheep and goats used for only mating and meat due to this male sheep sale at earlier age than female. This study was comparable with the report of [28], who reported that, farmers in the Bale zone culled their goats at average age of 8.17±0.16 years for male and 8.5±0.16 years for female goat.

**Average Reproductive Performance of Sheep and Goats in the in Three Districts:** Average reproductive performance of sheep and goats in the study area are summarized in Table 18. Evaluations of the performance of economically important traits of the livestock are very useful inputs for planning a breeding program [31]. Good reproductive performance is a prerequisite for any successful genetic improvement and it determines production efficiency [32].

The average age at sexual maturity of male goats but not in sheep across the three districts had significant differences ( $P<0.05$ ) between districts. The average age at sexual maturity of male sheep was 7.12±1.07 months and average age at sexual maturity of female sheep was 6.44±0.57 in the study area. The result indicated that female sheep reach sexual maturity at early age as compare to male in sexual maturity. The current finding was in agreement with [29] who reported that an average age of 7.1 months was reported for Afar sheep. On the

other hand the average age at sexual maturity of male goat was 7.61, 7.12 and 7.48 months, whereas age at sexual maturity of female goat was 6.51, 6.66 and 6.51 for ArtumaFursi, Dewacheffa and JileTimuga districts respectively. The current finding was lower as compare with [16] who reported that the age at sexual maturity was 8.21±0.28 for male and female goats at Bati district.

The age at first lambing and age at first kidding was 12.53±.94, 12.55±.96 and 12.61±1.10 months for sheep and 12.37±1.13, 12.74±1.10 and 12.55±1.05 months for goats in ArtumaFursi, Dewacheffa and JileTimuga districts, respectively. The current finding was comparable with [20] and [27] who reported that the first age lambing was 12.84 ±0.24 months while age at first kidding was 13.85±0.12 in Bensa and West shewa zone districts, respectively. The present results in respect of both species had similarity this could be due the districts found in same agro climatic zone. The mean overall lambing interval and kidding interval of the study area was 7.12±.91 and 6.90±1.05 months respectively. The lambing/kidding interval in the present study were lower than the earlier reports in [29] who reported 9.01 months for Afar sheep and [16] reported 7.95±0.19 months for goats in Bati district.

There was significant difference ( $P<0.05$ ) between districts in average lambs and kids produce per life time of sheep and goats. The ability of ewes to produce in life time was 8.50, 8.37 and 9.01 lambs whereas; the ability of does produce in life time was 12.25, 12.62 and 12.14 kids for ArtumaFursi, Dewacheffa and JileTimuga districts, respectively. The difference of producing ability in across the districts may be due to management difference and the producing ability difference in both species. In present result goats have higher producing ability than sheep the possible reason of this due to breed and species difference. The current result was comparable with [29] who reported that Menz sheep produce 9.3 lambs in life time and [16] reported that goats produce 11.08 kids per life time of does in Bati districts.

There was no significance difference ( $P>0.05$ ) across the districts in average reproductive life span of both species. The overall mean reproductive life span was 8.16±.88 years for sheep and 8.23±1.04 years for goats in the study area. The current result was comparable with [27] who reported that 8.1 ±0.11 years for sheep while, [16] reported 8.02±0.23 years for goats in Bensa and Bati district respectively. There was no significant difference ( $P>0.05$ ) between the districts in average weaning age of sheep however, there was significant difference ( $P<0.05$ ) in goats across the districts. The weaning age of lambs

was 3.68±.50, 3.70±.53 and 3.74±.48 months whereas; the weaning age of kids was 3.81±.39, 3.88±.41 and 3.57±.49 months in ArtumaFursi, Dewacheffa and JileTimuga districts respectively. The result in the three districts for weaning age of lambs and kids were lower than [20] in Ada Barga and Ejere districts of west Shoa zone, who reported that the overall average weaning ages of lambs and kids were 3.92 and 3.77 months respectively.

The result indicated that overall liter size of sheep was 1.27±.49 and 1.73±.82 was for goats in the study area. In the study area, the liter size of goats was higher than sheep, this is important for farmers to select species which produce more animals. High litter size is economically important trait that enhances sheep and goat productivity in terms of producing more number of lambs and kids. These finding were higher than report of [20] who reported that liter size 1.19±0.42 for sheep and 1.28±0.33 for goats in Ada Barga and Ejere districts of west Shoa zone.

#### **Reproductive Problems of Sheep and Goats in the Study Area:**

The major reproductive problems of sheep and goat in the study area are summarized in Table 19. Abortion, dystocia; lamb mortality and low growth rate were major reproductive problems of sheep and goat for across in all the study area. From those abortion was the major (index value 0.47, 0.56 and 0.42) reproductive problems of sheep in ArtumaFursi, Dewacheffa and JileTimuga districts, respectively. Similarly, abortion was the major (index value 0.47, 0.49 and 0.46) reproductive problems of goats in ArtumaFursi, Dewacheffa and JileTimuga districts, respectively. Lamb/kid mortality was ranked as second reproductive problem for both sheep and goats in all the study area. High mortality of sheep and goats in abortion and at early age of lamb and kid this might be due to poor management of health condition and high prevalence of diseases. Farmers in the study area should be give attention for management of pregnant animals and small kids and lambs. The remaining other rank were dystocia and low growth rate ranked orderly for both species across in study area.

#### **Marketing**

**Market Place:** According to the group discussion in Artumafursi district there are three permanent market places namely ChefaRobit, Chereti and Karakori on Wednesday, Friday and Tuesday respectively. Whereas Dewacheffa district there are three permanent market places namely Kemise, Tucha and Mekoy on Thursday, Sunday and Tuesday respectively, in addition in JileTimuga district there are four permanent market places

Table 13: Means ±SD reproductive performance of sheep and goats in the study area

Reproductive Traits in sheep	ArtumaFursi	Dewachefa	JileTimuga	Overall
Age of males at sexual maturity (m)	6.79±.83	7.29±1.07	7.27±1.21	7.12±1.07
Age of females at sexual maturity (m)	6.35±.48	6.46±.60	6.51±.63	6.44±.57
Age at first lambing (m)	12.53±.94	12.55±.96	12.61±1.10	12.56±1.0
Lambing interval(m)	7.00±0.91	7.29±.86	7.07±.94	7.12±.91
Average number of lambs per ewe life	8.50±.1.16 <sup>ab</sup>	8.37±1.24 <sup>b</sup>	9.01±1.09 <sup>a</sup>	8.62±.1.19
Reproductive life span of ewes ( y)	8.31±.84	8.09±.83	8.07±.96	8.16±.88
Average weaning age (m)	3.68±.50	3.70±.53	3.74±.48	3.70±.50
Liter size	1.25±.48	1.22±.46	1.33±.54	1.27±.49
Reproductive Traits in goats				
Age of males at sexual maturity (m)	7.61±.91 <sup>a</sup>	7.12±.86 <sup>b</sup>	7.48±1.31 <sup>ab</sup>	7.40±1.0
Age of females at sexual maturity (m)	6.51±.86	6.66±.54	6.51±.50	6.56±.65
Age at first kidding (m)	12.37±1.13	12.74±1.10	12.55±1.05	12.55±1.10
Kidding interval(m)	7.14±1.17 <sup>a</sup>	7.03±1.02 <sup>a</sup>	6.53±.84 <sup>b</sup>	6.90±1.05
Average number of kids per doe life	12.25±1.03 <sup>ab</sup>	12.620±.97 <sup>a</sup>	12.14±.73 <sup>b</sup>	12.34±.94
Reproductive life span of does ( y)	8.35±.91	8.12±.91	8.22±1.2	8.23±1.04
Average weaning age (m)	3.81±.39 <sup>a</sup>	3.88±.41 <sup>a</sup>	3.57±.49 <sup>b</sup>	3.75±.45
Liter size	1.72±.73	1.90±.93	1.57±.76	1.73±.82

SD=Standard deviation;<sup>abc</sup>: means with different superscript in the same row are significantly different ( $P<0.05$ ).

Table 14: Reproductive problems of sheep and goats in the study area

Reproductive problem in Sheep	ArtumaFursi				Dewachefa				JileTimuga				Overall index
	R1	R2	R3	Index	R 1	R2	R3	Index	R 1	R2	R3	Index	
Abortion	30	22	2	0.47	35	11	6	0.56	24	21	4	0.42	0.48
Dystocia	1	5	6	0.07	3	1	3	0.06	3	5	10	0.09	0.07
Lamb mortality	20	23	4	0.38	12	18	12	0.35	22	16	12	0.39	0.37
Low growth rate	1	4	14	0.09	1	2	0	0.03	4	3	7	0.8	0.06
Reproductive problem in Goats													
Abortion	28	22	4	0.47	32	20	2	0.49	26	16	8	0.46	0.47
Dystocia	2	3	6	0.06	1	5	3	0.06	4	2	6	0.09	0.07
Kid mortality	24	20	8	0.43	21	24	8	0.43	17	12	14	0.34	0.40
Slow growth rate	0	2	8	0.04	0	3	0	0.02	6	3	5	0.11	0.06
R1=firstrank,	R2=secondrank,				R3=thirdrank,				I=index				

namely Senbeta, Beta, Jwuha and Ataye on Sunday, Wednesday, Thursday and Saturday respectively. All of the market places are functional at one day per week; however, consumers in all districts and restaurant owners can buy sheep and goats throughout the week from Kemisse and Shewarobit Town at temporary marketing places (*Gulit*). The market places of all the districts were fenced and contain taxation shade except temporary marketing places (*Gulit*).

**Number of Animals Sold and Sale Price of Sheep and Goats:** Average number animals sold and average sold price of adult sheep and goats in the study area presented in Table 20. The average sale price of adult sheep in both sex during planting time, female sheep after harvesting time and adult female goats after harvesting crop had significant ( $P<0.05$ ) difference across the districts of the study area. All age group of sheep and goats in both sex were marketed in the study area; however the present

study concerned on price information of sold adult sheep and goats in different season of marketing. The average sale prices of adult male sheep during festival were 1437.0, 1412.9 and 1418.5 birr whereas; the average sale prices of adult male goats during festival were 3140.7, 3200.0 and 3011.1 birr for ArtumaFursi, Dewachefa and JileTimuga districts respectively. On the other hand the overall average sale price for adult female sheep was 730.2 and 1505.5 birr for adult female goats during festival in the study area. The present result was much higher than the report of [14] who reported that the sale price of fattened sheep and goats were 378.1 birr and 334.4 birr respectively. This indicated that higher demand of sheep and goats rather than higher supply, the possible reason of this may be lower production of sheep and goats as compare to the human population growth. The productivity and production of sheep and goats should be improved in order to compensate this advent of high price.

Table 15: Mean±SD number of animals sold and average sale price of adult sheep and goats in the study area

Sale price of sheep in Birr		ArtumaFursi	Dewachefa	JileTimuga	Overall
During festivals	Male	1437.0±274.2	1412.9±155.4	1418.51±218.1	1422.8±220.2
	Female	729.6±130.5	727.7±126.1	733.3±133.8	730.2±129.0
During planting	Male	1066.6±250.1 <sup>b</sup>	1206.5±216.7 <sup>a</sup>	1164.8±237.0 <sup>ab</sup>	1145.9±240.8
	Female	678.7±129.0 <sup>b</sup>	699.0±122.6 <sup>ab</sup>	756.4±129.6 <sup>a</sup>	711.4±130.6
After Harvesting crop	Male	1153.7±223.5	1202.7±218.5	1144.4±198.5	1166.9±214.0
	Female	731.4±122.2 <sup>b</sup>	779.6±129.4 <sup>ab</sup>	798.1±123.6 <sup>a</sup>	769.7±127.4
Sale price of goats in Birr		ArtumaFursi	Dewachefa	JileTimuga	Overall
During festivals	Male	3140.7±680.04	3200.0±684.6	3011.11±706.2	3117.3±690.6
	Female	1494.4±301.2	1525.9±299.1	1505.5±320.6	1508.6±305.5
During planting	Male	2825.9±669.3	2922.2±711.0	2812.9±676.2	2853.7±683.2
	Female	1309.2±153.2	1383.3±188.0	1309.2±189.6	1333.9±180.1
After Harvesting crop	Male	3042.6±69.0	2972.2±796.0	2931.5±734.8	2982.1±738.7
	Female	1459.2±198.6 <sup>b</sup>	1505.5±189.7 <sup>a</sup>	1500.0±181.1 <sup>a</sup>	1488.2±189.9
Average number of sheep sold per household in a year		4.0±1.0 <sup>b</sup>	5.5±1.7 <sup>a</sup>	3.0±0.9 <sup>c</sup>	4.2±1.6
Average number of goats sold per household in a year		5.5±1.2 <sup>b</sup>	5.8±0.9 <sup>b</sup>	7.5±2.6 <sup>a</sup>	6.3±1.9

SD=Standard deviation; <sup>abc</sup>: means with different superscript in the same row are significantly different ( $P<0.05$ ).

The sale price of sheep and goats in both sexes were higher during festival and after crop harvests time than sale price of planting season. The possible reason of these could be during festivals (New Year, Easter, Christmas, Epiphany, Id Al Fetir and Id Al Adha) were high demand of sheep and goats marketing and also farmers bought the breeding sheep and goats rather than sale during crop harvests season in all the study districts. The present result was in agreement with [16] who reported that the meat demand grows much higher during major holidays/festivals. In addition the sale price of goats in both sexes was much higher than sale price of sheep in both sexes across all the study districts. This indicated that goats are economically important than sheep in earning high amount of income generation for farmers in Oromia zone of Amhara region.

The average number of sheep and goat sold per household was significantly ( $P<0.05$ ) different for both species across the three study sites. The variation might be due to the purpose of keeping, flock size, presence of high price breed and demands of sheep and goats. The overall average number of sheep and goat sold per household in a year was 4.2 and 6.3 respectively, presented in study area (Table 20). In the present study higher (5.5) number of sheep sold in Dewachefa district where as higher (7.5) number of goats sold in JileTimuga districts; the possible reason of this may be higher flock size of sheep and goats in these districts respectively. The current result was higher than [20] in Ada Barga and Ejere districts of west Shoa zone, who reported that one household sold on average 4.4 heads of sheep and 2.2 goats per year per household.

#### Marketing Participants of Sheep and Goats in the Study Area:

The result of marketing participants of sheep and goats in the study area presented in Table 21. In the study area the results showed that respondents sold their sheep and goats to traders (54.3%), hotels (22.8), farmers (13.0%) and civil servants (9.9%). The result showed that traders were the major marketing participants whereas; farmers and civil servants were less marketing participants in the study area. The current result was disagreement with Yadeta [20] who reported that farmers were the major marketing participants of sheep and goats in west Shoa zone. This difference might be due to the in season of collecting data, bought season of farmers and high demand of meat by farmers.

#### Marketing Constraints:

Major marketing constraints of sheep and goat in study area are presented in Table 22. According to the respondents, prices determine by visual, lack of public market information, long transportation and price determine by brokers were the major marketing constraints of sheep and goats in the study area. About (35.2%, 31.5% and 44.4%) of the respondents in Artumafursi, Dewachefa and JileTimuga districts respectively; responded that sheep and goats price determine by visual in negotiation between farmers and buyers as primary marketing constraint. The remaining overall percentage 27.2%, 19.1% and 16.7% of the respondents were recognized that brokers, lack of public market information and long transportation, respectively, were the other constraints of marketing in the study area. The current result was comparable with [14] who reported that brokers (30.8%),

Table 16: Major participants in sheep and goat marketing in Oromia zone, Amhara region, Ethiopia

Participants	ArtumaFursi		Dewacheffa		JileTimuga		Overall	
	N	%	N	%	N	%	N	%
Farmers	8	14.8	6	11.1	7	13.0	21	13.0
Traders	29	53.7	27	50.0	32	59.3	88	54.3
Hotels	12	22.2	14	25.9	11	20.4	37	22.8
Civil servants	5	29.3	7	13.0	4	7.4	16	9.9

Table 17: Major marketing Constraints of sheep and goat in study area

Major constraints	ArtumaFursi		Dewacheffa		JileTimuga		Overall	
	N	%	N	%	N	%	N	%
Price determine by visual	19	35.2	17	31.5	24	44.4	60	37.0
Lack of public market information	10	18.5	9	16.7	12	22.2	31	19.1
Long transportation	10	18.5	6	11.1	11	20.4	27	16.7
Price determine by brokers	15	27.8	22	40.7	7	13.0	44	27.2

Table 18: The major constraints of sheep and goat production in the study area

Parameter		ArtumaFursi		Dewacheffa		JileTimuga		Overall	
		N	%	N	%	N	%	N	%
Do you have breeding ram	Yes	46	85.2	48	88.9	38	70.4	132	81.5
	No	8	14.8	6	11.1	16	29.6	30	18.5
Do you have breeding buck	Yes	40	74.1	42	77.8	48	88.9	130	80.2
	No	14	25.9	12	22.2	16	11.1	32	19.8
Source of breeding ram	Own born	46	85.2	48	88.9	38	70.4	132	81.5
	Neighbors	8	14.8	6	11.1	16	29.6	30	18.5
Source of breeding buck	Own born	40	74.1	42	77.8	48	88.9	130	80.2
	Neighbors	14	25.9	12	22.2	16	11.1	32	19.8
Breeding/mating system	Control led	4	7.4	7	13.0	8	14.8	19	11.7
	Uncontrolled	50	92.6	47	87.0	46	85.2	143	88.3
Reason of uncontrolled mating	Graze/browse together	20	37.0	15	27.8	19	35.2	54	33.3
	Lack of awareness	27	50.0	31	57.4	25	46.3	83	51.2
	Insufficient no of ram/buck	7	13.0	8	14.8	10	18.5	25	15.4
Do you select breeding male and female	Yes	49	90.7	48	88.9	50	92.6	147	90.7
	No	5	9.3	6	11.1	4	7.4	15	9.3

R1=firstrank, R2=secondrank, R3=thirdrank, I=index

lack of price information (24.1%) and lack of access to markets (17.0%) were the constraints of sheep and goats marketing in southern Ethiopia.

**Major Constraints of Sheep and Goats Production in the Study Area:**

The major constraints of sheep and goat production in the study area are presented in Table 23. Disease, feed shortage, predator, lack of improved breed and drought and water shortage were major constraints of sheep and goats production across the study areas. Among those disease and feed shortage were the primary and secondary constraints of sheep in ArtumaFursi and Dewacheffa districts whereas, feed shortage and disease was the primary and secondary constraints of sheep in JileTimuga districts, respectively. On the other hand feed shortage and disease were

the primary and secondary constraints of goats in ArtumaFursi and JileTimuga district whereas, disease and feed shortage were the primary and secondary respectively constraints of goats in Dewacheffa districts. In the study area, feed shortage was one of the problems rearing sheep and goats especially in ArtumaFursi and JileTimuga district might be due to high Parthenium weed encroachment to the natural grazing land. Farmers should remove this Parthenium weed from the grazing land for avoiding feed shortage and favorable feed availability. The current result was in agreement with result of [16] who indicated that feed shortage and disease occurrences ranked 1<sup>st</sup> and 2<sup>nd</sup> as major goat rearing constraints in Bati area and [32] to which shortage of feed, disease, are the major constraints of sheep and goats in Tigray region.

## CONCLUSIONS

Sheep and goats production in all study districts was characterized by low input subsistence, multiple production objectives in marginal environments. Goats have better economically importance than sheep in prolific and income generation. In all the study districts sheep and goat marketing was traditional i.e. they did not use weighing balance, they did not have market information and the price determined by the involvement of brokers rather than seller and buyers. In all the study districts there is a high encroachment of *Parthenium* weed on the natural grazing lands. The major production constraints of small ruminant production in the study area were disease, feed shortages water scarcity, lack of improved breeds; uncontrolled mating system and market linked problems. So that it is better to improving the utilization of available crop residues and forage development by allotting part of their crop land or cultivation in order to avoid overcome the feed scarcity of sheep and goats during dry seasons. Uncontrolled breeding practice was common in all study districts consequently that should be minimized in order to increase productivity, enhance efficient utilization of selected breeding ram and buck. Qualitative traits like coat color type and pattern influenced the decision of farmers in selection of breeding sheep and goats so that farmers should consider the performance of the animals besides qualitative traits. *Parthenium* weed species weed encroachment in the natural grazing land was high so that removed from the grazing land in order to improve the natural feed resource and enhance productivity of sheep and goats.

## ACKNOWLEDGEMENTS

I am grateful thanks to Oromia Zone Animal and Fish resource Development office and ArtumaFursi, Dewachefa, and JileTimugaworeda office staffs for their help during data collection. I am also thankful for farmers participating in this study for providing their time.

## REFERENCES

1. CSA (Central Statistical Agency of Federal Democratic Republic of Ethiopia), 2017. Agri-cultural Sample Survey: Report on Livestock and Livestock Characteristics (Private Peasant Holdings). Statistical Bulletin, pp: 585.
2. Helen, N., M. Yoseph, K. Kefelegn, A. Solomon and K. Sanjoy Pal, 2013. Production objectives, breeding practices and selection criteria of indigenous sheep in eastern Ethiopia.
3. Woldu, T., A. Markemann, C. Reiber, P.C. Muth and A.V. Zárate, 2016. Optimising contributions of goat farming to household economic success and food security in three production systems in Ethiopia. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, 117(1): 73-85.
4. Tesfaye, A., 2004. Genetic characterization of indigenous goat population of Ethiopia using microsatellite DNA markers. A Thesis submitted to the National Dairy Research Institute (Deemed University) Karnal (Haryana), India, pp: 258.
5. IBC (Institute of Biodiversity Conservation), 2004. The State of Ethiopia's Farm Animal Genetic Resources: Country report. A Contribution to the first report on the State of the World's Animal Genetic Resources, Addis Ababa, Ethiopia.
6. Workneh, A., 1992. Preliminary Survey of Indigenous Goat Types and Goat Husbandry Practices in Southern Ethiopia. An MSc Thesis Presented to School of Graduate Studies of Alemaya University of Agriculture, Alemyaya, and Ethiopia, pp: 170.
7. ESGPIP (Ethiopia Sheep and Goat Productivity Improvement Program), 2011. Technical Bulletin No.44. Marketing your sheep and goat, pp: 15. Accessed 2 Nov. 2011.
8. Belete, A., K. Kefelegn and E. Kefena, 2015. Assessment of production and reproduction system of indigenous goat types in Bale Zone, Oromia, Ethiopia. *Academia Journal of Agricultural Research* 3(12): 348-360, December 2015. Madawlabu University, 2 Departments of Animal and Range Sciences, College of Agriculture, Ethiopia.
9. Aschalew Tsegahun, Sisay Lemma, Ameha Sebsibe, Abebe Mekoya and Zinash Seleshi, 2000. National Goat Research Strategies in Ethiopia. pp: 1-5. In: Merkel R.C, GirmaAbebe and A.L, Goetsch (Eds). The opportunities and Challenges of enhancing goat production in East Africa 10-12 November 2000. Debu University, Awasa, Ethiopia.
10. Tesfaye, T., 2009. Characterization of Goat Production Systems and On- Farm Evaluation of the Growth Performance of Grazing Goats Supplemented With Different Protein Sources in Metema, Amhara Region, Ethiopia. MSc Thesis Submitted to the School of Graduate Studies of Haramaya University, Ethiopia, pp: 108.

11. Mekuriaw, G., S. Gizaw and A. Tegegne, 2016. Genetic-phenotypic and production-system diversity in goat populations in Ethiopia: Options for sustainable production. LIVES Working Paper 22. Nairobi, Kenya: International Livestock Research Institute (ILRI). <https://www.researchgate.net/publication/311825404>.
12. Duguma, G., T. Mirkena, A. Haile, L. Iñiguez, A.M. Okeyo, M. Tibbo, B. Rischkowsky, J. Sölkner and M. Wurzinger, 2010. Participatory approaches to investigate breeding objectives of livestock keepers. Participatory definition of breeding objectives and implementation of community-based sheep breeding programs in Ethiopia, pp: 7.
13. Adane, H. and A. Girma, 2008. Economic significance of sheep and goats. pp: 32534. In: AlemuYami and R C Merkel (eds.). Sheep and Goat Production Handbook of Ethiopia.ESGPIP (Ethiopian sheepand goat productivity improvement program). Branna Printing Enterprise. Addis Ababa, Ethiopia.
14. Tsedeke, K., 2007. Production and marketing systems of sheep and goats in Alaba, Southern Ethiopia. An MSc Thesis Presented to the School of Graduate Studies of Hawasa University college of agriculture, Hawasa, pp: 120.
15. Halima, H., L. Samer, R. Barbara, B. Michael and T. Markos, 2012. Molecular characterization of Ethiopian indigenous goat populations. DOI 10.1007/s11250-011-0064-244:pp.1239-1246.
16. Hulunim, G., 2014. On- Farm Phenotypic Characterization and Performance Evaluation of Bati, Borena and Short Eared Somali Goat Population of Ethiopia. M.Sc. thesis presented to School of Graduate Study of Haramaya University, pp: 141.
17. OAFRDO, 2017/18. Oromia Zone of Animal and Fish resource Development Office.
18. Workneh, A. and J. Rowlands (Eds), 2004. Design, execution and analysis of the livestock breed survey in Oromiya Regional State, Ethiopia. OADB (Oromiya Agricultural Development Bureau), Addis Ababa, Ethiopia, ILRI (International Livestock Research Institute), Nairobi, Kenya.
19. Alubel, A., 2015. On-farm phenotypic characterizations and performance evaluation of Abergelle and Central highland goat breeds as an input for designing community-based breeding program. MSc thesis. Haramaya University, Haramaya, Ethiopia.
20. Yadeta, N., 2016. Production and Reproductive Performances, Procedures Traits Preferences and Marketing Systems of Small Ruminants in Ada Barga and Ejere Districts of West Shoa zone. MSc thesis submitted to the department of animal science, school of graduate studies, Jimma University, Ethiopia.
21. Dhaba, U., D. Belay, D. Solomon and T. Taye, 2013. Breeding Practices and Reproductive Performance of Traditionally Managed Indigenous Sheep and Goat in Ilu Abba Bora Zone of Oromia Regional State, Ethiopia. Department of Animal Sciences, College of Agriculture, Jimma University, Jimma, Ethiopia. *Global Veterinaria* 10 (6): 676-680, 2013. 10.5829/idosi.gv.2013.10.6.64163.
22. Solomon, G., T. Azage, G. Berhanu and H. Dirk, 2010. Sheep and goat production and marketing systems in Ethiopia: Characteristics and strategies for improvement. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 23. ILRI (International Livestock Research Institute), Nairobi, Kenya, pp: 58.
23. Shewangzaw Addisu and Adis Kassahune, 2016. Sheep Production and Marketing System in North Gondar Zone of Amhara Region, Ethiopia.
24. Mesfin, A., 2015. On Farm Phenotypic Characterization Of Indigenous Sheep Types And Their Production Systems In Wolaita Zone, Southern Ethiopia. M.Sc. Thesis, Haramaya University, Haramaya.
25. Bekalu, M., 2014. Phenotypic characterization of indigenous goat types and their production system in West Gojam Zone of Amhara region, Ethiopia. MSc Thesis Haramaya University.
26. Ahmed, S., 2013. On-farm phenotypic and production system Characterization of indigenous goats in HorroGuduruWollega Zone, Western Ethiopia M.sc. thesis Haramaya, university.
27. Hizkel, K., 2017. On-Farm Phenotypic Characterization and Consumer Preference Traits of Indigenous Sheep Type as an Input for Designing Community Based Breeding Program in Bensa District, Southern Ethiopia. M.Sc. thesis presented to School of Graduate Study of Haramaya University.<http://www.lrrd.org/lrrd24/1/asse24016.htm>.

28. Belete, A., 2013. On Farm Phenotypic Characterization of Indigenous Goat Types and their Production System in Bale Zone of Oromia Region, Ethiopia. MSc thesis. Haramaya University, Haramaya, Ethiopia.
29. Tesfaye, G., 2008. Characterization of Menz and Afar indigenous sheep breeds of smallholders and pastoralists for designing community-based breeding strategies in Ethiopia. MSc thesis, Haramaya University, Ethiopia.
30. Alefe, T., 2014. Phenotypic Characterization of Indigenous Goat Types and their Production System in Shabelle Zone, South Eastern Ethiopia. MSc thesis. Haramaya University, Haramaya, Ethiopia.
31. Solomon, A., 2014. Design of community based breeding programs for two indigenous goat breeds of Ethiopia. Doctoral Thesis. BOKU-University of Natural Resources and Life sciences, Department of Sustainable Agricultural Systems, Division of Livestock Sciences, Vienna, Austria.
32. Zewdu, E., 2008. Characterization of Bonga and Horro indigenous sheep breeds of smallholders for designing community-based breeding strategies in Ethiopia. MSc thesis, Haramaya University, Ethiopia.
33. Assen, E. and H. Aklilu, 2012. Sheep and goat production and utilization in different agro-ecological zones in Tigray, Ethiopia. *Livestock Research for Rural Development*. Volume 24, Article #16. Retrieved November 10, 2017.