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Herd Management and Breeding Practices of Indigenous Sheep Population in South Wollo, Eastern Amhara; Ethiopia

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Abstract
The objective of the study was to undertake herd management and breeding practices of indigenous sheep population in selected districts of South Wollo zone; Eastern Amhara, Ethiopia. Three districts were selected purposely based on their flock size, sheep production potential and their contribution to the farmers. About 180 households from Wogide, Borena and Legambo districts were used for household survey. The questionnaire was analyzed by using descriptive statistics. The parameters were analyzed using SPSS and SAS software. The breeding ewes had taken a major portion followed by lambs. Flock mixing practice would be a good opportunity for establishment of community-based breeding program as ram as it facilitates ram sharing which is one of the major component of community-based breeding program. In the study areas, all classes of the sheep were herded together during the day time though new born lambs were managed independently for some days near the house. About 25.48%, 35.56% and 39.06% of farmers in Wogide, Borena and Legambo sheep farmers were provided special management to their breeding ram while the remaining did not provide any management for their breeding ram, respectively. The survey discovered the high proportion of uncontrolled mating in the study areas. The main objectives of keeping sheep were for income generation followed by meat consumption and saving. Appearance/conformation, fast growth, coat colour, lambing interval, age at first sexual maturity and tail size were the most important traits for selection of breeding rams and ewes in the study areas. The most preferable colour in the study areas was white, red and gray and unwanted colour was black and black with white. An intervention to select best rams and culling of inferior ram would be suggested to enhance genetic gain.
Keywords: Breeding practices, district, indigenous sheep, selection criteria, trait preferences

INTRODUCTION

Genetic diversity provides the raw material for breed improvement and for the adaptation of livestock populations to changing environments and changing demands. Information on the origin and history of animal genetic resources (AnGR) is essential to the design of strategies for their sustainable management (Ajmone-Marsan *et al.*, 2010; Felius *et al.*, 2015). The top five countries by sheep population from the world are China, Australia, India, Iran and Nigeria by 202 million, 72.6 million, 63 million, 50.2 million and 40.6 million sheep population respectively (FAOSTAT, 2014). According to FAOSTAT (2014) Africa has 340.5 million sheep population and the 2nd largest continent next to Asia by sheep population.

Ethiopia's estimated livestock population is often said to be the largest in Africa. Ethiopia is endowed with huge livestock resources of varied and diversified genetic pools with specific adaptations to a wide range of agro-ecologies. In the country, there were approximately 57.83 million cattle, 29.70 million goats, 2.08 million horses, 0.41 million mules, 7.88 million donkeys, 1.23 million camels, 60.51 million poultry and 5.92 million beehives excluding the non-sedentary population of three zones of Afar & six zones of Somali Region (CSA, 2016). Farm animals as a whole are an integral part of the country's agricultural system and are raised both in the highland and lowland areas. In developing countries, livestock production is mostly subsistence oriented and fulfills multiple functions that contribute more to food security (Roessler *et al.,* 2008). The demand for livestock products is increasing due to the growing urban population, while farm areas are shrinking considerably as a result of an increase in the population (Siegmund-Schultze *et al.,* 2009).

Livestock also plays an important role in providing export commodities, such as live animals, hides, and skins to earn foreign exchanges to the country. On the other hand, draught animals provide power for the cultivation of the smallholdings and for crop threshing virtually all over the country and are also essential modes of transport to take holders and their families long-distances (CSA, 2016). The livestock sector in Ethiopia play significant role in the national economy. It contributes 15-17% and 35-49% of the total and agricultural Gross Domestic Product (GDP), respectively and provides livelihood for 37-87% of the population (CSA, 2011).

Ethiopia is home for at least nine breeds and 14 traditional sheep populations (Gizaw *et al*., 2007). The country has a diverse sheep population of about 14 sheep types in four major groups, i.e. sub-alpine short fat-tailed, highland long fat-tailed, lowland fat-rumped/tailed and lowland thin-tailed (Gizaw *et al.,* 2008). The sub-alpine short fat-tailed group consisting of Menz, Tikur, and Wollo and Simien sheep types is predominantly found in the central and northern highlands at an altitude of above 2500 m. In this area, sheep are mainly reared for income generation from the sale of lambs at market age although they are also important as a source of food, manure and socio cultural benefits (Gizaw *et al*., 2008; Getachew *et al.,* 2010).

From 28.89 million sheep population, about 72.84 percent are females, and about 27.16 percent are males from total number of sheep 99.85% are indigenous breeds the rest are improved sheep (CSA, 2016). Ethiopian indigenous sheep breeds have a great potential to contribute substantial amount to cash income, food (meat and milk) and non-food products such as manure, skins and wool. They also serve as a means of risk mitigation during crop failures, property security, monetary saving and investment, in addition to many other socio-economic and cultural functions. At the national level, sheep and goat account for about 90% of the live animal/meat and 92% of skin and hide export trade value (Asmare, 2010).

Amhara National Regional State has 15.45 million cattle, 9.80 million sheep, 6.09 million goats, 0.47 million horse, 0.18 million mules, 2.83 million donkeys, 0.06 million camels, 19.96 million poultry, and 1.33 million beehives (CSA, 2016). South Wollo zone has 1.75 million cattle, 1.86 million sheep, 0.81 million goats, 0.08 million horse, 0.04 million mules, 0.48 million donkeys, 0.02 million camels, 2.03 million poultry and 0.19 million beehives (CSA, 2016). They have special features like efficient utilization of marginal and small plot of land, short generation length, high reproductive rate, low risk of investment and more production per unit of investment as compared with cattle.

The objective of sheep rearing was for multiple functions; such as source of cash income, meat, manure, ceremony, saving/insurance, skin and as traditional values. Sheep provides social functions that allow an owner to join together within the community. Sheep is also used as mediums of gift exchange in various social circumstances and means to give social identity and status as well as ceremonial affairs (Hagos *et al*., 2015).

The farmers' decision of selection criteria could be affected by breed; production system and herd size (Thiruvenkadan *et al.,* 2009). The traits traditionally considered as criteria for selecting breeding stock are important in describing the adaptive attributes and genetic merits of the indigenous livestock and in identifying farmers' choice of sheep breeds and the underlying factors that determine the choice of genetic stock used.

Urbanization and growing human population in the country resulted in increased domestic demand for sheep meat, which also offers significant incentive for market-oriented production. It is very urgent to improve sheep productivity in order to satisfy the large population of the country estimated at 81 million with 2.7% an annual growth rate (AMFI, 2010). The transfer of successful animal breeding schemes from developed countries also proved to be difficult or impossible in many instances because such schemes are high-tech operations involving sophisticated methods of measuring and evaluating animals, biotechnologies, very high level of organization and high level of input of capital and labor (Kosgey *et al.,* 2006). Thus, this study was aimed at assessing herd management and breeding practices of indigenous sheep population in South Wollo zone, Eastern Amhara; Ethiopia.

MATERIALS AND METHODS

Description of the Study Areas

The study was conducted in South Wollo zone. South Wollo is one of 10 zones and 1 special district in the Amhara Regional State of Ethiopia. South Wollo is bordered on the south by North Shoa and Oromia Region, on the west by East Gojjam, on the northwest South Gonder, on the north by North Wollo, on the northeast by Afar Region, and on the east by the Oromia zone and Argobba special district. Its highest point is Mount Amba Ferit. Dessie is the capital city of South Wollo.

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this zone has a total population of 2,518,862, with an area of 17,067.45 square kilometers. South Wollo zone has 22 districts; from these districts the study was conducted in 3 selected districts of South Wollo zone, the three representative districts were Wogide, Borena and Legambo (CSA, 2008).

Table 1. Description of the districts

Study areas characteristics	Districts		
	Wogide	Borena	Legambo
Distance from Addis Ababa (km)	594	592	501
Distance from Bahir Dar (km)	673	671	580
Distance from Dessie (km)	193	191	100
Altitude (asl) (m)	500 to 2700	500 to 3200	1500 to 3700
Latitude and longitude	10°40′N 11°38′E	10°55′N 38°30′E	11°00′N 39°00′E
Rainfall (mm)	600 to 1100	1500 to 3660	700 to 1200
Temperature	23°c	16.5°c	13°c
Area (km^2)	1,110.69	1,027.61	1,017.35
Human population	151,257	158,209	165,026
Cattle	36,684	78,533	76,464
Sheep	15,442	68,642	146,954
Goat	48,059	35,417	11,815
Horse	63	1,552	6,662
Donkey	16,045	14,171	18,769
Mule	341	1.493	2,842
Poultry	47,389	73,903	74,494

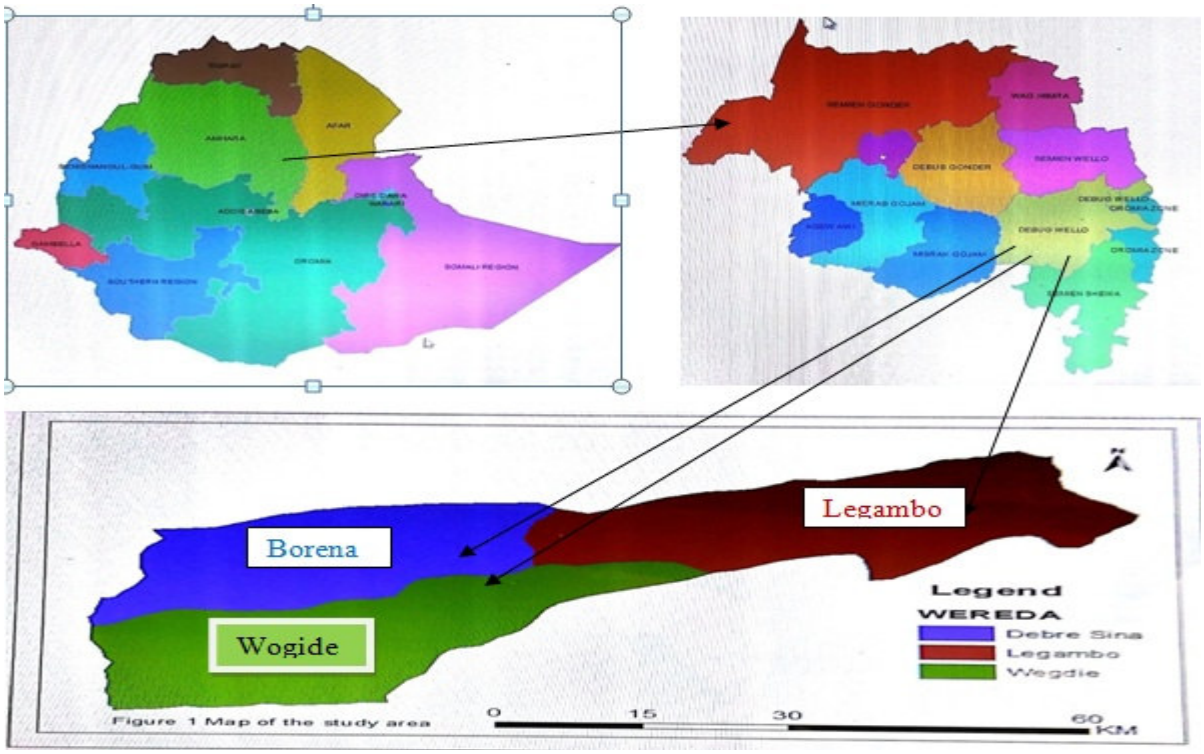

Figure 1. Map of the study areas

Sampling Techniques

South Wollo zone has 22 districts of which three districts were selected purposely based on their sheep flock size, sheep production potential and their contribution to the farmers.

A rapid reconnaissance survey was made prior to the actual survey work to assess the distribution of sheep and their production system in order to select specific site for characterization. Nomination of respondents was implemented together with the local Agriculture and Rural Development staffs and *kebele* administrators. Discussions were held with district agricultural experts and development agents about the distribution of Wollo sheep types. They were also participated in the identification of sampling units and data collection activities. This allowed in identifying the major potential area of Wollo sheep types in the study areas.

Kebele, the lower administrative hierarchy in Ethiopia, were selected considering the density of sheep types. From each district, 3 *kebele* (total of 9 *kebele*) were selected. About 15 household per *kebele* from Wogide,

20 household per *kebele* from Borena and 25 household per *kebele* from Legambo district (total of 180 households) were randomly selected for the interview from within the selected *kebele* having similar production system. The sample size 180 household was determined according to (Arsham, 2002) as under: $N = 0.25/SE^2$, where: N = Sample size, SE= Standard error (0.0373) with 95% confidence level.

Methods of Data Collection

Data were generated by administrating a semi structured questionnaire, organizing group discussion and from secondary sources.

Questionnaire and group discussions

Based on the questionnaire the following information were collected: Questionnaires were designed, translated to local language, pretested and administered to address the description of the socio-economic practice of the community (like sex, age, educational level, household size, livestock possession, economic benefit of sheep; description of the production environment) were collected. The main agricultural production by the local community besides to livestock rearing was surveyed. Sheep types, flock composition, number, breeding practices, sheep production objectives, selection criteria, culling age, were collected from each selected household.

In addition, information on main uses and special attributes of the breed type were collected from the sheep owner through designed questionnaire and group discussion (with extension workers, DA's, model farmers, clan or village leaders, elderly female and male member of the society who are known to have better knowledge on the present and past social and economic status of the area to strength the reliability of survey questionnaires.

Data Management and Statistical Analysis

Data collected from each site were coded and entered into the computer for further analysis. Data collected through questionnaire were entered into Statistical Package for Social Sciences (SPSS 20 for Windows and SAS 9.1 for Windows). Preliminary data analysis like homogeneity test, normality test and screening of outliers were employed before conducting the main data analysis.

Questionnaire data

Data collected through questionnaire were described by descriptive statistics using Statistical Package for Social Sciences (SPSS 20 for windows and SAS 9.1 for windows). Chi-square or t-test was employed when required to test the independence of categories or to assess the statistical significance.

Indices were calculated to provide ranking of the reasons of keeping sheep, selection criteria, and contribution of different farming activity. Index was calculated as Index = Sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) given for an individual reason, criteria or preference divided by the sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for overall reasons, criteria or preferences.

RESULTS AND DISCUSSION

General Household Information

Sex, age, position and educational background of the respondents are presented in Table 2. The survey showed that the majority of the households in three districts were headed by males which accounted for 80.0% in Wogide, 86.7 in Borena and 86.7% in Legambo district.

Table 2. Number and percentage of households per sex, age, position and education background in the study areas

Factors & levels	Districts						Test	
	Wogide		Borena		Legambo			
	N	%	N	%	N	%	X^2	P-value
Sex							91.02	**
Male	36	80.0	52	86.7	65	86.7		
Female	9	20.0	8	13.3	10	13.3		
Age							33.61	**
< 30	3	6.7	8	13.3	11	14.7		
31-40	14	31.1	20	33.3	13	17.3		
41-50	16	35.6	15	25.0	24	32.0		
51-60	10	22.2	10	16.7	19	25.3		
>61	2	4.4	7	11.7	8	10.7		
Marital status							302.80	**
Married	34	75.55	53	88.3	59	78.7		
Single	4	8.88	1	1.7	10	13.3		
Widow	4	8.88	2	3.3	2	2.7		
Divorced	3	6.65	4	6.7	4	5.3		
Position							323.24	**
Household head	35	77.8	50	83.3	63	84.0		
Spouse of a head	9	20.0	8	13.3	10	13.3		
Son	1	2.2	2	3.3	2	2.7		
Educational background							61.11	**
Illiterate	14	31.1	14	23.4	18	24.0		
Reading & writing	22	48.9	23	38.3	29	38.7		
Grade	8	17.8	23	38.3	26	34.7		
Certificate & above	1	2.2	-	-	2	2.6		

N = number of observation, **significant at 0.01

The remaining proportions of the households were headed by females. Female headed household in this study would point out either the husband has died or they were divorce (separated).

About 48.9% of household heads in Wogide were able to read and write either from religious school or from adult education, 31.1 were illiterate, 17.8% were grade (from 1-10) and the remaining or 2.2% were certificate and above. Thus, better educational background for smallholder farmers might be a good potential for adoption of improved technologies and facilitate performance and pedigree recording (Kosgey and Okeyo, 2007).

Flock Structure of Sheep

Flock structure of Wogide, Borena and Legambo sheep are showed in Figure 2. The mean ± standard deviation of flock size of Wogide sheep were 3.12 ± 1.40 lambs (both male and female of less than 6 months), 1.83± 0.99 ram lambs (males from 6 to 12 months), 2.15 ± 1.35 ewe lambs (females from 6 to 12 months), 1.54 ± 0.79 breeding rams (males above 1 year), 5.33 ± 3.16 breeding ewe (females above 1 year) and 1.24 ± 0.56 castrated males. The mean and standard deviation of Borena district were 3.02 ±1.87, 1.68±1.14, 1.71±1.22, 1.92 ± 1.18, 4.80±3.02, and 1.29±0.69 for lambs (both male and female), ram lambs (male from 6 to 12 months), ewe lambs (female from 6 to 12 months), breeding rams (males above 1 year), breeding ewes (females above 1 year) and 8.95 castrate, respectively.

The breeding ewes had taken a major portion 35.04%, 33.29% and 46.64% in Wogide, Borena and Legambo districts followed by lambs 20.51%, 20.94% and 18.91%, respectively. Larger proportion of breeding ewe obtained in this study is comparable with previous results reported 46.80% for Menz sheep and 49.2% for Afar sheep (Getachew *et al.,* 2010) and 38.9%, 41.7% and 39% for Medebay zana, Tahtay koraro and Asgede tsimbla (Hagos *et al.,* 2015) in Tigray Region. The proportion of breeding ewe (>1 year) in three districts would imply the production of larger number of lambs which in turn might be increase the intensity of selection. The proportion of breeding ram in Wogide and Legambo sheep is similar to (Hagos *et al.,* 2015) who reported for Degua sheep in Northwestern zone of the Tigray Region.

In Wogide and Borena the proportion of castrates of sheep were relatively similar 8.15% and 8.95%, respectively, but in Legambo district (6.90%) the lower than Wogide and Borena. The breeding ewe in Wogide (5.33) and Borena (4.80) are comparable with (Abera, 2013) who reported for Gozamen (5.82), Sinan (5.29) and Hulet eju district (5.24), whereas, in Legambo district breeding ewe are higher than the (Abera, 2013) in Gozamen, Sinan and Hulet eju districts. Average flock size breeding ewe in this study is higher than (Edea *et al.,*

2012) who reported for Adiyo Kaka and Horro districts.

The ratio of ram to ewe of more than one year of age was 1:4, 1:2.94 and 1:5.24 for Wogide, Borena and Legambo sheep, respectively. The ratio of ram to ewe in Wogide and Legambo sheep is similar with 1:4.69 (Hagos *et al.,* 2015) for Degua sheep in Tigray Region. But this ratio of ram to ewe found in this study is lower than the 1:8.30 and 1:17.4 for Menz and Afar sheep reported by (Getachew *et al.,* 2010), respectively. The ratio of ram to ewe observed in this study is high beyond the recommendation 1:25. Thus an intervention to select best rams and culling of inferior ram would be suggested to enhance genetic gain.

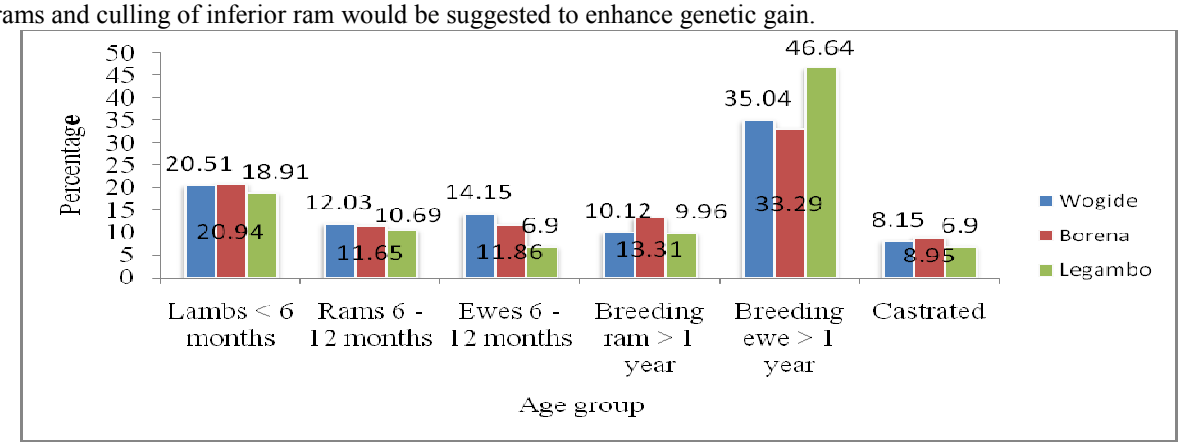

Figure 2. Sheep flock structures in the study areas

Herding Practice

In Wogide, Borena and Legambo districts, all classes of the sheep were herded together during the day time though new born lambs were managed independently for some days near the house. The percentage of households mixing their sheep flock with other species and other sheep flocks in Wogide, Borena and Legambo districts are presented in Table 3. About 68.9%, 71.7% and 72.0% of the sheep owners in Wogide, Borena and Legambo districts keep sheep with other species (cattle, goat and equine), respectively. About 84.4%, 95.0% and 80.0% keep sheep more than one household run as a flock and the remaining of the farmers keep them sometimes separately and other times by mixing with other livestock species depending on the availability of labor and feed. Because of their feed habit farmers prefer to manage sheep of a household run as a flock but shortage of labor forced them to keep them with other livestock.

In three districts, the farmers had their own herder usually children. They also reported that the possibility of mixing with other neighboring sheep flocks within a village. Flock mixing practice would be a good opportunity for establishment of community-based breeding program as ram as it facilitates ram sharing which is one of the major component of community-based breeding program.

Table 3. Percentage of households mixing their sheep flock with other species

Sheep herding	Districts					
	Wogide		Borena		Legambo	
	N	%	N	%	N	%
Sheep with other species						
Sheep together with cattle	7	15.6	4	6.7	6	8.0
Sheep together with goat	1	2.2	7	11.7	3	4.0
Sheep together with equine	6	13.3	2	3.3	5	6.7
All herded together	31	68.9	43	71.7	54	72.0
Sheep herded separately	-	-	4	6.7	7	9.3
Sheep with other sheep flock						
Sheep of a household run as a flock	7	15.6	3	5.0	15	20.0
Sheep of more than one household run as a flock	38	84.4	57	95.0	60	80.0

N = number of observation

Figure 3. Sheep herding with other livestock in Legambo district

Castration

The majority of Wogide (86.7%), Borena (96.7%) and Legambo (97.3%) sheep owners were practiced castration. The result of Borena (96.7%) and Legambo district (97.3%) is similar with Menz (96.7%) and Afar (97.2%) reported by (Getachew *et al.,* 2010) and 98.2% for Adiyo Kaka (Edea *et al.,* 2012). In this study especially in Wogide district (86.7%) sheep castration practice is comparable with (Alemayehu *et al.,* 2015) who reported that 84.7% for Mareka district.

About 92.31%, 81.03% and 82.19% of the Wogide, Borena and Legambo sheep owners were use traditional castration method to castrate their sheep the remaining were use modern method, respectively. The three districts sheep owners reported that they crash the vas deference using rounded stone locally known as *'allelo'*. Wogide, Borena and Legambo rams were castrated in average age of 18.33 months, 19.80 months and 23.47 months, respectively. This result is in line with (Getachew *et al*., 2010).

But the presence result is higher than 10.80±2.53 months for Adiyo Kaka district sheep reported by (Edea *et al.,* 2012). In this study, Legambo rams castrated almost reached 2 years. In three districts farmers gave more attention for castration. Reasons of castration for Wogide, Borena and Legambo sheep owners were to improve fattening 56.41%, 88.4% and 71.23% the remaining were to avoid unwanted mating and for both of the above cases. The current result is comparable to Edea *et al. (*2012) who reported 63.30% for Adiyo Kaka and 47.40 for Horro farmers castrated for the purpose of improve fattening potential and to get higher price in local market. This indicates that farmers need to be convinced of the importance of improved genotype and incentives might be provided for those keeping their best rams for breeding purposes.

The majority of Wogide and Borena farmers were castrate their sheep during spring (September, October and November) and sometimes winter (December, January and February) season. Farmers were needed these seasons for sheep fattening. Their reasons were better availability of feed and the other reasons were different ceremonies like religious festivity (Christmas, Ethiopian Easter and Arefa) and wedding ceremonies. The majority of Legambo farmers were castrate their sheep during spring (September, October and November) and autumn (March, April and May) season due to the availability of good quality and quantity of feed; aims to specific market for different ceremony (Christmas, Ethiopian Easter, Arefa and wedding).

The most important supplementary feed for fattening sheep across all districts, natural pasture (grazing), crop residue like (Wheat, Barley, Bean, Pea, Vetch and Chickpea), *atela*, grain and salt were the major feed sources used for fattening. In Legambo district *Avena Sativa* (common name oat and locally known as '*selalie/sinar* was the common feed source for fattening sheep.

Objectives of Keeping Sheep

Knowledge of reasons for keeping animals was a prerequisite for deriving operational breeding goals. The reasons for keeping sheep were rational and are related to the farmers' needs in the long or short term. The results indicated the relative importance of tangible benefits of sheep keeping (such as regular source of income, meat, saving and manure). Most farmers in three districts kept sheep primarily as source of income. The majority of farmers were keep sheep for the purpose of income with an index value of 0.47, 0.46 and 0.51 in Wogide, Borena and Legambo districts, respectively. Next to income Wogide farmers kept sheep for purpose of meat followed by saving and manure with an index value of 0.22, 0.13 and 0.09, respectively. Borena farmers also kept sheep for the reason of meat followed by saving and manure with an index value of 0.23, 0.08 and 0.06, respectively. Next to income Legambo farmers kept sheep for the purpose of meat followed by saving and manure with an index value of 0.22, 0.12 and 0.06, respectively. The purposes of keeping sheep in three districts were similar according to farmers report. Ranking of the sheep production objectives by districts are presented in Table 4.

Similarly, multipurpose functions of sheep rearing were reported for sheep keepers in Adiyo Kaka and Horro (Edea *et al.,* 2012). Generally the primary reasons in this current study the farmers kept sheep for the

purpose of generate income. This finding is in agreement with Getachew *et al.* (2010) the primary reason for keeping sheep owners were to generate income followed by meat consumption, manure, hair and as means of saving in Menz area but contradict in Afar because the farmers keep sheep primarily for the purpose of milk.

This result also in agreement with Edea *et al.,* (2012) who reported most farmers in Adiyo Kaka and Horro district keep sheep primarily as source of income and Hagos *et al.* (2015) who reported for the primary reason was income source. The use of manure from sheep was practiced and sheep production was integrated with crop production in the study areas.

Table 4. Ranking of the sheep keeping objectives by smallholder farmers across districts

Production objectives	Districts											
	Wogide				Borena				Legambo			
	Rank 1st	Rank 2nd	Rank 3rd	Index	Rank 1st	Rank 2nd	Rank 3rd	Index	Rank 1st	Rank 2nd	Rank 3rd	Index
Meat	5	18	13	0.22	7	27	8	0.23	4	43	5	0.22
Tail fat	-	2	5	0.03	2	4	7	0.06	-	3	13	0.04
Ceremony	-	1	4	0.02	-	3	13	0.05	-	3	6	0.03
Manure	2	5	7	0.09	-	5	11	0.06	1	5	13	0.06
Income	36	7	2	0.47	49	11	8	0.46	68	12	2	0.51
Skin	-	2	6	0.04	-	3	4	0.03	-	-	7	0.02
Saving	2	10	8	0.13	2	7	9	0.08	2	9	29	0.12

Index= sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) given for each purpose divided by sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for all purpose of keeping sheep for each districts.

Functions of sheep for saving against crop failure were also well ranked in this study especially in Wogide and Legambo. Based on the stated functions of sheep, the main breeding objectives that have been defined are increasing marketable lambs, meat, secure the household cash income and insurance/saving and to improve growth rate and conformation for meat production as household consumption and source of manure as organic fertilizer to increase crop production.

Farmers who have large flocks support their poorer relatives was known as ribi. In this tradition the poorer relative was given a flock of sheep, composed of mainly breeding ewes. The poor relative will be given a traditionally formal access to profit from the flock lamb crop.

Management of Breeding Ram

About 25.48%, 35.56% and 39.06% of farmers in Wogide, Borena and Legambo sheep farmers were provided special management to their breeding ram while the remaining did not provide any management for their breeding ram, respectively. This result is contradicting form Alemayehu *et al.* (2015) who reported all respondent in Tocha (100%) and Mareka (100%) responded that they provide special management to their breeding ram.

In Legambo district the farmers gave supplementary feed like crop residues, hay and *Avena Sativa* (common name oat and locally known as '*selalie' and 'sinar')*. This finding is in line with Getachew *et al.* (2010) who reported for Menz sheep owners gave supplementary feed like crop residues, hay and weed.

Ram Possession Pattern

Ram possessions in three districts are presented in Table 4.13. Out of all Wogide, Borena and Legambo sheep owners 35.6%, 25.0% and 14.7% had no breeding ram, 28.9%%, 38.3% and 36.0% owned one ram and 35.5%, 36.7% and 49.3% owned more than one breeding ram with average of 1.76, 1.67 and 3.22 breeding ram per flock, respectively.

Breeding Practices

Mating system and sources of breeding rams

Out of total interviewed farmers, 76.67 % had their own ram and the remaining 23.33% of interviewed did not have their own ram. Sheep breeders without a breeding ram indicated that they use neighboring ram or their ewe mated with breeding ram from other flock in communal grazing land. Most important reasons for keeping more than one ram were for fattening and selling according to sheep owner report.

The overall sources of breeding ram according to respondents were born in the flock (57.22%), purchased (18.89%), relatives/neighbors (11.67%) and some farmers were not known (12.22%). Wogide (53.3%), Borena (61.7% and Legambo (56.0%) were reported to use breeding ram from their own flock.

Mating was predominantly uncontrolled and no report of controlled breeding in Wogide and Borena districts. All farmers reported that female animals were served randomly by any intact male in Wogide and

Borena districts. This result is in agreement with (Getachew *et al.,* 2010; Abera *et al.,* 2014; Haile *et al.,* 2015) who reported mating was predominantly uncontrolled. About 90.67% of mating was uncontrolled and the remaining 9.33% was controlled in Legambo district. Mechanisms of control mating in Legambo district were culling low-grade rams through sale and slaughter and castration. The current finding is in line with Hagos *et al.* (2015) who reported 16.83% of respondents were to control mating. Their communal grazing land, watering points and lack of awareness about disadvantages of inbreeding were mentioned as main factors for the high proportion of uncontrolled mating practices in the study areas.

A selected breeding ram can served up to 4.31 years in Wogide, 3.10 years in Borena and 3.44 years in Legambo districts of mean age after which it was usually disposed through sale or slaughter and castration. The result of breeding ram service in the flock of this study of Borena and Legambo districts are similar to (Hagos *et al.,* 2015) but higher than (Edea *et al.,* 2012) 2 years for Adiyo Kaka and Horro.

Purpose of Keeping Breeding Ram

The purpose of keeping breeding ram/s in the study areas are presented in Figure 4. About 41.38%, 51.16% and 20.0% of respondent in Wogide, Borena and Legambo, respectively, keep breeding rams for the purpose of breeding. About 37.93%, 37.21% and 60.00% farmers in Wogide, Borena and Legambo farmers keep rams for fattening purpose. The purpose of keeping rams for breeding in the present result is lower than Alemayehu *et al.* (2015) about 65.5%, 100% and 83.3% of respondent in Tocha, Mareka and Konta, respectively; keep breeding rams for the purpose of breeding. Legambo farmers keep ram for the purpose of mating is comparable with Menz area (24.1%) reported by (Getachew *et al.,* 2010).

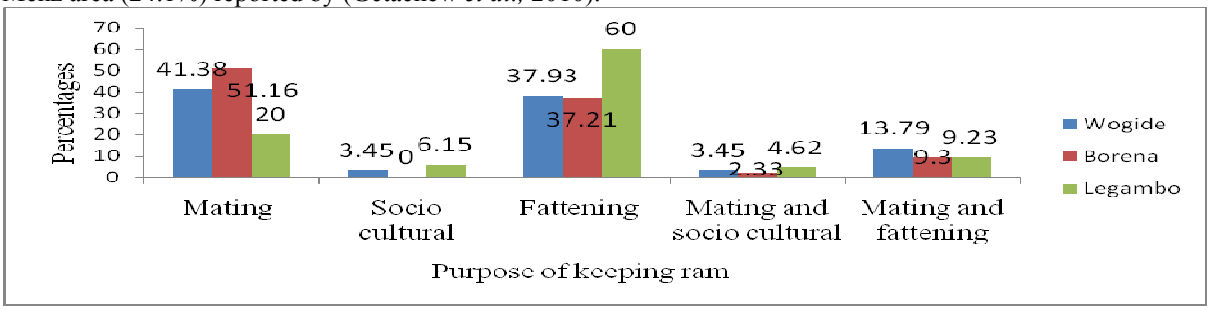

Figure 4. Purpose of keeping rams

Selection Criteria

Selection of parents of the next generation was common in all the study areas. Ranking of farmers for the selection of breeding rams and ewes are indicated in Table 5. Majority of farmers 91.1%, 88.3% and 97.3% in Wogide, Borena and Legambo, respectively, reported that they recognize the importance of selection and practiced with their own selection criteria's. The current result is in agreement with (Edea *et al.,* 2012) about 79.7% and 94.7% (Hagos *et al.,* 2015) 95.7% and 74.9% of the farmers practice selection for breeding ram and ewes, respectively and farmers were reported to select breeding ram from own flock, neighbors/relative. In case of selection for breeding ewes and rams the outstanding females and males were kept for breeding while unwanted ones were disposed mostly through sale. Generally, stage of selection for breeding ram was different from breeding ewes; rams were selected at their youngest age, whereas, ewes were selected mostly at older age. This was due to early sexual maturity of male sheep than female.

Selection criteria for breeding rams

The available breed type is definitely the result of long term manmade and natural selection (Getachew *et al.,* 2010). Mean (standard deviation) selection age of rams for Wogide, Borena and Legambo ram breeds were 9.95 ±1.58, 10.48 ± 1.74 and 8.04 ± 1.84 months, respectively. This result is comparable from (Getachew *et al.,* 2010), but longer than Edea *et al.* (2012) who reported 4.39 ± 2.24 months for Horro rams.

Traits like appearance/conformation, fast growth, coat colour, and tail size/length were all considered as important in three districts and given due emphasis for selecting breeding rams. Appearance/conformation of breeding ram ranked first for Wogide and Borena sheep owners with an index value of 0.30 and 0.32, respectively. Fast growth of breeding ram ranked first for Legambo district sheep owner with an index value of 0.32. Coat colour, growth rate and tail type/length were ranked second, third and fourth with an index of 0.26, 0.25, 0.12, in Wogide district. Fast growth, colour and tail size/length were ranked second, third and fourth important traits with an index of 0.27, 0.24, 0.11 in Borena district.

Appearance/conformation, colour and tail size/length were ranked second, third and fourth important traits with an index value of 0.26, 0.21, 0.14 in Legambo district. Selection criteria of ram is similar to (Abera *et al.,* 2014; Haile *et al.,* 2015) who reported fast growth, coat colour and tail length were the most preferred traits

by most of the farmers; and (Hagos *et al.,* 2015) for Medebay Zana, Tahtay Koraro and Asgede Tsimbla. Adult males were usually kept for market purpose, if not selected for breeding. Price was strong-minded by body size and conformation of the animal, colour and tail size. According to farmers report appearance/conformation, fast growth, coat colour and tail size were the most highly rated traits in selecting breeding males in the study areas.

Selection criteria for breeding ewes

Average selection age of Wogide, Borena and Legambo ewes were 11.00.±1.67, 11.39±1.34 and 8.97±1.90 months, respectively. This result is higher than Edea *et al.* (2012) for breeding ewe was 7.42±3.01 and 4.54±1.90 months for Adiyo Kaka and Horro districts. Appearance/conformation of breeding ewes ranked first for Wogide, Borena and Legambo sheep owners with an index value of 0.25, 0.30 and 0.25, respectively. Lamb growth, age at first lambing and colour of breeding ewes were ranked second, third and fourth with an index value of 0.20, 0.17, 0.12 in Wogide district, respectively. Lambing interval, lamb growth and age at first sexual maturity and coat colour of ewes were ranked second, third and fourth with an index of 0.16, 0.14, 0.13 and 0.13 in Borena district, respectively.

Farmers believed that appearance/conformation, lamb growth, lambing interval, age at first lambing and coat colour were important traits in the study areas. Use of mother history in selecting breeding ram can also be taken as an indirect means of selecting ewes as certain criteria was considered on the mother's performance. The result of current study is in agreement with Getachew *et al.* (2010) who reported for Menz sheep in Menz area, (Hagos *et al.,* 2015) who reported colour, body size and mothering ability were mentioned and ranked as first for their choice of best female sheep at each district for Medebay Zana, Tahtay Koraro and Asgede Tsimbla and Haile *et al.,* (2015) who reported for Basonawerena and Angolelatera. Conformation traits such as tail size, body size, body condition and colour were also frequently mentioned to select breeding sheep.

Table 5. Selection criteria for breeding ram and ewes in the study areas

Class and criteria	Districts											
	Wogide				Borena				Legambo			
	Rank 1st	Rank 2nd	Rank 3rd	Index	Rank 1st	Rank 2nd	Rank 3rd	Index	Rank 1st	Rank 2nd	Rank 3rd	Index
Breeding ram												
Appearance/conformation	21	1	8	0.30	29	7	2	0.32	23	19	9	0.26
Colour	6	19	9	0.26	8	13	25	0.24	11	15	29	0.21
Horn	1	3	9	0.07	-	5	8	0.06	-	3	8	0.03
Growth	12	7	8	0.25	11	25	4	0.27	33	17	4	0.32
Tail type/length	1	10	7	0.12	5	3	14	0.11	4	15	18	0.14
Pedigree	-	-	-	-	-	-	-	-	2	4	5	0.04
Breeding ewe												
Appearance/conformation	16	6	2	0.25	26	6	4	0.30	29	8	4	0.25
Color	1	5	17	0.12	5	3	19	0.13	2	7	15	0.08
Lamb survival	1	3	5	0.06	3	3	5	0.06	7	5	10	0.09
Lamb growth	7	12	5	0.20	7	9	5	0.14	9	17	21	0.19
Age at 1st sexual maturity	9	6	4	0.17	6	9	6	0.13	6	7	9	0.09
Lambing interval	4	3	3	0.09	3	18	6	0.16	17	24	2	0.23
Twining ability	-	4	3	0.05	-	1	3	0.02	-	2	6	0.02
Tail type/length	3	2	2	0.06	3	4	5	0.07	3	3	6	0.05

Index = sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) give for each selection criteria divided by sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for all selection criteria for each districts.

Coat Colour Preferences

Among the wide range of colours, farmers do have preference only for certain types of colours. Wogide, Borena and Legambo farmers gave attention for the coat colour and pattern of their sheep. The most preferable colour in Wogide district was red, white and gray with an index value of 0.35, 0.27 and 0.22, respectively and unwanted colour was black and black with white. In Borena district red, white and gray also the most preferable colour with an index value of o.35, 0.30 and 0.18, respectively and black, black with white and red with white were the most unwanted colour by sheep owners likes Wogide smallholder farmers. While, the most preferable colour in Legambo district were white, red and gray with an index value of 0.33, 0.28 and 0.22, respectively and pure black, black with white and red with white was unwanted colour in this district by farmers.

Plain black and black associated colours were not preferred by famers in all district implies that traits associated with this colour being at risk. Further studies to identify traits associated with black colour and devising conservation strategy for black colour might be considered. The current result is similar to (Alemayehu *et al.,* 2015) farmers give less attention for black coat colour in Tocha, Mareka and Konta. Coat colour preference of farmers in this study are differ from Edea *et al. (*2012) who reported that solid red or light brown colours were more preferred by both of the Adiyo Kaka and Horro and white colour is less preferred by Konta

farmers since they believe that white coloured animals are easily attacked by predator, disease and harsh environment (Alemayehu *et al.,* 2015).

Sheep Culling and Market Age

Culling was a common practice in livestock production and management program. According to respondents, culling due to disease problem was unusual, although it was one of the serious production constraints in the study areas. The farmers cull mostly when the sheep was old. Culling of rams was practiced by the majority of the farmers in the study areas. Colour was the common criteria to cull their breeding ram in the study areas. The most unwanted colour was pure black and black with white or red colour was totally discouraged because they link this colour market price (from group discussion with elders and model farmers).

The average culling age of Wogide breeding rams and ewes were 5.56 and 8.18 years, respectively. Average culling age of breeding rams and ewes in Borena were 4.82 and 7.65 years, respectively. Legambo district were culled from breeding at average age of 4.35 and 7.92 years for male and females, respectively. Culling was practiced for a pressing need of cash, unsatisfactory production and old sheep. The culling age of sheep in this study is higher than the Menz sheep in Menz area whereas, similar to Afar sheep in Afar (Getachew *et al.,* 2010).

In Wogide district the ram 6 – 12 months, breeding rams and castrated were sold first, second and third with an index value of 0.39, 0.32 and 0.18, respectively for cash needed and in Borena district castrated, ram 6 – 12 months and older ram were sold first, second and third with an index value of 0.31, 0.21 and 0.17, respectively. Whereas, in Legambo district castrated, ram 6 – 12 months and old ewes were the first, second and third to be sold with scores of 0.36, 0.27 and 0.22, respectively for cash needed. Generally in three districts farmers sold male sheep rather than female. It might be the farmers needed female sheep for breeding purpose.

The average market age of male and female sheep in Wogide district was 8.27 and 10.78 months, and average market age of male and female in Borena district was 7.93 and 8.97, respectively. While average market age of male and female in Legambo district was 7.89 and 9.48 months, respectively. Most of the sheep sale in the study areas was concentrated to the months of major festival like (Christmas, Ethiopian Easter and Arefa), ceremony like wedding. In the study areas during religious festival and wedding season, the demand of meat was high. The farmers also sold their sheep from May to June for purchase of fertilizer for crop production and seed.

Generally income obtained from sheep was used up for expenses related to education for children, for the purchase of food and clothing for the family, and for the purchase of fertilizer, seed and other inputs for crop production. The average market age of male and female sheep in Wogide district were higher than the Gozamen district of male and female (Abera, 2013). The market age of male and female sheep in this study is shorter than (Alemayehu *et al.,* 2015) in Tocha (11.0±2.74 for male and 12.7±2.46 for female), Konta (12.4±4.8 for male and 13.8±5.7 for female and Mareka districts (11.4±1.37 for male and 12.0±2.19 for female).

Conclusions

The study of herd management and breeding practices of indigenous sheep population is carried out in south Wollo zone mainly in three districts (Wogide, Borena and Legambo). In this study the sheep flock size of Legambo was higher than Wogide and Borena. Larger sheep flock size, more dependence in sheep for income and food source along with poor production potential of the area make Legambo site more suitable for sheep production. The breeding ewes had taken a major portion in the study areas followed by lambs.

Mating was predominantly uncontrolled in Wogide and Borena but in some extent there was controlled mating in Legambo district and uses of ram from own flock was a predominant practice in all districts. Their communal grazing, freely watering and lack of awareness about inbreeding were the main factors for the high proportion of uncontrolled mating in the study areas. Majority of sheep owners in the study areas was use traditional castration method to castrate their sheep the remaining were use modern method.

The majority of farmers were keep sheep for the purpose of income generation, meat, saving and manure in the study areas. Farmers in the study areas reported that they recognize the importance of selection and practiced with their own selection criteria's. Appearance/conformation, fast growth, coat colour, tail size, lambing interval and age at first sexual maturity were the most important selection criteria for rams and ewes in the study areas.

Recommendations

In the study areas there were high sheep population, but the production was very poor; therefore, supporting the extension service given by the agricultural and rural development office is needed to improve the breeding practices of the farmers and reduce constraints of feed shortage and disease prevalence. Training should be given in different breeding and husbandry practices to reduce the effect of inbreeding as well as in order to select and use genetically superior breeding are undertaken. An intervention to select best rams and culling of inferior ram would be suggested to enhance genetic gain. Further studies to identify traits associated with black colour and

devicing conservation strategy for black colour might be considered.

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