Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.4, No.17, 2014

Within Breed Phenotypic Diversity of Sokota/Tigray Sheep in Three Selected Zones of Tigray, Northern Ethiopia

Mulata Hayelom[1]* Solomon Abegaz[2] Yoseph Mekasha[3]
1.Department of Animal Science, Adigrat University, P.O .Box 50, Adigrat, Ethiopia
2.Ethiopian Institute of Biodiversity, P.O.Box 30726, Addis Ababa, Ethiopia
3.International Livestock Research Institute (ILRI), LIVES, Hawassa, Ethiopia
*Corresponding author: mulata.ha@gmail.com

Abstract
The study was carried out in Atsibi wonberta, Wukro kilteawlaeo, Ofla, Alamata, Enderta and Degua Temben district of Tigray Regional State of Ethiopia. The objectives of the study were to characterize the sheep breeds based on their different qualitative and quantitative traits in their natural environment. Data were gathered through semi-structured questionnaire, focus group discussions, field observations and linear body measurements of sample populations. Body weight, linear body measurements and qualitative records were taken and observed from 600 sheep. The most frequent sheep types were the short fat tailed and fat rumped type of sheep. These include Begie- Degua (common highland) sheep breed which is found in Atsibi-wonberta, Wukro-Kilteawlaelo, Ofla and Degua-Tembien districts, Elle (Afar) sheep breed mostly found in Alamata district and mixed sheep breeds found in Enderta district. For Elle sheep, Sex of the sheep had highly significant ($p<0.01$) effect on Heart girth (HG), Wither height (WH), tail length (TL). Whereas body weight (BW) and Body length (BL) was affected by sex of the sheep ($p<0.05$) and ear length (EL) of Elle sheep were not affected ($p>0.05$) by sex of the sheep. Differently in Common highland and mixed sheep breeds, BW, BL, HG, WH, TL and EL were not affected ($p>0.05$) by sex of the sheep. Chest girth had consistently showed the highest correlation coefficient ($r=$ 0.22 to 0.84) in the Elle, common highland and mixed sheep breeds in this study.
Keywords: Sheep breeds, district (s), linear body measurement

1. INTRODUCTION

In developing countries, livestock genetic resources in general have not been adequately characterized, evaluated or fully utilized through selection and in some cases local populations are threatened with extinction before their genetic value is even properly described and studied (Madalena, 1993; Kassahun Awgichew, 2000). In spite of this, adapted indigenous animal genetic resources (AnGR) provide sustainable options to smallholder livestock production in developing countries. However, numerous indigenous AnGR are endangered by extinction, and some are disappearing at an alarming rate due, for example, to uncontrolled crossbreeding and replacement with exotic breeds.

Formulation of appropriate strategies for long-term maintenance and use of the genetic variation within livestock species requires characterization of animal genetic resources, to identify the variation and appropriate germplasm that is optimal for each system. Until there is proper information on the genotypic and phenotypic characteristics of our indigenous breeds, no rational decisions can be made regarding their utilization and conservation (Rege *et al*., 2001).

The concern for conservation of livestock diversity arises from the fact that the majority of rural and urban households in developing countries like Ethiopia depend directly upon genetic, species and ecosystem biodiversity for their livelihoods (Workneh *et al.,* 2004; DAGRIS, 2006). Therefore, efficient utilization of Animal Genetic Resources (AnGR) in developing countries is a prerequisite for the opportunities to meet the future demands of food and to improve the livelihood of poor people. In order to meet the increased demands for food of animal origin, a livestock revolution has to take place. Animals and production systems must, therefore, be adapted to local environment, socio-economic and cultural conditions, and adequate genetic diversity for the unknown future needs to be ensured (ILRI, 2006; Solomon , 2007).

Breed characterization requires the distillation and documentation of all available knowledge for present and future utilization. It involves all activities associated with description of animal genetic resources, which contributes to the reliable prediction of genetic variation and performance in defined environments (Rege and Okeyo, 2006; FAO, 2007).

Ethiopian sheep breeds have been traditionally classified into four broad categories based on tail type and fiber type: the Hairy Thin Tailed, Woolen Thin Tailed, Fat Tailed and Fat Rumped (MOA, 1975). Accordingly, attempts have been made to group some of the indigenous sheep types in to these different categories. Galal (1983) and Sisay (2009) described the physical characteristics and eco-regional distribution of some of the sheep types in Ethiopia and Amhara National Regional State, respectively. Recent molecular study of the Ethiopian sheep population has led to the classification of the country's sheep resources into six breed groups, nine breeds and 14 populations (Solomon, 2007). However these studies reported Sokot /Tigray sheep breed in general. This

might leave room for presence of phenotypic and genotypic differences within Sokota or Tigray sheep breed. Therefore, this research work was launched,

- To study within breed phenotypic diversity of Sokota/Tigray sheep in three selected zones of Tigray.

The specific objectives of the study were:

- To characterize the sheep breeds based on their different qualitative and quantitative traits in their natural environment.

3. MATERIALS AND METHODS

3.1. Description of the study area

The study was conducted in six districts namely, Atsbi-Wonberta, Wukro-Kilteawlaelo, Ofla, Alamata, Enderta and Degua-Temben. Atsbi-Wonberta and Wukro-Kilteawlaelo districts are found in Eastern zone of Tigray; while Ofla and Alamata are in Southern Zone of Tigray Regional State. The remaining two districts viz, Enderta and Degua-Temben are part of South Eastern of Tigray Region (figure 1). The mean annual temperature of the study areas varies from 14^{o}c to 22^{o}c. The mean annual rainfall ranges from about 400 mm to around 969 mm. The altitudes of districts were situated at 1500- 3200 masl. The farming system in all of the surveyed districts is a crop livestock mixed farming system. The major crops grown in Southern; South Eastern and Eastern zones of Tigray Regional state are sorghum, Teff (Eragrostis tef), maize in Alamata, Enderta and Wukro-Kilteawlaelo districts. Whereas, wheat, bean, barley, pea, lentil, grass pea, chick pea, rarely linseed wheat and other highland crops in Ofla, Atsibi-Wonberta, Degua-Tembien districts. Cattle, goat, sheep, equines, poultry and honey bees also reared in these districts. Detail description of the above six districts was made in (appendix Table 1).

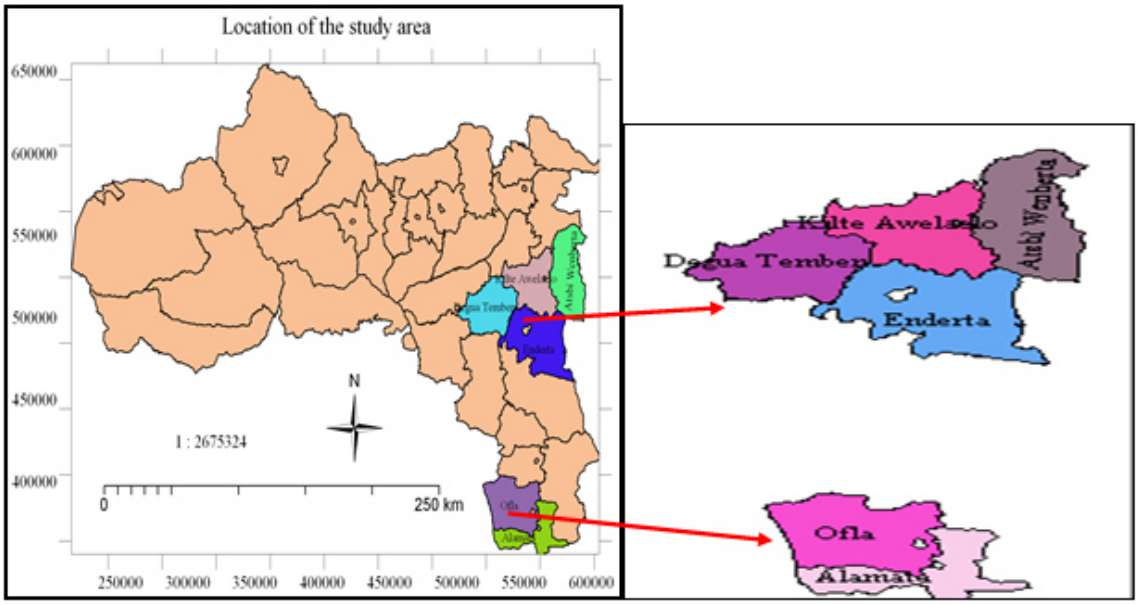

Figure 1. Location of the study districts in Tigray Region.

3.2. Selection of the study site

Study sites were selected based on their suitability for sheep production, sheep distribution patterns, agro-ecology, and access to infrastructures like road and public transport. A rapid reconnaissance survey was done before the main survey to know the distribution and sampling framework from which sampling of district was taken. Two districts from each of three Zones (Eastern Tigray, South Eastern Tigray and Southern Tigray) were purposively selected. The selections of districts from the Zones were made to include one dominantly highland and one dominantly lowland district. The districts included in the study are (Atsbi-Wonberta, Wukro-Kilteawlaelo, Ofla, Alamata, Enderta and Degua-Tembien). A total of 12 peasant associations **(**Felege wein, Golgolnaele, Genfel, Aynalem, Menkere, Wonberet, Timuga, Limat, Debri, Maitsedo, Mahibere-silassie and Hagereselam), 2 from each district were selected randomly. A total of 180 households 30 from each district and 15 from each peasant associations were selected randomly for the interview.

3.3. Procedures and methods of data collection

Data from primary (observation, questionnaire and interview) and secondary sources (different offices) were collected. Data were generated through use of structured questionnaires, field observation and group discussions and from secondary sources**.** A modified questionnaire was prepared by adopting a questionnaire prepared by Oromiya Agricultural Development Bureau (OADB) for survey of livestock breeds in Oromiya (Workneh and Rowlands, 2004). The pre-tested questionnaires were administered to 180 households by the researcher and

development agents.

3.4. Data management and analysis

Data collected through questionnaire were described by descriptive statistics using (*JMP5, 2002)*.

4. Result and Discussion

4.1. Sheep Types in the Study Area

Sheep production wasn't found to be the dominant farming practice in the study area; however, substantial number of farmers keeps sheep. The most frequent sheep types were the short fat tailed and fat rumped type of sheep. These include Begie- Degua (common highland) sheep breed which is found in Atsibi-wonberta, Wukro-Kilteawlaelo, Ofla and Degua-Tembien districts and Elle (Afar) sheep breed mostly found in Alamata district. The mixed sheep breeds found in Enderta district. The mixed sheep breeds of Endera district includes Elle sheep, common highland sheep and fat rumped sheep found at Debri peasant association. Appendix figure (1) shows the different pictures of the sheep types in the study area.

4.2. Phenotypic Characteristics

The traditional description of breeds using the phenotype is based upon morphological characters such as coat colour, horn, tails, body measurements and other specific visible traits. Phenotypic characterization has been suggested and used to describe and classify breeds of farm animal species (FARM-Africa, 1996; Lanari *et al*., 2003; Nsoso *et al.,* 2004; Traore *et al*., 2008). The advantages of morphological data are that it is relatively easily obtained, requiring relatively inexpensive instrumentation in comparison to molecular instruments (Desalle and Grimaldi, 1991).

The percentage of morphological characteristics of sheep found in the study districts were summarized in (Table 1). The numbers of observations in each wereda are 100. Because of this the number of observations and percentage of the qualitative traits are the same for each district. The dominant coat color type in all of the sheep types was red brown, brown, red, white and black respectively. In addition a few sheep had Grey (*Jimo*) and beige coat color. The common highland sheep types of Atsibi-Wonberta (54 %; n= 54) and Ofla (33 %; n=33).

Table 1. Percentage of qualitative traits of sheep in the study districts.

Character	Attribute	Atsibi-Wonberta	Wukro-Kilteawlaelo	Ofla	Alamata	Enderta	Degua-Tembien
Horn	Presence	20	13	10	12	8	13
	absence	80	87	90	88	92	87
Fiber type	Hair	31	89	55	100	91	66
	Course wool	54	2	33	-	6	20
	Fine wool	15	9	12	-	3	14
Hair length	Short	27	90	51	100	90	65
	Medium	21	9	15	-	5	13
	long	52	1	34	-	6	22
Hair type	Straight	10	100	29	100	33	75
	curly	90	-	71	-	67	25
Face profile	Flat	50	36	48	38	40	36
	Concave	39	52	43	62	51	64
	convex	11	12	9	-	9	-
Tail type	Short-fat-tailed	100	84	95	11	68	94
	Fat-rumped	-	15	5	89	32	6
Tail cruled	Yes	100	100	100	15	70	100
	No	-	-	-	85	30	-
Toggles	Present	20	10	19	15	20	16
	Absent	80	90	81	85	80	84
Wattle	Present	9	14	15	84	27	13
	Absent	91	86	85	16	73	87
	Lateral	60	69	59	68	60	66
	Dropping	40	31	41	32	40	34
Wool	Whole body	84	22	29	-	29	25
Distribution	Absent on legs	14	28	33	12	30	35
	Absent	2	50	38	88	41	40

About 20 % (n=20) of Degua-Tembien had course wool type of fiber. Whereas, the types of sheep found in Alamata (100 %), Enderta (91 %), Wukro-kilteawlaelo (89 %), Degua-Tembien (66 %), Ofla (55 %) and Atsibi

(31 %) were hair type. Majority (80 %) of the sheep types found in the study districts were polled (absence of horn). Most of the sheep had concave and flat (straight) face profile except few types of sheep which have convex face profile.

Short fat tailed type of sheep was the dominant sheep type in Atsibi-wonberta, Wukro-kilteawlaelo, Ofla, Enderta and Degua-Tembien districts. Whereas, In Alamata (89%) and about 32 % in Enderta districts long fat rumped (Elle breed) of sheep were dominant. Except the Elle breed the tail of the short fat tailed sheep was curled up at the end of the tail. Presence of toggle was not exceeding 20 percent of the total sheep population in all of the above mentioned districts. Majority (84 %) of the Elle sheep breeds have wattle. But, except few, the common highland sheep types have no wattle.

4. 3. Linear Body Measurements and Body Weight

Information on body size of specific sheep breed at constant age has paramount importance in the selection of genetically superior animals for production and reproduction purpose (Yoseph, 2007).

Sex effect: The least squares means and standard errors for the effect of sex, age group and site on body weight and other body measurements are presented in Tables 2, 3 and 4, for Elle, Common highland and Mixed sheep breed. For Elle sheep, Sex of the sheep had highly significant ($p<0.01$) effect on Heart girth (HG), Wither height (WH), tail length (TL). Whereas body weight (BW) and Body length (BL) was affected by sex of the sheep ($p<0.05$) and ear length (EL) of Elle sheep were not affected ($p>0.05$) by sex of the sheep. Differently in Common highland sheep, BW, BL, HG, WH, TL and EL were not affected ($p>0.05$) by sex of the sheep. Similar to the Common highland sheep breed the effect of sex on body weight and other body measurments of Mixed sheep breed was not significant ($p >0.05$) while Tail length was highly affected by sex ($p<0.01$). Generally in the Elle and common highland sheep breeds lower values were observed in all of the measurements for male than female sheep except tail length. This might be due to the age of the male sheep was in the early age of the respected dentation class and the females in the later age of the dentition class. This also may be explained by environmental factors such as nutrition affecting livestock productivity. The effect of sex on body weight and other measurements of Elle and common highland sheep breeds obtained in this study is in agreement with previous results (Kasahun, 2000; Markos *et al.,* 2004).

Age effect: In the Elle sheep breed, age was found to strongly influence ($P<0.0001$) for body weight, body length, Heart girth, withers height and tail length except ($P<0.05$) for ear length. Whereas in the common highland sheep breed, body weight and other body measurements was increased with age even though there was not statistically significance ($p>0.05$). Similar to the common highland sheep breed, body length, height at wither, tail length and ear length of mixed sheep breed was not affected ($p>0.05$) by age while body weight and heart girth was strongly influence ($p<0.0001$) by age. In the Elle sheep breed there was wide variability as the age of the animals increased for these body measurements. This implies that these variables might best explain the growth pattern of the animals. On the contrary, variable like ear length was less influenced by age and showed less variation as age advances. Body weight and body measurements of both sexes of Elle sheep breeds increased at larger rate from 1 pair of permanent incisor (dentition class 1) to the eruption of 3 pairs of permanent (Dentition class 3), while after dentition class 3 it increased at diminishing rate. Similar trend was observed by (Riva *et al*., 2004) who observed little change in body weight and other measurements after 24 months in Bergamasca sheep breed of Italy.

The maximum variation in values for all measurements of Elle sheep breed, except ear length at bottom, was observed between animals of dentition groups one and two. There was a spiky decline in difference between values for body weight, body length, and heart girth and tail length post dentition group three. Meanwhile, the least variation in values for these parameters was observed between the dentition groups three and four. This is expectable since animals, under normal conditions, grow fast when younger but grow slowly when they reach maturity (Mekasha, 2007). Nevertheless, it also suggests that the age between the appearance of the first and second pairs of permanent incisor may be the physiological age possibility in which the animal shows the fastest growth rate. It also appears that some parameters achieve their maximum growth during this age.

Earlier findings by Mekasha (2007) has shown that large sized indigenous bucks reach maturity at later age as compared to early maturing small sized bucks. Yet, the generally lower values in body weight and other linear measurements in the current study do not suggest that the population could be described as large-sized, despite showing a late-maturing growth pattern. This might be explained by other environmental effects such as season and nutrition. This may coincide with the fact that the study was conducted accompanied by a drought condition that persisted in the area since 2008/2009.

Site effect: Site effect: In the common highland sheep breeds site (district) was found to significantly ($P<0.0001$) influence parameters such as height at wither, heart girth, ear length and tail length while body length and body weight was not significantly ($p>0.05$) affected by district. Similar to these common highland sheep breed the body weight and other body measurements of mixed sheep breed was strongly (at least $p<0.05$) influenced by peasant association (PA) except ear length ($p>0.05$) as presented in appendix Table 7. Mixed sheep breed found in Debri PA had large body weight and body length (29.22± 0.52 and79.92±0.68 respectively)

as compared to Maitsedo PA (26.98± 0.58 and 77.23±0.76) for body weight and body length respectively while height at wither, tail length and ear length are higher in the later PA than the former one (Table 4). Body weight and body measurements of Elle sheep breed was not affected by PA.

Generally the tail length of Elle sheep breeds was lower (Table 2) from previous reports of 36 cm for Horro sheep breed (Kasahun, 2000). But it is higher than menz sheep (18.7 cm) and Afar sheep breed (16.7 cm) (Tesfaye, 2008). The mean body weight of Elle ram (22.7 kg) is lower than the average body weight of Gumuz ram (34.63 kg) (Solomon, 2007), Washera (29.14 kg), Menz sheep (27.54 kg) and Dangila sheep (31.06 kg) (Sisay, 2009). But it is heavier than Afar (24.11kg).

Table 2. Least square means and standard error (LSM ± SE) for main effects of dentition (PPI) and sex on the body weight (kg) and linear measurements (cm) in Elle sheep breed.

Effects	Body Weight		Body Length		Heart Girth		Height at Wither		Tail Length		EL	
& level	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
Overall	100	25.63±2.9	100	53.75±3.21	100	73.73±3.2	100	59.56±2.55	100	27.12±2.37	100	7.4±2.17
Age		**		**		**		**		**		*
1PPI	40	22.39±0.67	40	48.83±0.83	40	71.1±0.83	40	54.2±0.53	40	24.3 ±0.45	40	7.25±0.38
2PPI	27	26.33±0.79	27	54.44±0.99	27	74.74±0.99	27	61.14±0.63	27	28.26±0.54	27	6.59±0.45
3PPI	24	29.08±0.89	24	58.92±1.1	24	76.29±1.1	24	63.96±0.71	24	29.83±0.61	24	8.47±0.51
4 PPI	9	28.67±1.38	9	59.78±1.72	9	75.67±1.7	9	66.89±1.1	9	29±0.94	9	7.56±0.78
Sex		*		*		**		**		**		Ns
Male	10	22.7±1.42^{b}	10	51.2±1.76^{a}	10	67.9±1.75^{b}	10	56.4±1.11^{b}	10	32.1±0.96^{a}	10	7.4±0.80^{a}
Female	90	25.95±-^{a}	90	54.03±-^{a}	90	74.38±-^{a}	90	59.91±-^{a}	90	26.56±-^{b}	90	7.39±-^{a}

a,b,c,d, means on the same column with different superscripts, within the specified class variable, are significantly different (p<0.05); Ns = non-significant;*P<0.05; ** P<0.01; BW= Body weight, BL= Body length; HG = Chest Girth; WH = Wither height; EL= Ear length; TL= Tail Length; TL= Tail Length; 1PPI =1 Pair of permanent Incisors; 2 PPI = 2Pairs of Permanent Incisors; 3PPI = 3 Pairs of Permanent Incisors; 4PPI= 4 pairs of permanent incosor; AW= Atsibi Wonberta; WK= Wukro kilteawlaelo; DT= Degua Tembien.

Table 3. Least square means and standard error (LSM ± SE) for main effects of dentition (PPI) and site (District) on the body weight (kg) and linear measurements (cm) of common highland sheep.

Effects	Body Weight		Body Length		Heart Girth		Height at Wither		Tail Length		EL	
& level	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
Overall	400	27.52±2.85	400	56.69±7.5	400	77.64±3.51	400	61.81±2.83	400	19.84±2.19	400	8.68±2.53
Sex		Ns		Ns		Ns		Ns		Ns		Ns
Male	67	26.96±0.55 ^{a}	67	56.72±3.85 ^{a}	67	77.4±0.83 ^{a}	67	60.73±0.54^{a}	67	21.03±0.43 ^{a}	67	8.74±0.32 ^{a}
Female	333	27.64±- ^{a}	333	59.72±- ^{a}	333	77.68±- ^{a}	333	61.18±-^{a}	333	19.6±- ^{b}	333	8.67±- ^{a}
Age		Ns		Ns		Ns		Ns		Ns		Ns
1PPI	123	26.76±0.65	123	62.71±4.53	123	76.08±0.98	123	61.22±0.63	123	20±0.51	123	8.57±0.38
2PPI	92	27.42±0.68	92	57.12±4.73	92	78.37±1	92	60.65±0.66	92	19.42±0.53	92	8.46±0.39
3PPI	124	28.09±0.64	124	58.07±4.46	124	78.32±0.97	124	61.31±0.63	124	19.83±0.50	124	8.79±0.37
4 PPI	61	28.06±-	61	57.66±-	61	78.28±-	61	61.11±-	61	20.14±-	61	9±-
District		**		Ns		**		**		**		**
AW	100	27.01±0.65^{b}	100	55.38± 4.55^{b}	100	77.63 ±0.98 ^{b}	100	62.88± 0.63 ^{a}	100	19.34±0.51^{cb}	100	11.06±0.38 ^{a}
WK	100	27.52±0.62^{ba}	100	55.9± 4.39^{b}	100	76.85± 0.95 ^{b}	100	57.92± 0.62 ^{b}	100	20.12±0.49 ^{b}	100	11.03±0.37 ^{a}
Ofla	100	27.33±0.65^{ba}	100	56.41±4.52 ^{b}	100	76.44±0.98 ^{b}	100	63.58 ± 0.63 ^{a}	100	21.19±0.51 ^{a}	100	6.09± 0.38 ^{b}
DT	100	28.23±0.62 ^{a}	100	59.03±4.35^{a}	100	79.63 ± 0.94^{a}	100	62.84±0.61 ^{a}	100	18.7± ^{c}	100	6.54±0.36^{b}

a,b,c,d, means on the same column with different superscripts, within the specified class variable, are significantly different (p<0.05); Ns = non-significant;*P<0.05; ** P<0.01; BW= Body weight, BL= Body length; HG = Heart Girth; WH = Wither height; EL= Ear length; TL= Tail Length; 1PPI =1 Pair of permanent Incisors; 2 PPI = 2Pairs of Permanent Incisors; 3PPI = 3 Pairs of Permanent Incisors; 4PPI= 4 pairs of permanent incosor; AW= Atsibi Wonberta; WK= Wukro kilteawlaelo; DT= Degua Tembien.

Table 4. Least square means and standard error (LSM ± SE) for main effects of dentition (PPI), sex and site (PA) on the body weight (kg) and linear measurements (cm) of mixed sheep breed.

Effects	Body Weight		Body Length		Heart Girth		Height at Wither		Tail Length		EL	
& level	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
Overall	100	28.1±2.5	100	56.28±2.3	100	78.58±2.7	100	58.98±2.8	100	20±3.2	100	6.08±2.4
Age		**		Ns		**		Ns		Ns		Ns
1PPI	22	25.07±0.74	22	56.54±0.82	22	77.45±0.97	22	60.95±1.22	22	24±1.6	22	6.68±0.89
2PPI	18	25.64±0.76	18	55.56±0.84	18	75.03±0.99	18	58.94±1.25	18	21.5±1.6	18	6.61±0.92
3PPI	35	30.46±0.64	35	56.66±0.71	35	80.86±0.84	35	58.77±1.05	35	17.83±1.39	35	6.01±0.78
4 PPI	25	29.24±-	25	56.04±-	25	78.92±-	25	57.58±-	25	18.44±-	25	5.26±-
Sex		Ns		Ns		Ns		Ns		Ns		Ns
male	11	28.82±.79	11	56.27±0.86	11	77.82±1.03	11	60.91±1.29	11	20.64±1.6	11	6.54±0.96
Female	89	28.01±-	89	56.28±-	89	78.67±-	89	58.75±-	89	19.92±-	89	6.02±-
PA		*		**		**		**		**		Ns
Debri	50	29.22± 0.52 [a]	50	55.30±0.57 [b]	50	79.92±0.68 [a]	50	56.49±0.84 [b]	50	14.32± 1.1 [b]	50	5.84±0.63 [a]
Maitsedo	50	26.98± 0.58[b]	50	57.26±0.64[a]	50	77.23±0.76 [b]	50	61.48±0.95 [a]	50	25.68± 1.3 [a]	50	6.32± 0.71 [a]

a,b,c,d, means on the same column with different superscripts, within the specified class variable, are significantly different ($p<0.05$); Ns = non-significant;*$P<0.05$; ** $P<0.01$; BW= Body weight, BL= Body length; HG = Chest Girth; WH = Wither height; EL= Ear length; TL= Tail Length; TL= Tail Length; 1PPI =1 Pair of permanent Incisors; 2 PPI = 2Pairs of Permanent Incisors; 3PPI = 3 Pairs of Permanent Incisors; 4PPI= 4 pairs of permanent incosor; AW= Atsibi Wonberta; WK= Wukro kilteawlaelo; DT= Degua Tembien; PA= peasant association

4.4 Correlation Coefficient between Body Weight and Linear Body Measurements

The correlation of body weight and linear body measurements of Elle, common highland and mixed sheep breeds were summarized from Table 5 to 8. Table 5 shows correlation coefficients between live weight and other body measurements of Elle (Afar) sheep breed by sex in Alamata district. Heart girth had strong positive correlation (r=0.84 and 0.75) with body weight in males and females respectively. That means, from the linear body measurements, heart girth had the highest correlation with body weight of both sexes. The highest association between height at wither and body length were observed in the males (r=0.77). Height at wither had also medium correlation (r = 0.68 and 0.56) with body weight in males and females respectively.

In the common highland sheep breed body weight is positively correlated with heart girth in I, II, III and IV dentition classes with correlation of 0.06 to 0.72 (Table 8). Similar to the Elle sheep breed height at wither and body length of common highland sheep breed was high to lower correlation (r= 0.74 and 0.15) for male and female sheep respectively.

The high correlation of different measurements with body weight would imply these measurements can be used as indirect selection criteria to improve live weight (Khan *et al.,* 2006; Solomon, 2008) or could be used to predict body weight (Fasae *et al.,* 2006). The high correlation coefficients between body weight and body measurements for all age groups suggest that either of these variables or their combination could provide a good estimate for predicting live weight of sheep from body measurements. Chest girth had consistently showed the highest correlation coefficient (r= 0.22 to 0.84) in the Elle, common highland and mixed sheep breeds in this study. This highest correlation of chest girth with body weight than other body measurements was in agreement with other results (Afolayan, *et al.,* 2006; Fasae *et al.,* 2006; Solomon, 2008; Tesfaye, 2008) and would imply that chest girth was the best variable for predicting live weight than other measurements.

Table 5. Coefficients of correlations between body weight and other body measurements of Elle (Afar) sheep breed in Alamata district, above diagonal male (N=10) and below diagonal female (N=90).

	HW	HG	BL	BW
HW	1.00000	0.75405*	0.77179**	0.68326*
HG	0.35354**	1.00000	0.49962Ns	0.83624**
BL	0.73702**	0.27843*	1.00000	0.25301Ns
BW	0.56252**	0.75332 **	0.50457**	1.00000

* HW= height at wither; BL= Body length; HG = Chest Girth; N= number of sheep

Table 6. Coefficients of correlation between body weight and linear body measurements for Common highland sheep within age group.

Trait		Age group			
		1PPI	2PPI	3PPI	4PPI
BL	N	123	92	124	61
	r	0.06^{Ns}	0.24*	0.45**	0.31*
HG	N	123	92	124	61
	r	0.25**	0.47 **	0.55**	0.72**
WH	N	123	92	124	61
	r	0.05^{Ns}	0.09^{Ns}	0.24**	0.21^{Ns}

* HW= height at wither; BL= Body length; HG = Chest Girth; 1PPI =1 Pair of Permanent Incisors; 2 PPI = 2Pairs of Permanent Incisors; 3PPI = 3 Pairs of Permanent Incisors; 4PPI = 4 Pairs of Permanent Incisors.

Table 7. Coefficients of correlations between body weight and other body measurements of common highland sheep, above diagonal male (N=67) and below diagonal female (N=333).

	HW	HG	BL	BW
HW	1.00000	0.58111**	0.73597**	0.11828Ns
HG	0.07927Ns	1.00000	0.49696**	0.22206**
BL	0.15296*	0.03107*	1.00000	0.24299*
BW	0.137*	0.49123**	0.01795Ns	1.00000

* HW= height at wither; BL= Body length; HG = Chest Girth; N= number of sheep

Table 8. Coefficients of correlation between body weight and linear body measurements for mixed sheep within age group.

Trait		Age group			
		1PPI	2PPI	3PPI	4PPI
BL	N	22	18	35	25
	r	0.02^{Ns}	0.002Ns	0.08Ns	0.25Ns
HG	N	22	18	35	25
	r	0.62**	0.25 Ns	0.76**	0.66**
WH	N	22	18	35	25
	r	0.37^{Ns}	0.19^{Ns}	0.12Ns	0.23^{Ns}

* HW= height at wither; BL= Body length; HG = Chest Girth; 1PPI =1 Pair of Permanent Incisors; 2 PPI = 2Pairs of Permanent Incisors; 3PPI = 3 Pairs of Permanent Incisors; 4PPI = 4 Pairs of Permanent Incisors.

5. SUMMARY AND CONCLUSIONS

5.1. Summary

The study on within breed phonotypic diversity of Sokota/Tigray sheep was based on survey of 180 households owning sheep. Characterization of physical features by observation and measurement of adult animals (N = 600) for some quantitative and qualitative traits was carried out. The survey was conducted in Atsbi-wenberta and Wukro-kilteawlaelo districts from Eastern Zone; Alamata and Ofla Districts from Southern Zone and Enderta and Degua-Tembien districts from South Eastern Zone of the Tigray National Regional State of Ethiopia. The above mentioned districts are located in the lowland (Alamata district), Midlowland (Enderta and Wuko-kilteawlaelo districts), highland (Atsbi-wonberta, Ofla and Degua-Tembien districts). The study was conducted by implementing single visit questionnaire, observing and recording of sheep morphological characters, and by recording body weight and body measurements.

The most frequent sheep types were the short fat tailed and fat rumped type of sheep. These include Begie- Degua (common highland) sheep breed; Elle (Afar) sheep breed and mixed sheep breeds of Enderta district. Majority (greater than 80 %) of the sheep types found in the study districts are polled, had concave and flat face profile. Elle and mixed sheep breeds are hair type but the common highland breeds are wool type.

Generally in the Elle and common highland sheep breeds lower values were observed in all of the measurements for male than female sheep except tail length. Generally males had large tail length than females in the study area. In the Elle sheep breed, age was found to strongly influence ($P<0.0001$) for BW, BL, HG, HW and TL except ($P<0.05$) for EL. Whereas in the common highland sheep breed, BW and other body measurements was increased with age even though there was not statistically significance ($p>0.05$). Similar to the common highland sheep breed, BL, HW, TL and EL of mixed sheep breed was not affected ($p>0.05$) by age while BW and HG was strongly influence ($p<0.0001$) by age.

Heart girth had strong positive correlation ($r=0.84$ and 0.75) with body weight in males and females

respectively for Elle sheep. In the common highland sheep breed body weight is positively correlated with heart girth in I, II, III and IV dentition classes with correlation of 0.06 to 0.72.

5.2. Conclusion

The basic important component of this phenotypic characterization of Elle, Common highland and mixed sheep breeds is the delimitation of those sheep breeds for further study. Based on this study, it can be hypothesized that the phonotypic diversity was observed within and between sampling districts and peasant associations. This reflects the genetic differentiation as a result of both natural and human influences. The physical description of sheep types can only dimly reveal the genetic relationships between individuals, but it is a first step in classifying a diverse population into a relatively homogenous sub-populations. Therefore To increase the validity of this on-farm preliminary study, it is important to undertake well planned on station study to identify the phonotypic and genetic characterization of sheep within breeds and then to improve their genetic potential.

6. ACKNOWLEDGMENT

Special thanks for Ministry of Education Federal Democratic Republic of Ethiopia, Ethiopia.

7. REFERENCES

Afolayan, R.A., I.A. Adeyinka and C.A.M. L. (2006). The estimation of live weight from body measurements in Yankasa sheep Czech. *J. Anim. Sci,* 51(8):343-348.

DAGRIS (2006)**.** Domestic Animal Genetic Resources Information System (DAGRIS). (eds. J.E.O. Rege, W. Ayalew, E. Getahun, O. Hanotte and T. Dessie). International Livestock Research Institute, Addis Ababa, Ethiopia. http://dagris.ilri.cgiar.org

DeSalle, R. and D.A. G. (1991). Morphological and molecular systematics of the Drosophilidae. *Annual Review of Ecology and Systematics,* 22: 447-475.

FAO (2007). The State of the World's Animal Genetic Resources for Food and Agriculture. Rischkowsky, B. and D. Pilling (eds.). FAO (Food and Agricultural Organization of the United Nations), Rome, Italy. 511p.

FARM-Africa, (1996). Goat Types of Ethiopia and Eritrea. Physical description and management systems. Published jointly by FARM-Africa, London, UK, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 76p.

Fasae, O.A., Chineke A.C and Alokan J.A. (2006). Relationship between some Physical Parameters of Grazing Yankasa Ewes in the Humid Zone of Nigeria. Department of Animal Production and Health. University of Agriculture. P.M.B. 2240. Abeokuta. Nigeria.

Galal, E.S.E. (1983). Sheep germ plasm in Ethiopia. FAO/UNEP *AGRI*. 1, 5-12.

ILRI (2006). Animal Genetics Training Resource, version 2, 2006. Ojango, J.M., Malmfors, B. and Okeyo, A.M. (Eds). International Livestock Research Institute, Nairobi, Kenya, and Swedish University of Agricultural Sciences, Uppsala, Sweden.

JMP, (2002). JMP Introductory and User's Guide, Version 5. SAS Institute Inc., Cary, NC, USA.

Kassahun A. (2000). Comparative performance evaluation of Horro and Menz sheep of Ethiopia under grazing and intensive feeding conditions. Ph.D. Dissertation Humboldt- University of Berlin,Germany.

Khan, H., F. Muhammd, R. Ahmed, G. Nawaz, Rahimullah and M. Z. (2006). Relationship of body weight with linear body measurements in goats. *Journal of Agricultural and Biological Science.* Asian Research Publishing Network (ARPN) 1:3.

Lanari, M.R., H. Taddeo, E. Domingo, M. Perez Centeno and L. G. (2003). Phenotypic differentiation of exterior traits in local Criollo goat population in Patagonia (Argentina). *Arch. Tires., Dummerstorf*, 46(4): 347-356.

Madalena, F. (1993). The conservation of animal genetic resources in the developing countries: A practical way forward. In: Mack, S. (ed.). Strategies for sustainable animal agriculture in developing countries. FAO Animal Production and Health Paper. *107:* 77-83.

Markos Tibbo, Workeneh Ayalew, Kassahun Awgichew, Ewnetu Ermias and J. E. O. Rege, (2004). On-station characterization of indigenous Menz and Horro sheep breeds in the central highlands of Ethiopia. *AGRI*, 35: 61-74

Ministry of Agriculture (MOA) (1975). National policy on sheep research and development. Report of the Technical Committee. Mimeograph. MOA, Ethiopia, Addis Ababa.

Nsoso, S.J., B. Podisi, E. Otsogile, B.S. Mokhutshwane and B. Ahmadu. (2004). Phenotypic characterization of indigenous Tswana goats and sheep breeds in Botswana. *Tropical Animal Health and Production*, 36: 789-800.

Rege J.E.O., Kahi A.K., Okomo-Adhiambo M., Mwacharo J. and Hanotte O. (2001). Zebu cattle of Kenya: Uses, performance, farmer preferences, measures of genetic diversity and options for improved use. Animal Genetic Resources Research 1. ILRI (International Livestock Research Institute), Nairobi, Kenya. 103 pp.

Rege, J.E.O. and A.M. Okeyo, (2006). Improving our knowledge of tropical indigenous animal genetic resources. In: Ojango, J.M., B. Malmfors and A.M. Okeyo (eds.), Animal Genetics Training Resource, CD version 2. ILRI (International Livestock Research Institute), Nairobi, Kenya, and Swedish University of Agricultural Sciences,

Uppsala, Sweden.
Riva, J., R. Rizzi, S. Marelli, L.G. Cavalchini, (2004. Body Measurements in Bergamasca Sheep. *Small Rumin. Res.* 55: 221–227.
Sisay L. (2009). Phenotypic classification and description of indigenous sheep types in the Amhara National Regional State of Ethiopia. An M.Sc. Thesis presented to the School of Graduate Studies Haramaya University. 96 p.
Solomon A. G. (2007). *In Situ* Characterization of Gumuz Sheep under Farmers Management in North Western Lowlands of Amhara Region M.Sc Thesis presented to the School of Graduate Studies of Haramaya University of Agriculture, Dire Dawa, Ethiopia. 86p.
Solomon G. (2008). Sheep resources of Ethiopia: genetic diversity and breeding strategy. PhD thesis, Wageningen University, The Netherlands.
Solomon G., H. Komen, O. Hanotte, J.A.M. Van Arendonk, (2008). Indigenous sheep resources of Ethiopia: types, production systems and farmers preferences. Animal Genetic Resources Information, No. 43, 2008.
Tesfaye G. (2008). Characterization of Menz and Afar Indigeneous sheep breeds of smallhoders and pastoralists for designing community based breeding sterategies in Ethiopia. MSc Thesis presented to the school of graduate studies of Haramaya University. 158p.
Traore, A., H.H. Tamboura, A. Kabore, L.J. Royo, I. Fernandez, I. Alvarez, M. Sangare, D. Bouchel, I.P. Poiveye, D. Francois, A. Toguyeni, L. Sawadogo and F. Goyache, (2008). Multivariate analyses on morphological traits of goats in Burkina Faso. *Arch. Tierz., Dummerstorf*, 51 (6): 588-600.
Workneh Ayalew, van Dorland A and Rowlands J. (eds), (2004). Design, execution and analysis of the livestock breed survey in Oromiya Regional State, Ethiopia. OADB (Oromiya Agricultural Development Bureau), Addis Ababa, Ethiopia, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 260 pp.
Workneh Ayalew, Ephrem Getahun, Markos Tibbo, Yetnayet Mamo and J. E. O Rege, (2004). Current states of knowledge on characterization of farm Animal Genetic Resource in Ethiopia.pp. 1-21. In: Proceeding of the 11th Annual conference of Ethiopian Society of Animal Production (ESAP). August 28-30, 2004. Addis Ababa, Ethiopia.
Yoseph M. (2007). Reproductive traits in Ethiopian male goats: With special reference to breed and nutrition. Doctoral thesis, Swedish University of Agricultural Sciences, Uppsala, Sweden.pp61.

Appendix

Table 1. Description of the Study districts

Name of Woreda	Distance (Km) from Adiss Ababa & Mekelle respectively	Attitude (masl)	Mean annual temperature (^{o}C)	Mean annual rainfall (mm)	Total human population (CSA,2008)
Atsbi-Wonberta	843N & 65NE	918-3069	19	400	112,234
Wukro-Kilteawlaelo	823 N & 45 N	1977	19.7	400	129,896
Ofla	620 N & 158 S	2300-3200	14	942	142,803
Alamata	600 NE & 180 S	< 1500	22	693	118,557
Enderta	766 N & 12 S	1185-2169	22	500	114,277
Degua-Temben	828 NW & 50 N	1595-2760	18	969	113,526

**masl= meter above sea level*

Figure 1. Different Sheep Types in the Study Districts.

Flock of sheep with cattle in Ofla district (Wenberet PA)

Flock of sheep and goats in Ofla district (Menkere PA)

Atsibi ewe with course wool (local name is Jimo)

Horned Atsibi ram with shaded coat pattern

Elle ram in Alamata district

Elle ewe in Alamata district

Fat-rump with short ear type of Abergelle sheep in Enderta district (Debri PA)

Cross of Elle and highland breed) without horn in Enderta district (Maitsedo PA)

Hair type Common highland sheep in Ofla (wonberet PA)

Common highland sheep with course wool in Ofla (wonberet PA)

Short tail highland with pendulous ear type of sheep in Enderta district (Maitsedo PA).

Elle ram in Enderta district (Maitsedo PA)

Hair type common highland sheep in Degua-Tembien district (Hagere selam PA)

* *PA=peasant association*

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar