

**Original Article****Characterization of Indigenous Goat Production System and
Production Constraints in East Arsi Zone, Oromia Region, Ethiopia****Teramaj Abebe¹, Ahmed Seid² and Samuel Tilahun²**¹Mekdela Amba University, Department of Animal Science, Ethiopia²Jimma University, College of Agriculture and Veterinary Medicine, Ethiopia**ABSTRACT**

This study was aimed to generate organized information based on household survey. The study was conducted in three districts each representing different agro-ecologies. A total of 156 households (52 in each agro-ecology) were interviewed for the household survey. Data on goat production system were collected through questionnaire. The collected data recorded and analyzed by using SPSS version 20 and then described by descriptive statistics. According to this study, the average goat flock size in household was 7.6 in highland, 7.75 in midland and 10.2 in lowland study areas. The main reason of keeping goat in study area was for cash income, milk production, saving purpose. Natural pasture and river were the major feed and water source for goats in the study area in dry and rain season respectively. The majority of the households use separate type of housing in highland (59.6%) and in midland (76.9%) study areas, while in lowland (73.1%) study area uses kraal types of housing system. Herding practice of farmers 78.8% in highland, 90.4% in midland and 67.3% in lowland study areas of households run their goats separate from other households. Most of goat owners in the study area use uncontrolled type of mating. Growth rate, body appearance, litter size and color are most important traits in study area to select breeding bucks and does. In this area about 53.8% in highland, 51.9% in midland and 75% in lowland farmers did not carry out castration practice. As indicated present result, goat pox, diarrhea, ticks, anthrax and foot and mouth disease were goat diseases prevail in the study area. For treating their goats majority (62.8%) of goat owners in the study area accessed only government veterinary clinics. Feed shortage, disease and predator were main goat production constraints in study area. From this study results, improved forage establishment program, developing water sources,

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animal health service extension, awareness regarding the importance of castration and fattening and training for goat owners to focus on economically important traits during selection are forwarded for this study area.

Keywords: Constraints, East Arsi Zone, Indigenous goat, production system

INTRODUCTION

Goats provide comparative advantage for resource poor livestock keepers over other species due to their small body size, broad feeding habits, adaptation to unfavorable environmental conditions and short reproductive cycle (Umeta *et al.*, 2011). Habitats of goat breeds extend from the arid lowlands (the pastoral and agro-pastoral production system) to the humid highlands (mixed farming systems) covering even the extreme tsetse-infested areas of the country (Workneh, 1992). The flock size of goats is larger in the lowland mixed crop-livestock and pastoral and agro-pastoral systems (Solomon *et al* 2010). In the highlands, because of shrinking cultivated areas per household, reduced feed availability and land degradation, goats are kept in a small flock size (Tegegn *et al.*, 2012).

In Ethiopia, goats are important for increasing income, building capital, contributing to human nutrition and reducing risk (Tegegn *et al.*, 2012). The short generation interval and high frequency of multiple births of goats allow for rapid increases in number of goats. This builds financial capital and allows the sale of surplus goats for cash that can be used for different purposes in a country (Alemu; Merkel, 2008).

Despite the wide distribution and large size of Ethiopian goat population, the productivity per unit of animal and the contribution of this sector to the national economy is relatively low. Goat production accounts for 16.8% of total meat supply (Ameha, 2008) and 16.7% of milk consumed in the country (Tsedeke, 2007). The average annual meat consumption per capital in the country is estimated to be 8 kg/year which is lower than the global average meat consumption which is 38 kg /year (Ameha, 2008). The average carcass weight of Ethiopian goats is 10 kg, which is the second lowest in sub-Saharan Africa (Adane and Girma, 2008). This may be due to different factors such as poor nutrition, prevalence of diseases, lack of appropriate breeding strategies and poor understanding of the production system as a whole (Tsfaye, 2009). A number of technical, institutional and socio-economic problems also have been identified for low productivity (Solomon et al 2010).

To solve these problems in a country, knowing production system and production environment of livestock is essential. But there are some places in Ethiopia that production system of goats did not addressed by research particularly East Arsi Zone. East Arsi zone is one of the sources of indigenous goat genetic resource from Oromia region. The Zone has total goat population of 789,864 and they are source for meat, cash income and milk production (EAZAO, 2018). Despite these goat sources and their significance, their system of production has received little attention in research. Therefore, this study was aimed to characterize production system and production constraints of goats in east Arsi Zone of Oromia Region.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in East Arsi Zone of Oromia Regional State of Ethiopia. Its capital city is Asella and it is far from Addis Ababa by 175km and located at 7.950° North Latitude and 39.117° East Longitude. East Arsi Zone is one among 20 zones of the Oromia regional state and consists of 24 rural districts and one town administration. The zone is bordered on the south by Bale, on southwest by the West Arsi Zone on the northwest by East Shewa on the north by the Afar Region and on the east by West Hararghe. It is characterized by three agro-ecological zone highland, midland and lowland settings. Its general elevation ranges from 500 to 4245masl. It receives 700–1658 mm rainfall per annum and annual temperature ranges from 10°C to 22.6°C (EZAEO, 2018).

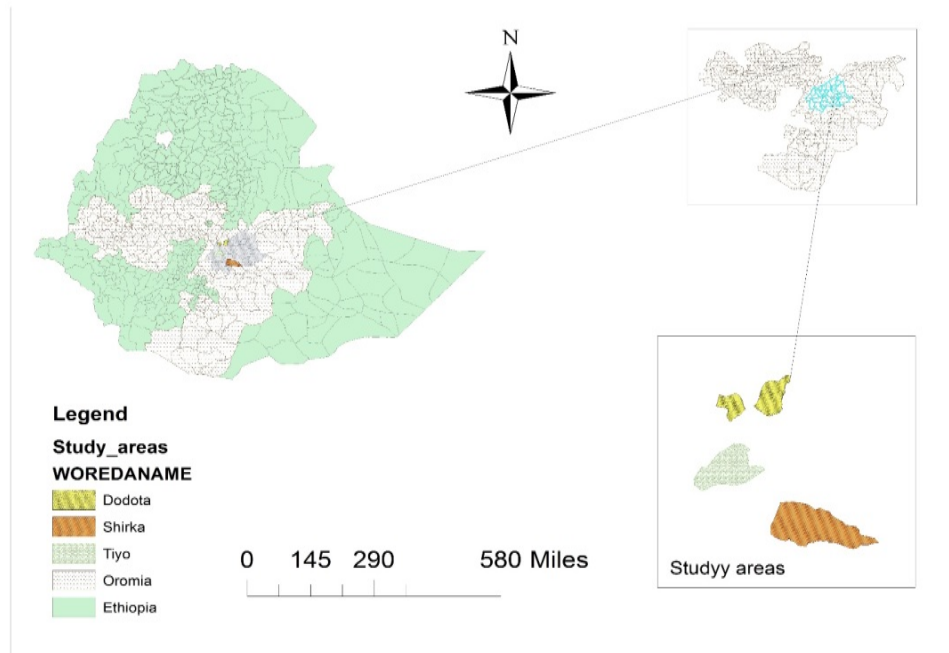


Figure 1. Map of the study area

Sampling Technique and Sample size determination

Sampling technique

Based on the information obtained from secondary data sources, the districts in east Arsi zone (twenty-four) were stratified into three according to their agro-ecological variations. From each agro-ecological zone, one sample district was purposively selected based on relatively large goat population. Accordingly, Tiyo for highland, Shirka for midland and Dodota for lowland part of the Zone were selected for actual data collection. From each district, three kebeles were purposively selected again based on relatively large goat population. From each sample kebele, households were stratified according to their ownership of goats; goat owners (households who have at

least two goats). From the total goat owner households, representative sample households were randomly selected for the interview of their management practices.

Sample size determination for households

Sample size of the households was determined according to the formula given by Cochran's (1977).

$$n = \frac{Z^2 * (P)(q)}{e^2}$$

n = sample size

Z = standard normal deviation (1.96 for 95% confidence level)

P = 0.115 (estimated population variability proportion, 11.5%)

q = 1-P i.e. (0.885)

e = level of precision (0.05)

Based on the formula, the following numbers of respondents were selected.

$$n = \frac{Z^2 \times p(q)}{e^2} = \frac{[(1.96)^2 \times 0.115(1 - 0.115)]}{(0.05 \times 0.05)} = \frac{3.8416 \times 0.101775}{0.0025} = 156$$

Data Types and Methods of Data Collection

Questionnaire and group discussion were used to collect primary data about management system, breeding practices and production constraints of goat owners. A questionnaire was prepared by adopting a questionnaire developed by ILRI (International Livestock Research Institute) for survey of livestock breeds. The questionnaire was re-arranged, and corrected in accordance with respondent perception. Then, it was administered to the randomly selected household heads by enumerators recruited and trained for the purpose with close supervision by the researcher. Based on the questionnaire, information on flock structure, breeding practice, feed sources, water sources, housing, herding practice, selection criteria, castration and fattening practices, diseases prevalence and production constraints were gathered.

Focused group discussion was made with elder farmers, women goat owners, village leaders, and socially respected farmers who are known to have better knowledge on the present and past social and economic status of the study areas to substantiate the information collected through questionnaire. Through group discussion information on the existing goat breed, current status of goats and major constraints for goat production were collected.

Secondary sources

Secondary data was collected from the respective district office of livestock and Fishery resource to complement the production system along with the climatic data, vegetation cover, topography, geographical location, and human and livestock demography.

Statistical data Analysis

All collected data were entered Microsoft office Excel 2007 computer software and analyzed using different types of statistical analysis depending upon the nature of the data. Descriptive statistics were employed to summarize and describe categorical variables. Data generated from questionnaire were analyzed by SPSS statistical package (SPSS version 20). Chi-square (χ^2) test was carried out to assess the statistical significance among categorical variables using agro-ecology as fixed effect. An index was calculated to provide overall ranking for qualitative data such as constraints of goat production, purpose of keeping goat, disease, selection criteria of female and male goats by the following formula: Index = Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular qualitative variable divided by Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all qualitative variables considered.

RESULT AND DISCUSSION

Goat flock size and structure

Flock size and structure of goats in the study area are presented in Table 1. The proportion of the different classes of animals reflects the management decision of the producers which in turn is determined by their production objectives (Solomon *et al.*, 2010). Goat flock structure in lowland study area in all age and sex categories were significantly ($p < 0.05$) different, except in male kids less than 6 months, male from six months to one-year age (buck kid) and castrated than midland and highland study areas. Breeding does take a major portion (43%, 39% and 44%) in highland, midland and lowland agro-ecological zone, respectively, followed by female kids < 6 month (12% in highland 14% in midland, and 12.45% in lowland. According to the report of the respondents, large proportion of breeding does in the study areas implied that the desire of farmers to have more number of kids and milk access. This finding is in agreement with FARM-Africa (1996) who reported that high proportion of females reflecting the owners' desire for milk.

Table 1: Average goat flock size per household and structure in the study area

Goat flock structure	Agro-ecology			
	Highland	Midland	Lowland	Overall
	Mean $\pm$ SE	Mean $\pm$ SE	Mean $\pm$ SE	Mean $\pm$ SE
Male kids < 6 months	0.88 $\pm$ 0.06	0.94 $\pm$ 0.08	1.1 $\pm$ 0.05	0.97 $\pm$ 0.04
Female kids < 6 month	0.92 ^b $\pm$ 0.06	1.08 ^{ab} $\pm$ 0.07	1.27 ^a $\pm$ 0.05	1.1 $\pm$ 0.03
Male 6-month-1 year	0.86 $\pm$ 0.09	0.98 $\pm$ 0.06	1.04 $\pm$ 0.05	0.96 $\pm$ 0.02
Female 6-month-1 year	0.90 ^b $\pm$ 0.05	1.08 ^{ab} $\pm$ 0.07	1.15 ^a $\pm$ 0.06	1.05 $\pm$ 0.04
Breeding buck	0.40 ^b $\pm$ 0.07	0.38 ^b $\pm$ 0.05	0.71 ^a $\pm$ 0.06	0.49 $\pm$ 0.03
Breeding doe	3.28 ^b $\pm$ 0.15	3.02 ^b $\pm$ 0.12	4.48 ^a $\pm$ 0.16	3.6 $\pm$ 0.1
Castrated	0.38 $\pm$ 0.07	0.27 $\pm$ 0.06	0.40 $\pm$ 0.07	0.35 $\pm$ 0.04
Total	7.62 ^b $\pm$ 0.19	7.75 ^b $\pm$ 0.12	10.2 ^a $\pm$ 0.07	8.5 $\pm$ 0.12
Doe: Buck	1:8	1:8	1:6	1:7

The proportion of breeding buck in lowland study area were significantly ($p < 0.05$) higher than the midland and highland study areas. Moreover, in lowland study area the number of kids less than 6 month and males between 6 months and 1 year were higher

in the flock than highland and midland study areas. In the study area, the ratios of breeding buck to breeding doe were 1:8 in highland, 1:8 in midland and 1:6 in lowland. The overall ratio of breeding doe to breeding buck in study area was 1:7. This result was lower when compared with (1:9) the report of Nigatu (1994) for Ethiopia and Eritrea goats in pastoral flock. In contrast, the result of this finding was higher as compared to the report of Grum (2010) and Endeshaw (2007) who reported the ratio of buck to doe was 1:5 and 1:4, respectively.

Purpose of goat keeping in the study area

The purpose of keeping goat by the respondents in the study area is presented in Table 2. Knowledge of reasons for keeping animals is a prerequisite for deriving outfitted breeding goals (Jaitner *et al.*, 2001). In highland and midland study areas, the primary reason of rearing goats by goat owners were income generation. ($I = 0.45$ for highland and $I=0.51$ for midland study areas). Keeping goats for saving purpose were the secondary objective of goat owners with an index value of 0.17 and 0.20 for highland and midland study areas, respectively. However, in lowland study area keeping goats for milk production and income generation purpose were the primary and secondary objectives of goat owners with index values of 0.33 and 0.32, respectively. Goat keeping for milk production purpose was the third objective of goat owners in highland and midland study areas. While in lowland study area, the third purpose of keeping goats was saving with an index values of 0.13. Functions like ceremony and manure took relatively low ranking among the reasons for keeping goat in the three study area. The results of this survey revealed that goat play multi-functional roles in the three study areas with similar production objectives.

The primary purpose of keeping goats reported in this study was in line with the result of Mahilet (2012) who reported that goats in Eastern Hararghe zone were primarily reared for generating income followed by milk production. In contrast to this study, in Gonji Kolela district the primary purpose of keeping goat by goat owners was for meat consumption followed by saving (Bekalu, 2014)

Table 2. Purpose of goat keeping in the study area

Purpose of keeping	Agro-ecology												Overall
	Highland				Midland				Lowland				
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I	
Income	36	15	1	0.45	45	5	0	0.51	24	11	6	0.32	0.43
Milk	4	14	6	0.15	2	11	12	0.14	18	23	4	0.33	0.21
Meat	2	14	12	0.14	1	12	12	0.10	2	8	18	0.13	0.12
Saving	8	8	13	0.17	4	19	7	0.20	6	5	13	0.13	0.16
Ceremony	0	3	11	0.05	0	1	0	0.01	0	0	1	0.00	0.02
Manure	0	1	9	0.04	1	3	19	0.04	3	5	8	0.09	0.06

R=rank, I=Index = sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for particular purpose divided by sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all purpose.

Housing of goats in study area

The type of housing, housing materials and flock of goats in the house are presented in the Table 3. The chi square test indicated that the type of housing used by the

respondents for their goats was significantly different ($p < 0.05$) among the three agro ecologies. Majority (59.6% in highland and 76.9% in midland) of goat owners used separate type of housing but, 73.1% of goat owners in lowland agro ecology used kraal. About, 40.4% and 23.1% of goat owners in highland and midland used veranda housing system. However, 26.9% of households in lowland agro ecology used yard housing system. In lowland agro ecology the reason for using yard housing system and kraal type of housing was due to high temperature in the area.

The most dominant housing systems in the study area were separate house (45.5%) followed by kraal (24.4%), veranda (21.2%) and yard (9%). In line to this finding, Ahmed (2013) reported that majority (77.12%) of respondents in Horro Guduru wollega zone practiced housing of goats in separate house. This result contradicts with the result of Alubel (2015) who indicated that proportion of farmers (67.9%) practicing housing of goats in family house were significantly higher when compared with separate house in LayArmachiho district and dominant housing system in Bale zone was kraal (45.55%) followed by separate house (28.10%) and yards (25.28%) (Belete, 2013).

Table 3: Housing of goats in the study area

Housing enclosure for adult goats	Agro-ecology							
	Highland		Midland		Lowland		overall	
	N	%	N	%	N	%	N	%
Separate house	31	59.6	40	76.9	-	-	71	45.5
Veranda	21	40.4	12	23.1	-	-	33	21.2
Kraal	-	-	-	-	38	73.1	38	24.4
Yard	-	-	-	-	14	26.9	14	9
X^2								161.39*
Goat housed								
Alone	32	61.5	29	55.8	23	44.2	84	53.8
Together with sheep	15	28.8	16	30.8	12	23.1	43	27.6
Together with cattle	5	9.6	7	13.5	17	32.7	29	18.6
X^2								10.66*
Type of housing Material								
Wooden with grass	26	50	30	57.7	-	-	56	35.9
Stone with grass	14	26.9	12	23.1	-	-	26	16.7
Wooden with iron sheet	12	23.1	10	19.2	-	-	22	14.1
Wooden without roof	-	-	-	-	34	65.4	34	21.8
Stone without roof	-	-	-	-	18	34.6	18	11.5
X^2								156.93*

N=Number of households. X^2 = chi-square value

The type of material used for housing of their goats was significantly different ($p < 0.05$) among the three agro ecologies. This study showed that goat owners used wooden with grass (50% in highland and 57.7 % in midland), stone with grass (26.9% in highland and 23.1% in midland) and wooden with iron sheet (23.1% highland and 19.2% in midland) for housing their goats. However, in lowland agro ecology, 65.4% and 35.4% of goat owners used wooden without roof and stone without roof for housing their goats. The difference in housing materials might be due to availability of housing materials and environmental condition in the study area.

In the study area, most of the households (53.8%) housed their goats separate from other species while 27.6% of them with sheep and 18.6% of them with cattle. Similar to this study, Ahmed (2013) reported that most (75.4%) of the households in Horro Guduru wollega zone housed goats separate from other species while 24.51% of them housed goats together with sheep. The current result is in contrast with the result of Tsigabu (2015) who indicated that (47%) respondents housed their goats together with other animals in the open yard. Housing systems in three agro ecologies are shown below in Figure 2.



Figure 2. a. Goat houses in midland b. Goat houses in highland c. Goat houses in lowland

Herding practices in the study area

The goat herding practice of respondents in the study area is presented in Table 4. The main objectives of herding in the study area were to prevent goat from damaging crops, theft and predators. The result of this study showed that, 78.8% in highland, 90.4% in midland and 67.3% in lowland study areas of households run their goats separated from other households while 21.2% in highland, 9.6% in midland, and 32.7 % in lowland study areas of households run their goats with other household goats. The reason why they herded their goats together with neighboring goats was that they use communal grazing land. In this study, 69.2%, 61.5%, and 34.6% of goat owners in highland, midland and lowland study areas, respectively herded all classes of goats together. However, 30.8% of goat owners in highland, 38.5% in midland and 65.4% in lowland keep kids separated from other class of goats. Kids were separated from other flock higher in lowland study area than midland and highland study areas. The reason is that milk is the main product for the society, which causes competition with kids. These figures were similar to the report of Belete (2013) who reported that about 97.8% of the respondents herded kids separate from the adult goats in Bale Zone. In study areas, 36.5% in midland and 46.2% in lowland of the owners herded their goat alone however, 32.7% of goat owners in highland study area herded their goats with other animals. While the remaining households 25% in highland herded together with sheep, 26.9% in midland herded with all animals together and 25% in lowland herded together with cattle. The overall herding practice of respondents in the three study areas were 19.2% with sheep, 21.2% with cattle, 25.6% all animals together and

34% herded goats alone. In contrary to this study, Bekalu (2014) reported that majority (74.81%) of goat owners in West Gojam Zone kept their goats with cattle.

Table 4: Goat herding practice in the study area

Goat herding system	Agro-ecology							
	Highland		Midland		Lowland		Overall	
	N	%	N	%	N	%	N	%
Goat of household	41	78.8	47	90.4	35	67.3	123	78.8
More than households	11	21.2	5	9.6	17	32.7	33	21.2
X^2								8.30*
How goat flocks herded								
Kids are separated	16	30.8	20	38.5	34	65.4	70	44.9
All classes together	36	69.2	32	61.5	18	34.6	86	55.1
X^2								13.89*
Goat flocks herded								
Together with sheep	13	25	11	21.2	6	11.5	30	19.2
Together with cattle	12	23.1	8	15.4	13	25	33	21.2
All herded together	17	32.7	14	26.9	9	17.3	40	25.6
Herded alone	10	19.2	19	36.5	24	46.2	53	34
X^2								12.02 ^{ns}

X^2 =chi-square value, N=number of respondent

Breeding practices

Mating systems and sources of buck for mating in the study area are presented in Table 5. Majority (73.7%) of goat owners in the study area used uncontrolled type of mating. In highland agro ecology, the proportion of goat owners practiced uncontrolled mating was less (65.4%) compared with the proportion of goat owners (84.6%) in lowland agro ecology. The reasons could be more than a house hold goats were grazing together in the same grazing land in lowland agro ecology than highland agro ecology. From the farmers who practiced uncontrolled mating, majority of them (67%) could not identify the sire of a kid and some of respondents (33%) could identify only by its color and body size. The reason of respondents practiced uncontrolled mating method was that more than household's goats were grazing together in the same grazing land. In addition, majority of goat owners indicated that there was no separate housing and herding for male and female goats (male and female goats were housed and herded together throughout the year) in the study area. The result of this study was similar with the result of Ahmed (2013) indicated that, most (72%) of goat owners used uncontrolled mating method. On the other hand, 34.6% of respondents in highland, 28.8% in midland, and 15.4% in lowland indicated that they were practiced semi-controlled mating method for breeding their goats.

In the study area, most (78.8%) of respondents allowed their does to be served by anyone else buck from the mixed flock while only 21.2% of goat owners protected their does from anyone else buck from the mixed flock. As they indicated during the group discussion, they protect their does from the buck which had black coat color type. The goat owners did not prefer goat with black coat color due to their cultural preference and ignorance of this color in the market.

Most of the households in the study area did not practice special management for bucks. About 43.8% of the respondents in the study area kept bucks for both mating and fattening while 35.4% of the farmers reserved bucks for mating only and the remaining (20.8%) of them kept buck for fattening purpose only. In the other study, which is different from this, the majority (44.79%) of the pastoralists in Gewane district kept breeding bucks for the purpose of breeding and socio-cultural purposes (Seifemichael, 2013).

Table 5: Breeding practices of farmers in the study areas

Breeding practice	Agro-ecology							
	Highland		Midland		Lowland		Overall	
	No	%	No	%	No	%	No	%
Mating systems								
Uncontrolled	34	65.4	37	71.2	44	84.6	115	73.7
Partially controlled	18	34.6	15	28.8	8	15.4	41	26.3
χ^2								5.3^{ns}
If uncontrolled could you able to identify the sire of a kids								
Yes	23	67.6	24	64.9	30	68.2	77	67
No	11	32.4	13	35.1	14	31.8	38	33
χ^2								0.11^{ns}
Do you allow your doe to be served by any buck								
Yes	41	78.8	38	73.1	44	84.6	123	78.8
No	11	21.2	14	26.8	8	15.4	33	21.2
χ^2								2.75^{ns}
Do you have local buck								
Yes	16	30.8	20	38.5	12	23.1	48	30.8
No	36	69.2	32	61.5	40	76.9	108	69.2
χ^2								2.89[*]
Do you allow your buck to serve does other than yours								
Yes	11	68.8	13	65	8	66.7	32	66.7
No	5	31.2	7	35	4	33.3	16	33.3
χ^2								0.06^{ns}
Purpose of keeping Buck								
Mating only	6	37.5	7	35	4	33.3	17	35.4
Fattening only	3	18.8	5	25	2	16.7	10	20.8
Mating and fattening	7	43.8	8	40	6	50	21	43.8
χ^2								0.5^{ns}
Source of breeding Buck								
Born in the flock	7	43.8	12	60	5	41.7	24	50
Purchased in partner	4	25	2	10	3	25	9	18.8
Purchased in private	5	31.2	6	30	4	33.2	15	31.2
χ^2								2.12^{ns}

N=Number of household, χ^2 = chi-square value

Selection criteria

Selection of parents for the next generation from both bucks and does was very common in the study area and the selection criteria in the study areas are presented in Table 6. Growth rate, body size/appearance and color were most important traits and given first, second and third ranks in the study area to select breeding bucks. Bucks

which grow at faster rate and have large body size with white color are the most preferred bucks by most of the farmers in all the study areas.

For selecting does, growth rate, litter size and size/appearance were most important traits. In highland and midland agro ecologies, growth rate, litter size and size/appearance were the 1st, 2nd and 3rd ranks given by goat owners to select their breeding does, respectively. However, in lowland agro ecology litter size was the primary criteria to select breeding does, followed by both growth rate and size/appearance.

Table 6. Selection criteria of breeding buck and does in the study area

Selection Criteria	Agro-ecology												Overall I
	Highland				Midland				Lowland				
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I	
For buck													
Color	6	10	10	0.17	10	4	6	0.20	4	6	10	0.11	0.16
Growth rate	16	20	7	0.29	13	9	11	0.32	17	10	7	0.25	0.29
Size/appearance	14	11	13	0.26	7	14	8	0.27	12	16	12	0.26	0.26
Docility	2	1	4	0.05	1	2	8	0.07	0	9	7	0.08	0.07
Libido	1	6	9	0.09	1	4	0	0.05	3	0	6	0.05	0.06
Horn presence	3	4	1	0.05	0	0	0	0.06	5	2	3	0.08	0.06
Family History	7	1	4	0.09	1	0	2	0.03	13	7	1	0.17	0.10
For doe													
Color	2	1	2	0.04	7	0	1	0.09	3	7	1	0.08	0.07
Growth rate	11	20	9	0.29	15	12	10	0.31	6	20	12	0.21	0.27
Age at 1 st kidding	1	5	2	0.05	1	2	3	0.05	5	3	3	0.07	0.06
Litter size	14	10	15	0.27	9	10	18	0.26	17	10	9	0.24	0.26
Size/appearance	12	5	13	0.21	6	11	8	0.19	14	7	12	0.21	0.20
Family history	5	3	4	0.1	4	0	1	0.02	1	2	3	0.17	0.10
Kidding Interval	2	2	4	0.04	1	8	1	0.08	1	0	4	0.02	0.05

Index= sum of (3 X selection criteria ranked first + 2 X selection criteria ranked second + 1 X selection criteria ranked third) given for each districts divided by sum of (3 X selection criteria ranked first + 2 X selection criteria ranked second + 1 X selection criteria ranked third) for all district. I=index, R=rank.

Castration and fattening

Goat castration practice, castration reason, fattening practice and types of goats for fattening in the study area are summarized in Table 7. About 53.8%, 51.9% and 75% of respondents in highland, midland and lowland agro ecologies, respectively did not carry out castration practice. The reason that most of respondents did not practice castration in the study area was due to male goats sold before reach for castration age. In contrast to the result of this study, Mahilet (2012) indicated that among the

respondents in Meta, Gurawa and Babbile districts majority of the farmers (70.99%) practiced castration.

On the other hand, the remaining respondents (46.2% in highland, 48.1% in midland and 25% in lowland) practiced castration. About 59.7% of the respondents in study area practiced modern castration method, which was made by animal science experts at animal health station or veterinary clinic. On the other 40.3% of the respondents in study areas, apply traditional castration methods by selected farmers that use traditional material (hammer) and the type of castration they practiced was close castration. Most of respondents that reported the main age of castration was from one year to two years (53.2%) followed by less than six months (29%) and greater two years (17.7%) in study areas.

Table 7. Fattening and castration practices of goats in the study area

Fattening and castration practices	Agro-ecology							
	Highland		Midland		Lowland		Overall	
	N	%	N	%	N	%	N	%
Farmer use castration practice								
Yes	24	46.2	25	48.1	13	25.0	62	39.7
No	28	53.8	27	51.9	39	75.0	94	60.3
Castration reason								
Control breeding	4	16.7	2	8.00	4	30.8	10	16.1
Improve fattening	12	50.0	21	84.0	6	46.2	39	62.9
Better temperament	8	33.3	2	8.00	3	23.1	13	21.0
Castration methods								
Modern	13	54.2	17	68	7	53.8	37	59.7
Traditional	11	45.8	8	32	6	46.2	25	40.3
Age of castration								
<6month	8	33.3	6	24	4	30.8	18	29
1-2 year	12	50	14	56	7	53.8	33	53.2
>2 year	4	16.7	5	20	2	15.4	11	17.7
Fattening practice								
Yes	18	34.6	22	42.3	16	30.8	56	35.9
No	34	65.4	30	57.7	36	69.2	100	64.1
Category of animal to be fatten								
Old female	7	38.9	8	36.4	6	37.5	21	37.5
Castrates male	11	61.1	14	63.6	10	62.5	35	62.5

N=Number of household,

The main reason for castration of goats was for improving fattening (50% in highland, 84% in midland and 46.2% in lowland). Castration for better temperament was also the other reason of respondents (33.3% in highland, 8% in midland and 23.3% in lowland) next to improving fattening. Castration for controlling unwanted breeding was the reason of the remaining few respondents in the study area. The lower result was reported in Amibara and Gewane districts, 22.7% and 24.7%) respectively, that of respondents castrate their bucks to improve fattening (Seifemichael, 2013)

The result of this study showed that majority of respondents in the study area did not practice fattening (65.4% in highland, 57.7% in midland and 69.2% in, lowland agro

ecologies) while the remaining goat owners (34.6% in highland, 42.3% in midland and 30.8% in lowland) practiced traditional fattening. According to the respondents, the reasons they practiced traditional fattening were lack of information about fattening methods, no enough feed resource, and lack of market access in the study areas. In contrast to this finding, Bekalu (2014) reported that in west Gojjam zone, majority (98.89%) of goat owners practiced fattening of goats.

Types of goats commonly used for fattening in the study area were old female and castrated male. Those goat owners who carry out fattening preferred castrated male and old female. None of the goat owners used young female goats for fattening because they mostly used them for breeding purpose. The type of feed resources used for fattening was natural pasture and few farmers used food left overs in addition to natural pasture for fattening of goats. Fattening usually practiced following the end of the main rainy season and in the beginning of dry season due to the availability of good quality and quantity of natural pasture, better forage production and aim to specific market (holiday market).

Feed resources

Feed resources during dry and rainy seasons in the study area are presented in Table 8. There was significant difference among study areas ($p < 0.05$) for sources of feed in rainy season. Most (90.4%) of respondents in lowland study area, used natural pasture only as a sources of feed for their goats while in midland study area, only 57.7% of goat owners used natural pasture alone as a sources of feed for their goats. Nearly half (42.3%) of respondents in midland study area used natural pasture and fallow land together as sources of feed for their goats in rainy season where as in lowland study area only 9.6% of respondents used natural pasture and fallow land together as a sources of feed for their goats in rainy season.

Table 8: Major feed resources during the dry and wet seasons in the study area

Type of feed sources	Agro-ecology							
	Highland		Midland		Lowland		Overall	
	N	%	N	%	N	%	N	%
Rainy season								
Natural Pasture Only	37	71.2	30	57.7	47	90.4	114	73.1
Fallow land + Natural pasture	15	28.8	22	42.3	5	9.6	42	26.9
X²								14.27*
Dry Season								
Natural Pasture Only	27	51.9	20	38.5	30	57.7	77	49.4
Fallow land +Natural pasture	10	19.2	8	15.8	9	17.3	27	17.3
Crop after month+Fallow land+	15	28.8	24	46.2	13	25	52	33.3
Natural pasture								
X²								6.24*

N=Number of household

In dry season, there was no significant difference among study area ($p > 0.05$) in source of feed. As the survey result indicated 51.9%, 38.5% and 57.7% of goat owners in highland, midland and lowland study areas, respectively used natural pasture only as sources of feed for their goats. Around 28%, 46.2%, and 25% of respondents in

highland, midland and lowland study areas, respectively used crop aftermath, fallow land and natural pasture together to feed their goats in dry season.

Most of the goat owners in this study area used the natural pasture as the first source of feed for their goats. Not only for goat but also for other livestock, natural pasture was the main feed source in the study areas. This indicates the main access of feed for livestock production in these study areas was natural pasture. A few number of the goat owners in this study reported improved pasture as their animal feed source for example elephant grass. Crop byproduct was also common in this study area indicating there was trend of crop production by the study communities. The current study was in agreement with different authors Belete (2013), Ahmed (2013) and Hulumin (2014) who reported in Bale Zone, Horro Gudruu Wollega Zone and Somali area natural pasture was major source of feed, respectively.

Water sources and availability

Water sources, watering frequency and watering point for goats in the study area are presented in Table 9. The main water sources in the study area were river, spring, pipe, rain water and ponds. However, the importance of these water resources was slightly different in different seasons. In the study area, rivers were the main source of water in both dry and rainy season which accounts 50 % in dry season and 34.6% in wet season. The second source of water in dry season was pipe water whereas in rainy season rain water was the main source of water next to river. The amount of water during dry season was decreasing and sometimes totally absent in lowland agro-ecology. When water was missed in the area, the owners traveled distant area for searching of water and sometimes used pipe water to overcome the problem. The respondents reported that this problem was mainly common during the dry season especially in lowland study area. Similar to this study, Ahmed (2013) indicated that rivers were generally the most important sources of water during dry and wet seasons in mixed production system of Horru Guduru Wollega zone. The current result is also in agreement with the result of Alubel (2015) who reported that rivers were an important source of water during dry and wet seasons in crop livestock production system.

Table 9. Water sources and frequency of watering for goat in the study area

Variables	Agro-ecology							
	Highland		Midland		Lowland		Overall	
	N	%	N	%	N	%	N	%
Dry season								
River	29	55.8	33	63.5	16	30.8	78	50
Spring	11	21.2	10	19.2	7	13.5	28	17.9
pipe water	7	13.5	6	11.5	19	36.5	32	20.5
Pond	5	9.6	3	5.8	10	19.2	18	11.5
Wet season								
Rain water	19	36.5	17	32.7	14	26.9	50	32
Spring	15	28.8	13	25	10	19.5	38	24.4
River	14	26.9	19	36.5	21	40.4	54	34.6
Pond	4	7.7	3	5.8	7	13.5	14	9

N=number of respondents

Major goat disease in study area

Being free from diseases for livestock is pre-requisite for genetic improvements as maximum productivity in a given system of production emerges when disease control is in place (Gaten 1986 cited by Tassew, 2012). The major goat diseases found in the study area are presented in Table 10. The result of present study indicated that, goat pox ranked first in midland agro ecology (index = 0.28) while in both highland (index = 0.31) and lowland agro ecologies (index = 0.33) diarrhea was the primary disease affecting goats. Ticks, anthrax and foot and mouth disease were also other important diseases of goats in the study area.

Table 10. Major goat diseases in the study area

Name of the disease	Symptoms	Agro-ecology												Overall
		Highland				Midland				Lowland				
		R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I	
FMD	Vesicles	3	4	5	0.08	7	4	13	0.14	7	6	0	0.11	0.11
Goat pox	Coughing	8	16	14	0.21	22	7	6	0.28	1	11	16	0.13	0.21
Anthrax	Sudden death	7	14	7	0.17	7	7	9	0.14	7	8	4	0.13	0.15
Diarrhea	Diarrhea	22	14	8	0.31	9	21	8	0.24	18	18	14	0.33	0.29
Tick	Emaciation	12	10	17	0.23	8	11	15	0.20	18	13	15	0.30	0.24

R=rank, I= index; Index =sum of (3 x type of disease ranked first + 2 x type of disease ranked second +1 x type of disease ranked third) given for each type of disease divided by sum of (3 x types of disease ranked first + 2 x types of disease ranked second + 1 X type of disease ranked third) for all common diseases

Veterinary accesses

Majority (62.8%) of goat owners in the study area accessed only government veterinary clinics while 23.1 % of the farmers accessed to both government veterinary clinics and drug shops. The remaining 14.15% of goat owners in the study area had veterinary access from both government and private clinics. Among the three agro ecological areas, most (80.8%) of goat owners in highland agro ecology had access to obtain drugs only from government veterinary clinics while in low land and mid land agro ecologies the proportion of goat owners that had only access to government clinics were relatively low (Table 11).

Table 11. Veterinary accesses

Veterinary access	Agro-ecology							
	Highland		Midland		Lowland		Overall	
	N	%	N	%	N	%	N	%
Government veterinary clinic	42	80.8	31	59.6	25	48.1	98	62.8
Government and private clinic	4	7.7	8	15.4	10	19.2	22	14.1
Government and shop	6	11.5	13	25	17	32.7	36	23.1

N=number of respondents.

Goat production constraints

Prioritizing the constraints of goat production is a base to identify and solve the problems and to improve goat productivity. Thus, major constraints challenging goat production in the study area were feed shortage, disease, predator, financial problem, poor veterinary services and market access (Table 12). Feed shortage was the first ranked major constraints in the three agro-ecologies which had an index value of 0.30, 0.32 and 0.36 in highland, midland and lowland areas, respectively. According to the respondents the main cause of feed shortage in study area was grazing land limitation and lack of improved animal feeds. Disease was the second goat production constraint in the three agro-ecologies with an index value of 0.29, 0.25, and 0.30 in highland, midland and lowland areas, respectively. Predator was also the other goat production constraints in the study areas. The major predators of goat in the study areas were fox, hyena, and wild dogs. The predators affect goat when they browse in natural grazing land in the day time as well as in open yard during the night time. Similarly, feed shortage, disease and predator were the three major constraints of goat production in West Gojjam zone (Bekalu, 2014). In contrast with this finding, Grum (2010) reported that water shortage was the second frequently mentioned constraint at Jeldesa and Mudianeno districts next to feed shortage.

Table 12. Major constraints of goat production in the study area

Variables	Agro-ecology												
	Highland				Midland				Lowland				Overall
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I	I
Disease	10	23	5	0.29	11	18	10	0.25	13	20	14	0.30	0.28
Feed	20	13	5	0.30	18	18	9	0.32	22	17	13	0.36	0.33
shortage													
Financial	1	12	8	0.11	9	5	12	0.16	6	6	4	0.11	0.13
problem													
Predator	8	4	20	0.17	15	6	14	0.18	8	7	12	0.16	0.17
Poor	4	4	6	0.09	2	3	3	0.06	3	1	2	0.04	0.06
veterinary													
Market	0	2	10	0.04	1	2	3	0.03	2	1	2	0.03	0.03
access													

R=rank, I= index.

CONCLUSION AND RECOMMENDATIONS

The average goat flock size in this study per household was 7.6 in highland, 7.75 in midland and 10.2 in lowland study areas. These figures indicate presence of large number of goat population in lowland of study area because goats are more adaptive to lower altitude than mid and higher. The primary goat production objective in the study area are cash income generation, milk production and saving. These imply that goats play multi-functional roles in improving livelihoods of households. Natural pasture and river are the major source of feed and water in both seasons in all study area. Most of the households in highland and midland study area use separate type of housing and households in lowland study area use kraal housing types for their goats. Large number of goat owners in the study area use uncontrolled type of mating due to more than a house hold goats were grazing together in the same grazing land. Growth

rate, body size/appearance and color are most important traits in the study area to select breeding bucks. While for breeding does growth rate, litter size and body size/appearance are most important traits in study area. Most of the respondents in this study area do not practice castration and fattening. Feed shortage, disease and predator are the major constraint in the study area. From these conclusions, the following recommendations are forwarded:

- ✚ Extension services are expected to train goat owners in improving forage establishment program to alleviate feed shortage, developing water sources (ground water and pond) to reduce long movement of goats.
- ✚ Extension of animal health service is required to reduce loss of goat productivity caused by major diseases.
- ✚ Creating awareness regarding the importance of castration and fattening is very essential.
- ✚ Training should be provided for goat owners to focus on economically important traits during selection.

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