Original Article

Assessment of Production System, Opportunities and Constraints of Sheep Production in Lagambo District, South Wollo Zone, Amhara National Regional State, Ethiopia

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ABSTRACT

As result of sheep is managed by poor smallholder farmers and pastoralists under traditional and extensive production systems. The level of production and productivity of sheep in Ethiopia is generally low. The aim of this study was assessing sheep production system, opportunities and constraints of sheep production in Lagambo district based on household survey. A total of 289 households (130 in highland and 159 in midland) were interviewed for the household survey data collected. Data was analyzed using SPSS version 20 and then described by descriptive statistics. According to the study, the average sheep flock size per household was 9.5 in highland and 7.86 in midland of study areas. The main reasons of keeping sheep in the study area were for cash income, meat production and for saving purpose. Natural pasture and river were the major feed and water source for sheep in the study area in dry and rain season. Majority (50.8% in highland and 71.7% in midland) of sheep owners used separate type of housing. Short maturity period, High market demand for sheep and low cost of sheep production were found as the major opportunity of sheep owner in the study area. Feed shortage and disease are the major constraints in the

study areas. Therefore, to improve the productivity of sheep in the study area, developing alternative strategy to deal with shortage of feed resources, evaluating the available feed resources in terms of quantity and quality, developing water sources and extending animal health service in the area are suggested.

Keywords: Constraints, opportunity, sheep production system, South Wollo Zone.

INTRODUCTION

Ethiopia is one of the African countries with the largest small ruminant population in the continent (CSA, 2014). Small ruminant production is a major component of the livestock sector in Ethiopia. Thus, farmers and pastoralists depend on small ruminants for much of their livelihood, often to a greater extent than on cattle, because sheep and goats are generally owned by the poorer sectors of the community (Gizaw, 2011).

According to IRLI (2012), small ruminants account on average for 40% of the cash income and 19% of the total value of subsistence food derived from all livestock production. They also contribute a quarter of the domestic meat consumption; about half of the domestic wool requirements; about 40% of fresh skins and 92% of the value of semi-processed skin and hide export trade (Mengesha, 2012). The population of sheep in Ethiopia is estimated to be about 31.30 million (CSA 2018). Sheep production is considered to be advantageous compared to cattle production, due to their high fertility, short generation interval, adaptation in harsh environment and their ability to produce in limited feed resource (Tsedeke, 2007). As result of sheep is managed by poor smallholder farmers and pastoralists under traditional and extensive production systems, the level of production and productivity of sheep in Ethiopia is generally low (Solomon *et al.*, 2011).

Even though Ethiopia is endowed with large population of livestock, the livestock sub-sector's contribution to the economy and foreign currency earnings in particularly is very low (Negassa *et al.,* 2011). This is because of socio economic and technical limitations like inadequate feed quality and quantity, diseases, poor genetic potentials, inadequate livestock production policies, and poor management (Mengistu, 2003; Gizaw *et al.*, 2010 and IGAD, 2011). There are different problems challenging sheep production in many parts of Ethiopia. Sheep diseases, feed shortage and lack of adequate veterinary service are the main constraints which decrease sheep productivity and farmers income (Yenesew *et al.,* 2013).

Many researches were done in different parts of Ethiopia on sheep production system, indigenous knowledge of management, identification of production goals and productivity level of sheep in their habitat and other sheep production constraint. In south wollo zone research was done on herd management and breeding practices of indigenous sheep population with taking non representative sample from Lagambo district. In the same research issues of agro ecological factors on herd management

and breeding practices of indigenous sheep population didn't get attention (Nurilign *et al.,* 2017).

The current research is different from others mainly in fulfilling the above gap. Generally, there is limited information on sheep production system, opportunities and constraints of sheep production. Therefore, this study was designed to assess production system, opportunities and constraints of sheep production in Lagambo district.

MATERIALS AND METHODS
Description of the study area

The study was conducted in Lagambo district of south Wollo Zone Amhara Regional State of Ethiopia. Its capital town is Akesta and it is far from Addis Ababa by 501km. It is located at 39'00° North Latitude and 11'00°E East with an altitude of 1500 to 3700 meters above sea level. Lagambo district is one among 22 districts of the south wollo zone Amhara regional state and consists of 38 rural kebeles. The district is bordered on the south by Lagahida and Kalala, on west by Borena, on the northeast by Dessie Zuriain and on the southeast by the WaraIlu. It is characterized by two agro ecological zone highland and midland settings. It receives 700–1200 mm rainfall per annum and annual temperature ranges from 0°C to 13°C (LDAO, 2018).

Sampling technique and sample size determination
Sampling technique

For this study, sampling technique was implemented to identify sample households. In the first step, Lagambo district was purposely selected considering sheep production potential of the district, agro ecological representations and its proximity to Mekdela Amba University. Secondly, from this district, six kebeles were purposively selected based on relatively large number of sheep population and agro-ecology representations. Thirdly, from each sample kebele, households were stratified according to their ownership of sheep; sheep owners (households who have at least two sheep). Finally, from the total sheep owner households, representative sample households were randomly selected for the interview of their management practices.

Sample size determination for household

For accomplishing the study hence determination of sample size is must, it was calculated as the following. Sample size of the households was determined according to the formula given by Cochran's (1977).

$$n = \frac{z^2(p)(q)}{e^2}$$…………………………………………..Eqn (1)

n = sample size

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

P = 0.25 (estimated population variability proportion, 25%)

q = 1-P i.e. (0.75)

e = level of precision (0.05)

Based on the formula,

$$n = \frac{Z^2 \times p(q)}{e^2} = \frac{[(1.96)^2 \times 0.(1-0.25)]}{(0.05 \times 0.05)} = \frac{3.8416 \times 0.2464}{0.0025} = 289$$

Therefore 289 of Respondents were selected**.**

Data types and methods of data collection

In this study, both quantitative and qualitative data were collected and analyzed. In order to generate these data, both primary and secondary data sources were used. Questionnaire and group discussion were used to collect primary data about management practices of sheep 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 feeds and feeding management, watering and watering point, housing, herding practice, diseases prevalence, production opportunity and production constraints were gathered. Focused group discussion was made with elder farmers, women sheep 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 such as current status of sheep production system, major sheep production opportunities and constraints for sheep production.

Secondary data sources were 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

Data analysis and presentation

All collected data were entered to Microsoft Office Excel 2010 computer software and analyzed using different types of statistical analysis depending on the nature of the data. Descriptive statistics were employed to summarize and describe categorical variables. Data generated from questionnaire was analyzed by SPSS statistical package (SPSS version 20). Chi-square test was used to make comparisons between different groups of households with respect to the characteristics under consideration. Chi-square (x^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 opportunities and constraints of

sheep production, purpose of keeping sheep and disease prevalence 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
Livestock holding and species composition

Average numbers of various livestock species per household in the study area are summarized in Table 1. The major livestock species in the study area were cattle, sheep, goat, chicken, horse, donkey and mule. The number of sheep was higher than all livestock species recorded per household in both midland and highland of study areas. The average number of sheep per household was significantly (p<0.05) different between highland (9.5) and midland (7.86) of study areas. Next to sheep, respondents in highland of study area had significantly (P<0.05) higher number of horse than midland of study area. On the other hand, chicken were the second ranked livestock species reared in midland of study area and there was significant difference (p<0.05) between highland and midland of study areas. This could be due to the adaptation behavior of sheep and horse (sheep and horse prefer highland agro ecology and chicken prefer midland than highland agro ecology). The overall average holding of sheep (8.5) in this finding was higher than the average holding of sheep (4.45) in Bensa District, Southern Ethiopia which was reported by Hizkel (2017). There was no significant difference (P>0.05) among the two study areas for cattle, goat, donkey, mule and beehive population.

Table 1: Average livestock holdings per household in the study area

Species	Highland	Midland	Overall	p-value
	Mean ± SE	Mean ± SE	Mean ± SE	
Cattle	4.37±0.16	3.47 ± 0.15	3.92 ±0.12	0.55
Sheep	9.5 ± 0.45	7.86 ± 0.45	8.5 ± 0.27	0.01
Goat	2.56 ± 0.13	2.68±0.12	2.63 ± 0.09	0.11
Chicken	5.87± 0.30	7.7± 0.5	6.70 ± 0.28	0.01
Donkey	1.09 ± 0.05	1.59 ± 0.07	1.42 ± 0.05	0.19
Horse	1.16± 0.11	0.22 ±0.05	0.63 ± 0.06	0.01
Mule	0.08 ± 0.06	0.05 ± 0.02	0.06 ± 0.02	0.51
Beehive	0.3± 0.11	0.6± 0.17	0.5 ± 0.12	0.56

SE = Standard Error

Trend in livestock population

The trends in major livestock population in the study area were summarized in Table 2 below. Respondents (57.7%) in highland and 69.2% in midland of study areas

reported that, the sheep population was decreasing from time to time. On the other hand, the respondents in highland (36.2%) and midland (23.3%) reported that the sheep population was increasing from time to time in the study area, due to development of watering point and expansion of veterinary and vaccination services. Concerning population trend in cattle, 54.6% and 56.6% of the respondents indicated that cattle population showed a decreasing trend in highland and midland of study areas respectively. Similarly, 60% and 58.5% of the respondents indicated that goat population showed decreasing trend in highland and midland of study areas, respectively. On the basis of proportion of respondents, overall decline number was highest for sheep (64%), followed by goat (59.2%), cattle (51.9%) and chicken (31.5%). The possible reasons reported by respondents for the decline in number of livestock were mainly shortage of feed, scarcity of grazing land, frequent occurrence of disease, prevalence of external parasites, poor veterinary service, and presence of predator and frequent selling of animals to mitigate crop failure. Similar reasons were reported in Shinile Zone and Bensa District, southern Ethiopia by Fekerte (2008) and Hizkel (2017), respectively. Contrary to this, Solomon (2007) indicated that the population of livestock was increasing in Metema Woreda. It was related to the increasing human population due to resettlement, availability of extensive grazing land and attractive price for livestock due to cross-border market.

Table 2: Population trend of major livestock species in the study area

| Species | Agro-ecology | | | | | |
| | Highland | | Midland | | Overall | |
	N	%	N	%	N	%
Sheep						
Decreasing	75	57.7	110	69.2	185	64
Increasing	47	36.2	37	23.3	84	29.1
Stable	8	6.2	12	7.5	20	6.9
X^2					5.76*	
Goat						
Decreasing	78	60	93	58.5	171	59.2
Increasing	43	33.1	62	39	105	36.3
Stable	9	6.9	4	2.5	13	4.5
X^2					3.81^{ns}	
Cattle						
Decreasing	71	54.6	90	56.6	161	55.7
Increasing	51	39.2	54	34	105	36.3
Stable	8	6.2	15	9.4	23	8
X^2						1.56^{ns}
Chicken						
Decreasing	44	33.8	47	29.6	91	31.5
Increasing	81	62.3	107	67.3	188	65.1
Stable	5	3.8	5	3.1	10	3.5
X^2					0.79^{ns}	

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

Sheep flock size and structure

The proportion of the different classes of animals reflects the management decision of the owner which in turn is determined by their production objectives (Solomon, 2010). Flock size and structure of sheep in the study area are presented in Table 3. In this study, sheep flock structure in highland of study area in all age and sex categories were significantly (p<0.05) different, except in breeding ram and female from six months to one-year age than midland of study area. Breeding ewe takes a major portion (43% and 27%) in highland and midland agro -ecological zone, respectively, followed by female lamp<6 month (11.4% in highland and 17.8% in midland. According to the reply of the respondents, large proportion of breeding ewe in the study area was due to the desire of farmers to have more number of lamps. The higher proportion of females in the flock in the present findings is consistent with sheep flock structure for Menz sheep reported that breeding ewes were dominant with taking a major portion from the flock (Getachew *et al.,* 2010).The proportion of male between six month to one year in midland study area was significantly (p<0.05) higher than highland of study area. Moreover, in midland of study area the number of male lamps less than six month and males between 6 months and 1 year were higher in the flock than highland study areas. In the study area, the ratio of breeding ram to breeding ewe was 1:5 in highland and 1:3 in midland. The overall ratio of breeding ram to breeding ewe was 1:4 in study area.

Table 3: Average sheep flock size per household and structure in each agro-ecology

Sheep flock structure	Agro-ecology			
	Highland Mean ±SE	Midland Mean ±SE	Overall Mean ±SE	p-value
Male lamps<6months	0.81±0.04	1.08±0.03	0.96±0.03	0.00
Female lamps <6 month	1.2±0.08	1.6±0.11	1.44±0.07	0.08
Male 6-month-1 year	0.93±0.07	1.1±0.07	1.04±0.05	0.02
Female 6-month-1 year	1.2±0.09	1.1±0.09	1.12±0.09	0.16
Breeding ram	0.91±0.06	0.87±0.06	0.89±0.04	0.97
Breeding ewe	4.48±0.19	2.39±0.1	3.38± 0.19	0.00
Castrated	1.0±0.08	0.83±0.06	0.90±0.05	0.02
Total	9.5±0.9	7.86±0.22	8.5±0.12	
ram: ewe	1:5	1:3	1:4	

SE = Standard Error

Purpose of keeping sheep

Knowledge of reasons for keeping animals is a prerequisite for deriving outfitted breeding goals (Jaitner *et al*., 2001). Under the current study, the purpose of keeping sheep by the respondents in the study area is presented in Table 4 below. In this

finding, in highland and midland of study area, the primary reason of rearing sheep by sheep owners was income generation (I = 0.42 for highland and I=0.45 for midland of study area). The income generated from sell of sheep was spent on school fees, purchase of food & clothes, farm investment, medication, social activities and re-stocking. In agreement with the current study, there is finding that indicates sheep are reared in many parts of the country mainly for income generation (Gebrekidan, 2018). Keeping sheep for meat purpose were the secondary objective of sheep owners with an index value of 0.28 and 0.27 for highland and midland of study areas, respectively. Sheep keeping for saving purpose was found the third ranked objective of sheep owners in highland and midland of study areas. Functions like ceremony, manure, wealth status and hide took relatively low ranking among the reasons for keeping sheep in the study area. The results of this survey revealed that sheep play multi-functional roles in the study area. The primary purpose of keeping sheep reported in this study was in line with the result of Hizkel (2017) who reported that most farmers in both agro ecologies were keeping sheep primarily as source of income followed by saving purpose in Bensa District, southern Ethiopia.

Table 4: Purpose of sheep keeping in the study area

Purpose of keeping	Agro-ecology								
	Highland				Midland				Overall
	R1	R2	R3	I	R1	R2	R3	I	I
Income	90	24	7	0.42	122	28	4	0.45	0.44
Meat	21	52	54	0.28	26	68	45	0.27	0.28
Saving	18	42	55	0.25	7	40	78	0.19	0.22
Ceremony	1	1	0	0.01	0	11	6	0.03	0.02
Manure	1	9	10	0.04	4	9	20	0.05	0.05
Wealth	0	2	0	0.01	0	0	2	0.00	0.00
Hide	0	1	2	0.01	0	3	4	0.01	0.01

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.

Feed resources in the study areas

Feed resources during dry and rainy seasons in the study area are presented in Table 5.There was significant difference among highland and midland of study area ($p<0.05$) in sources of feed during rainy season. Most (53.5%) of respondents in midland of study area, used natural pasture only as a sources of feed for their sheep while in highland of study area, only 41.5% of sheep owners used natural pasture alone as a sources of feed for their sheep. Around (32.3%) of respondents in highland of study area used crop aftermath + natural pasture + fallow land together as sources of feed for their sheep in rainy season where as in midland of study area only 18.9%

of respondents used crop aftermath + natural pasture + fallow land together as sources of feed for their sheep in rainy season. Similarly 27.7 % and 26.2 % of respondents used both fallow land and natural pasture as sources of feed for their sheep in midland and highland of study areas respectively.

In dry season, there was no significant difference among study areas (p>0.05) in source of feed. As the survey result indicated that 54.6% and 54.7% of sheep owners in highland and midland of study areas, respectively used natural pasture only as sources of feed for their sheep. Around 27.7% and 30.2% of respondents in highland and midland of study areas respectively were used fallow land and natural pasture together to feed their sheep in dry season. However small number of respondents 17.7% in highland and 15.1% midland of study areas were used crop aftermath +fallow land+ natural pasture as source of feed for their sheep.

Most of the sheep owners in this study area used the natural pasture as the primary source of feed for their sheep. Not only for sheep but also for other livestock, natural pasture was the main feed source in this study area. This indicates the main access of feed for livestock production in these study areas was natural pasture. A few number of the sheep owners in this study reported that improved grass as their animal feed source for example elephant and Selale grass. Crop byproduct was also common in this study area with indicating that there was trend of crop production by the communities. The current study was in agreement with different author's Feleke *et al.,* (2015), Fekerte (2008) and Hizkel (2017) who reported in kambata Tambaro Zone, Shinile Zone and in Bensa District, southern Ethiopia natural pasture was major source of feed, respectively.

Table 5: Major feed resources during the dry and wet seasons in the study area

Type of feed sources	Highland		Midland		Overall	
	N	%	N	%	N	%
Rainy season						
Natural pasture only	54	41.5	85	53.5	139	48.1
Fallow land + natural pasture	34	26.2	44	27.7	78	27
Crop aftermath + fallow land+ natural pasture	42	32.3	30	18.9	72	24.9
X^2						7.36*
Dry season						
Natural pasture only	71	54.6	87	54.7	158	54.7
Fallow land +natural pasture	36	27.7	48	30.2	84	29.1
Crop aftermath +fallow land+ natural pasture	23	17.7	24	15.1	47	16.3
X^2						0.45^{ns}

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

Grazing practices

The management practice of respondents with respect to grazing during dry and rainy seasons are summarized in Table 6. In dry season, 53.1% and 54.1% of the sheep owners in highland and midland of study areas respectively practiced free grazing only. However in highland (17.7%) and midland (17%) of study areas practiced both free grazing and herding together. One eighth (12.3%) and one sixth (16.4%) of sheep owners in highland and lowland of study areas practiced both herding and tethering whereas only 17.3 % of respondents in midland study area practiced herding only. Few numbers of farmers practice only tethering and herding in study area.

During the rainy season, 52.3% and 62.9% of the sheep owners in the highland and midland of study areas respectively practiced herding their sheep. However, the remaining 27.7% and 25.2 % of farmers practiced both tethering and herding in both highland and midland of study areas, respectively. It also found that small number of respondents practice only tethering in both agro ecological zone of study areas. In contrast to this study, in Bensa District, southern Ethiopia during the wet season the majority (71.9%) of sheep owners practiced tethering grazing system in order to prevent sheep from grazing cultivated annual food crops (Hizkel, 2017).

Table 6: Grazing management practiced by owners with respect to season (%)

Grazing management	Highland		Midland		Overall	
	N	%	N	%	N	%
Dry season						
Free grazing only	69	53.1	86	54.1	155	53.1
Herding only	12	9.2	14	8.8	26	9
Tethering only	10	7.7	6	3.8	16	9
Free grazing + herding	23	17.7	27	17	50	17.3
Herding + tethering	16	12.3	26	16.4	42	14.5
X^2						2.84^{ns}
Rainy season						
Herding only	68	52.3	100	62.9	168	58.1
Tethering only	26	20.0	19	11.9	45	15.6
Herding + tethering	36	27.7	40	25.2	76	26.3
X^2					4.53^{ns}	

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

Herding practices in the study area

The sheep herding practice of respondents in the study area is presented in Table 7. The main objectives of herding in the study area were to prevent sheep from damaging crops, theft and predators. The result of this study showed that, 70% of respondents in highland and 47.2% of respondents in midland of study areas run their sheep with other household, while 30% of respondents in highland and 52.8% respondents in

midland of study areas run their sheep separated from other households. The reason why they herd their sheep together with neighboring sheep was that they use communal grazing land. In this study, 61.5% and 55.5% of sheep owners in highland and midland of study area respectively herded all classes of sheep together. However, 38.5% of sheep owners in highland and 44.7% in midland keep lamps separated from other class of sheep. Lamps separated from other flock in midland study area were higher than highland study area. The reason is that predator was the main problem for the society, which causes attack to their lamps.

In study areas, 51.5% of sheep owners in highland and 52.2% sheep owners in midland of the owners herded their sheep with other animals. However, 20.8% of sheep owners in highland and 15.1% in midland of study areas herded their sheep with cattle, while the remaining households 16.9% in highland and 21.4% in midland herded together with goat and 10.8% in highland and 11.3 % in midland herded sheep alone. The overall herding practice of respondents in the two study areas were 11% herded sheep alone 19.4% of them herded sheep with goats, 17.6% with cattle and 51.9% of them herded sheep all animals together.

Table 7: Table sheep herding practice in the study area (%)

	Highland		Midland		Overall	
Sheep herding system	N	%	N	%	N	%
Sheep of household	39	30	84	52.8	123	42.6
More than households	91	70	75	47.2	166	57.4
X^2						15.25*
How sheep flocks herded						
Lamps are separated	50	38.5	71	44.7	121	41.9
All classes together	80	61.5	88	55.3	168	58.1
X^2						1.13^{ns}
Sheep flocks herded						
Together with goats	22	16.9	34	21.4	56	19.4
Together with cattle	27	20.8	24	15.1	51	17.6
All herded together	67	51.5	83	52.2	150	51.9
Herded alone	16	10.8	18	11.3	32	11.1
X^2						2.07^{ns}

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

Water resources and availability

Water sources, watering frequency and watering point for sheep in the study area are presented in Table 8. 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 seasons which accounts for 48.8% in dry season and

46.4% in wet season. The second source of water in both dry and rainy seasons was spring water next to river. The amount of water during dry season was decreasing and sometimes totally absent in midland agro-ecology. When water was missed in the area, the owners travel 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 midland study area. Similar to this study, (Hizkel, 2017) indicated that the proportion of sheep watered by river water were 78.12 % and 75 % during the dry and wet seasons, respectively, in highland agro-climate while it was 65.62%, and 60.9 % during the wet and dry seasons, respectively, in mid-altitude agro-climate in Bensa District, southern Ethiopia.

In the study area, the distance of watering points from the respondents' home during dry and rainy season was almost the same. In dry season, 29.4%, 53.6% and 17% of respondents had access of watering point at home, < 1km, and 1-5 km, respectively. Similarly, in rainy season, 29.8%, 47.8% and 22.5% of respondents watered their sheep at home, by traveling < 1km and 1-5 km, respectively. Majority of respondents in study areas 53.6% in dry season and 47.7% in wet season had access of watering point at <1km.

Concerning the frequency of watering, 46.2% of respondents in highland and 45.9% in midland agro ecologies had free access to water for their sheep in wet season while in dry season only 11.5% of respondents in highland and 18.2% midland agro ecologies had free access to water for their sheep. In dry season, 60% of respondents in highland and 59% in midland agro ecologies watered their sheep once a day. Frequency of watering was higher during the wet season indicating that water is freely available during this season.

Housing of sheep

Livestock housing may vary based on the production system. Good housing can determine productivity by reducing stress, disease and making management easier. The type of housing, housing materials and flock of sheep in the house are presented in the Table 9. The chi-square test indicated that the type of housing used by the respondents for their sheep was significantly different (p<0.05) among the two agro ecologies. Majority of sheep owners in (50.8% in highland and 71.7% in midland) of study areas used separate type of housing. About, 28.5% and 12.6% of sheep owners in highland and midland used veranda housing system, respectively. However, 20.8% and 15.7% of households in highland and midland agro ecologies respectively, used in family house. The most dominant housing system in the study area was separate house (62.3%) followed by veranda (19.7%) and in family house (18%). Reason that most of respondents keeping the sheep in the separate house is a way to prevent a severe risk of zoonotic diseases which may affect the humans and animals. Similar to this finding

Zelealem *et al,* (2014) reported that majority of respondents in Northern Ethiopia used separate type of housing for their sheep.

Table 8: Water sources and frequency of watering for sheep in the study area (%)

Variables	Highland		Midland		Overall	
	N	%	N	%	N	%
Dry season						
River	55	42.3	86	54.1	141	48.8
Spring	35	26.9	28	17.6	63	21.8
pipe water	29	22.3	22	13.8	51	17.6
Pond	11	8.5	23	14.5	34	11.8
X^2						9.98*
Wet season						
Rain water	21	16.2	38	23.9	59	20.4
Spring	38	29.2	31	19.5	69	23.9
River	62	47.7	72	45.3	134	46.4
Pipe	9	6.9	18	11.3	27	9.3
X^2						6.51*
Distance to Watering point						
Dry season						
At home	40	30.8	45	28.3	85	29.4
<km	69	53.1	86	54.1	155	53.6
1-5km	21	16.2	28	17.6	49	17
X^2						0.25^{ns}
Wet season						
At home	30	23.1	56	35.2	86	29.8
<1km	62	47.7	76	47.9	138	47.8
1-5km	38	29.2	27	17	65	22.5
X^2						8.32*
Frequency of watering						
Dry season						
Freely available	15	11.5	29	18.2	44	15.2
Once a day	78	60	94	59.1	172	59.5
Twice a day	37	28.5	36	22.6	73	25.3
Wet season						
Freely available	60	46.2	73	45.9	133	46.0
Once a day	34	26.2	16	10.1	50	17.3
twice a day	36	27.7	70	44.0	106	36.7

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

This study showed that sheep owners used housing material like, wooden with iron sheet (66.9% in highland and 57.1% in midland), wooden with grass (26.2% in highland and 32.1% in midland) and stone with grass (6.9% highland and 10.7% in midland) for housing their sheep. The difference in housing materials might be due to availability of housing materials, and environmental condition in the study area. In this study area, most of the households (84.1%) housed their sheep separate from other species, while 11.4% of them housed with goats and 4.5% of them were housed with cattle. The current result is in contrast with the result of Hizkel (2017) who indicated the majority of respondents housed their sheep together with cattle while 3.1% of them house separately.

Table 9: Housing of sheep in the study area

	Highland		Midland		overall	
Housing enclosure for adult sheep	N	%	N	%	N	%
Separate house	66	50.8	114	71.7	180	62.3
Veranda	37	28.5	20	12.6	57	19.7
In family house	27	20.8	25	15.7	52	18.0
X^2						15.19^{*}
sheep housed						
Alone	115	88.5	128	80.5	243	84.1
Together with goat	10	7.7	23	14.5	33	11.4
Together with cattle	5	3.8	8	5	13	4.5
X^2						3.64^{ns}
Type of housing Material						
Wooden with iron sheet	87	66.9	91	57.1	178	61.6
Stone with grass	9	6.9	17	10.7	26	9.0
Wooden with grass	34	26.2	51	32.1	85	29.4
X^2						3.07^{ns}

X^2=chi-square value, N=number of respondent, ns=not significant

Major sheep disease in the study area

Diseases have numerous negative impacts on productivity of herds i.e. death of animals, loss of weight, slow growth, poor fertility performance, decrease in physical power etc. Farmers in the study area do not exactly know the type of disease which causes mortality but they were able to describe the symptoms. According to the livestock and fishery office of Legambo district, the major types of diseases and parasites of sheep which frequently occurred in the study area are presented in Table 10. The result of this study indicated that, Diarrhea ranked first in highland agro ecology (index = 0.29) while in midland (index = 0.28) sheep pox was the primary disease affecting sheep. Ticks, anthrax and foot and mouth disease were also other important diseases of sheep in the study area.

Table 10: Major sheep diseases in the study area

Name of the disease	Symptoms	Agro-ecology								Overall
		Highland				Midland				
		R1	R2	R3	I	R1	R2	R3	I	I
FMD	Vesicles	9	12	11	0.08	21	13	39	0.13	0.11
Sheep pox	Coughing	24	40	32	0.23	67	22	19	0.28	0.25
Anthrax	Sudden death	19	35	17	0.18	22	22	27	0.14	0.16
Diarrhea	Diarrhea	48	34	24	0.29	27	64	25	0.25	0.27
Tick	Emaciation	30	24	41	0.22	24	33	46	0.19	0.21

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

Major opportunity of sheep production in the study area

As concerned with opportunities, the study has identified the major ones in sheep production. Short maturity period, high market demand for sheep and low cost of sheep production were found as the major opportunity of sheep owners in the study area. Short maturity period of sheep was found being the highest ranked opportunity of sheep production across highland and midland of the study areas with Index value of 0.35 and 0.31, respectively. This indicates sheep can mature for mainly sell or meat consumption within short period of time counted in months so the farmers cover their money demand. This result is consistent with the finding stating that small ruminants (sheep) have high turnover rate as being the significant opportunity in sheep production (Belete, 2009).

High market demand for sheep was also found to be the second ranked opportunity of sheep production over all parts of the study area. This implies that even though there is limited access to market with producers being at far distance from main market (Akesta), sheep are demanded highly by consumers and sold after taken to market. The result is similar with findings of Duguma and others from Horro district of Oromia regional state where they found that increasing trend of demand for live sheep as the major opportunity in sheep production (Duguma *et al,.* 2012). Eyob (2018) also identified that increased demand for sheep meat in local and foreign markets to be an opportunity for sheep investment in Adama district where the current result has been similar with.

The third ranked opportunity (with over all I=0.11) was that the low cost required budgeting sheep production. This implies that with few amount of money available one can finance the production of sheep across the study area. This result is in line

with the finding that was reported by Greg and Paul (2017) that stated sheep are produced at lower cost with no intensive investment budget requirement.

Table 11: Major opportunity of sheep production in the study area

Variables	Agro-ecology								Overall
	Highland				Midland				
									-
	R1	R2	R3	I	R1	R2	R3	I	I
Short maturity period	60	25	20	0.35	44	35	49	0.31	0.33
High market demand for sheep	44	20	53	0.32	39	36	51	0.30	0.31
Low cost of sheep production	7	32	16	0.14	3	11	38	0.09	0.11

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

Major constraints of sheep production in the study area

Constraints are hurdles affecting any business from getting done. Constraints of sheep production are so hurdles affecting sheep production which have been identified for both high land and midland of study areas. Throughout the study, it was identified major constraints of sheep production in the study areas to be diseases, feed shortage, financial problem, predator, poor veterinary services and lack of market access for both high land and midland of study areas. The study also identified the constraints had no similar impact against sheep production across the study areas (in high land and midland). Accordingly, it was found that disease to be the most high ranked or of highest index value constraint in sheep production in both high land and midland of study areas (I=0.38 for high land and I= 0.37 for midland).

Feed shortage is the second high ranked constraint of sheep production in high land and midland part of the study area with index values of 0.37 and 0.33 respectively. Among all constraints the least ranked was found to be lack of sufficient market access for both high land and midland of study areas with similar index value of 0.02. Feeds were not provided for sheep with expected quality and quantity according to the survey and information collected across the study area. With feed problem, the study has found that absence of intervene of any concerned bodies in introducing feed production in areas that address problem of all effectively and sufficiently. This result is consistent with finding from Wolaita Sodo where feed quality, quantity shortage and improper feeding of sheep in farmer level have an impact on production and productivity of sheep (Tolera, 2007).

Financial services in case sheep producers are in need of getting credit is also another hurdles of producing sheep in the study area. Financial problem is found the third ranked (over all I=0.17) constraint in both high land and midland of the study areas. It

was indicated that Farmers were unable to get fund from credit providing institutions as they want for credit even though there was also hint that farmers use loans for home consumption rather than improving sheep production for which financial institutions refuse to give them credit. This result is in parallel with the finding in Horro district stating that: lack of flexibility in the credit system and the inconvenience of having group collateral, misuse or use of credit money for unintended purposes are among constraints in sheep production (Duguma *et al*, 2012).

With no doubt market access also found among challenges in producing and marketing sheep across the study area. It was observed and discussed that market is far from the villages under study with taking three to five travelling hours to Akesta town. The result is found consistent with the finding of Zelalem and others that stated traveling for long distances and road quality are among the various stressing factors (Zelealem *et al,* 2012).

Table 12: Major constraints of sheep production in the study area

Variables	Agro-ecology								
	Highland				Midland				Overall
	R1	R2	R3	I	R1	R2	R3	I	I
Disease	62	49	5	0.38	81	37	29	0.37	0.37
Feed shortage	55	54	8	0.37	32	79	28	0.30	0.33
Financial problem	4	14	47	0.11	34	28	49	0.22	0.17
Predator	2	6	11	0.04	8	6	23	0.06	0.05
Poor veterinary	3	3	44	0.08	1	6	21	0.04	0.06
Market access	1	1	11	0.02	1	1	6	0.01	0.02

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

CONCLUSION AND RECOMMENDATIONS

The average number of sheep per household was different between highland and midland of study areas. This indicates presence of higher number of sheep population in highland study area and the reason is sheep are more adaptive to higher altitude than lower. The primary reasons of rearing sheep in this study are income generation, meat and saving purposes. These imply that sheep play multi-functional roles in improving livelihoods of households. Natural pasture and river were found to be the major feed and water source in both dry and wet seasons across the study area. Most of respondents in the study area use separate types of housing following veranda and

in family house. Regarding the opportunities of sheep production, short maturity period, high market demand for sheep and low cost of sheep production were found as the major ones in the study area. Contrary the study has also identified major constraints of sheep production in the study area to be diseases, feed shortage, financial problem, predator, poor veterinary services and lack of market access for both high land and midland of study areas. Therefore, this study suggested the following to be considered in this study area:

- To improve the productivity of sheep in the study area, there is need to develop alternative strategy to deal with shortage of feed resources.

- Further assessing and evaluating the available feed resources in terms of quantity and quality need to be done.

- Extension services are expected to train sheep owners in improving forage establishment program to alleviate feed shortage, developing water sources to reduce long movement of sheep.

- Extension of animal health service and more specifically establishment/strengthening of community based Animal Health Workers is required to reduce loss of sheep productivity caused by major diseases.

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