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Morphological Characterization of Indigenous Woyto Guji Goat Breed in Loma District, Southern Ethiopia

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Abstract: This study was conducted on 810 goats in three agro ecological zones (Highland, midland and lowland) of Loma district in southern Ethiopia were considered with sex and age groups factor to characterize morphologically Woyto Guji goat in their home tract and production system. The goat population in the study area was characterized by higher proportion of plain coat patterns with brown coat color, straight head profile, semi pendulous ear formation and long ear type. The horns were characterized by backward orientation with a straight shape. Body weight of the goats' changes at increasing rate at 0PPI to 3PPI and gradual increase was observed at older ages. Sex, age, agro ecological zones, sex by age and age by agro ecologies interaction had a significant ($p<0.05/p<0.01$) effect on body weight and many of the linear body measurements. The mean BWT, BC, BL, HG, HW, CW, PW, RH, RL, EL and HL of females are 26.53±2.91kg, 3.01±0.45, 57.48±0.64cm, 70.20±0.21cm, 64.12±0.18cm, 13.74±0.07cm, 13.20±0.19cm, 66.04±0.52cm, 11.97±0.13cm, 13.74±0.16cm and 11.20±0.10cm respectively. The corresponding values for male counterpart were 27.16±0.70 kg, 3.31±0.01, 60.13±1.17cm, 74.98±0.33cm, 68.34±0.05cm, 14.48±0.41cm, 13.25±0.37cm, 68.37±0.50cm, 12.83±0.43cm, 14.02±0.020cm and 13.22±0.47cm respectively. The result indicated that phenotypic characterization, body weight and linear body measurement description could help as an input for efficient utilization, conservation and designing improvement strategy for this genetic resource in the community.

Key words: Age · Agro Ecology · Body Weight · Linear Body Measurements · Sex

INTRODUCTION

Ethiopia is home for diverse indigenous goat populations, numbering 22.8 million heads [1] and 15 breeds of goat exist though the goat characterization is not exhaustive [2] that have traditionally been an integral part of the farming systems in all agro-climatic conditions. It has been estimated that about 70% of the goat population is found in the lowlands and the rest 30% is found in the highland agro ecologies [3, 4].

The broad genetic variability of African small ruminant breeds enables them to survive under stressful environmental conditions like high disease incidence, poor nutrition and high temperature [5]. Environmental stress also maintains a wide range of genotypes, each adapted to a specific set of circumstances. The goat characterization in various forms has not been exhaustively undertaken in Ethiopia. Morphological characterization is one of the crucial means for describing the goat breeds. It is essential to characterize a breed for its conservation [6]. Body measurements in addition to weight estimate describe the individual or population than do the conventional methods of weighing and grading small ruminant [7]. Body dimensions have been used to indicate breed, origin and relationship through the medium of head measurements [8].

The information available regarding Woyto-Guji goat is more of on station based, not sufficient to describe the breed and morphologically characterization was undertaken before two decades. Indigenous livestock breeds are considered, for diverse reasons, as treasured genetic resources that tend to disappear as a result of new market demands, crossbreeding or breed replacement and mechanized agricultural operations. Therefore, with these all scenarios and the current global animal genetic resource mix up through inbreeding, interbreeding and environmental change it is important to characterize over different agro-ecological zones. The objective of this study was to characterize morphologically the Woyto-Guji goat breed in their home areas.

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MATERIALS AND METHODS

The study was conducted in Loma district, located in Dawuro Zone at 6.59° -7.34° N latitude and 36.68° -37.52° E longitudes with at altitudinal range between 501-3300 meters above sea level in Southern Nations, Nationalities and Peoples Region (SNNPR) [9].

The District was, selected based on its potential for goat production, diversified agro ecological zone which encompasses lowland, midland and highland and its varied production system. The total surface area of the district is 116,280ha; with the mean annual rainfall of 900-1800mm, with bimodal and erratic distribution and temperature ranges from 14°C to 30°C [10].

Data Collection: Before starting goat characterization, a rapid field survey was conducted by a team of researchers to assess the distribution, population and composition of and the goat in different agro ecology of the study areas. Three agro ecologies (lowland, midland and highland) were identified based on altitude and production system of the district. Three peasant associations (Kebeles) were considered in each agro-ecologies based on their goat production potential.

About 12 qualitative characters (head profile, ear formation, ear type, coat color pattern, coat color type, horn shape, horn orientation, ages, presence of wattle, ruff, bear and horn) and 11 quantitative morphological characters like live body weight (BWT), body condition score (BCS), heart girth (HG), height at wither (HtW), chest width (CW), pelvic width (PW), rump height (RH), rump length (RL), ear length (EL), horn length (HL) and scrotal circumference (SC) were collected from a total of 810 goats based on the standard description list developed. Goats were purposively grouped into 5 age categories based on dentition. These age groups were goats with no pairs of permanent incisors (0PPI) at weaning age below 12-14 months, one pair of permanent incisors (1PPI) at age of 15- 23 months two pairs of permanent incisor (2PPI) at age of 24-35 months, three pairs of permanent incisors (3PPI) at age of 36-48 months and four pairs of permanent incisors (4PPI) at age of over 48 months [11] and sex groups (male and female). Body condition score (BCS) was assessed subjectively and scored using the 5 point scale (1= very thin, 2=thin, 3= average, 4=fat and 5=very fat/obese) for both sexes [12].

Data Analysis: Statistical package for social Science (SPSS) computer software SPSS ver.20 was applied to analyze qualitative data like sex ratio, age proportions and physical description as descriptive statistics [13]. The General Linear Model (GLM) procedures of SAS ver.9.2 were employed to analyze quantitative data and ascertain the effect of sex, site (agro ecology) and age [14]. Mean separation was undertaken when it was significant to reveal the difference between means using Tukey-Karamers method

$$Yijkl = \mu + Ai + Sj + Dk + (AS)ij + (AD)ik + (SD)jk + eijk\,l \quad \text{Model 1}$$

where:

- Y_{ijkl} = l^{th} observation on i^{th} production site, j^{th} sex class and k^{th} age group;
- μ = Overall mean
- A_i = Fixed effect of i^{th} Agro ecology (i= 1, 2, 3 where 1=lowland, 2=midland and 3= Highland)
- S_j = Fixed effect of j^{th} sex (j =1, 2 where 1 = Male, 2= female);
- D_k = Fixed effect of k^{th} dentition (k =1, 2,3,4,5 where 1= 0PPI,2= 1PPI, 3= 2PPI, 4= 3PPI and 5=4PPI);
- $(AS)_{ij}$ = Fixed effect of interaction between agro ecology and sex
- $(AD)_{ik}$ = Fixed effect of interaction between agro-ecology and dentition
- $(SD)_{jk}$ = Fixed effect of interaction between sex and dentition e_{jik} = Random error;

RESULTS AND DISCUSSION

Goat Population Characterization: The average age of different categories of goats in terms of the eruption of permanent pairs of incisors (PPI) was assessed. The present study revealed that the average ages of goat with 0PPI, 1PPI, 2PPI, 3PPI and 4PPI were around 9±4.12, 18.4±3.19, 30.11±6.98, 41.4±8.86 and 49.83±12.55 months, respectively. The result in the current study was comparable with earlier study indicated 7±2.12, 16.4±4.19, 27.11±5.98 and 38±6.86 and 50.83±14.55 months, respectively in Harrarghe highland goats [15]. The variation of eruption of incisors and corresponding age could be caused due to variation in breed, environment, feeding habit and production system.

Qualitative Characteristics: The participatory descriptions of qualitative characters for both female and male goats are presented in Table 2. The result showed that both female and male goat exhibited white, brown, black, grey and cream white coat color type but in varying proportion in either same sex or across two sexes. In all white, brown, black, grey and creamy white coat color

Table 1: Sample sizes by age group, breed group and sex for goats studied.

	Agro ecology							
	Lowland		Midland		Highland		Overall	
Age	Male	Female	Male	Female	Male	Female	Male	Female
0PPI	13	25	13	10	3	16	29	51
1PPI	25	22	19	21	12	37	56	80
2PPI	22	36	10	35	11	64	43	135
3PPI	11	52	9	34	7	44	27	130
4PPI	27	57	21	88	17	49	65	194
Totally	98	192	72	188	50	210	220	590

PPI= Pairs of Permanent incisors

Table 2: Summary of the qualitative traits in the female and male sample goats

		Female		Male		Total	
Characters	Factors level	N	%	N	%	N	%
Coat color type	White	125	21.2	36	16.4	161	19.9
	Brown	259	43.9	111	50.5	370	45.7
	Black	124	21.0	39	17.4	163	20.1
	Grey	39	6.6	14	6.4	53	6.5
	Cream white	43	7.3	20	9.1	63	7.8
Coat color pattern	Plain	541	91.7	198	90.0	739	91.2
	Patchy	40	6.8	11	5.0	51	6.3
	Spotted	9	1.5	11	5.0	20	2.5
Head profile	Straight	473	80.2	180	81.8	653	80.6
	Slightly convex	93	15.8	30	13.6	123	15.2
	Concave	24	4.1	10	4.5	34	4.2
Ear formation	Rudimentary	2	0.3	1	0.5	3	0.4
	Short ear	8	1.4	11	5.0	19	2.3
	Long ear	578	98.0	208	94.5	786	97.0
Ear type	Semi pendulous	411	69.7	154	70.0	565	69.8
	Horizontal	179	30.3	66	30	245	30.3
Horn orientation	Rudimentary	58	9.8	13	5.9	71	8.8
	Front	57	9.7	21	9.5	78	9.6
	Backward	428	72.5	159	72.3	587	72.5
	Lateral	47	8.0	27	12.3	74	9.1
Horn shape	Straight	403	68.3	175	79.5	578	71.4
	Polled	64	10.8	16	7.3	80	9.9
	Spiral	123	20.8	29	13.2	152	18.8
Beard	Present	521	88.3	215	97.7	736	90.9
	Absent	69	11.7	5	2.3	74	9.1
Wattle	Present	51	8.6	52	23.6	103	12.7
	Absent	539	91.4	168	76.4	707	87.3
Ruff	Present	531	90.0	201	91.4	732	90.3
	Absent	59	10.0	19	8.6	78	9.6

type were observed in the sampled goats. The overall (pooled) results showed that proportion of brown, black, white, cream white and grey coat colour were in descending order in the sampled goats. The highest proportion of brown coat colour indicated that farmers prefer this coat colour and have selected these animals favourably. Three coat colour patterns, *viz:* plain, patchy and spotted, were found in sampled goats. The plain coat color pattern was dominant with 91.2% (overall / pooled) occurrence in the sampled goats. The other two coat colour patterns (patch and spotted) were less common. The head profile observed were straight, slightly convex and concave among the sampled goats in the present study. The straight head profile is dominant (overall average = 80.6%) followed by slightly convex (overall average = 15.2%) and concave (overall average = 4.2%).

Table 3: Least squares means±standard errors of body weight (kg), body condition score & other body measurements (cm) for Woyto-Guji Goat

Effects and levels	N	Body Weight LSM±SE	Body Length LSM±SE	Heart girth LSM±SE	Height at Wither LSM±SE	Chest Width LSM±SE	Body Condition score LSM±SE
Overall	810	26.7±3.10	58.20±4.73	73.11±4.37	66.65±4.011	14.34±1.68	3.09±0.45
CV		11.62	8.13	5.97	6.02	11.77	14.53
R^2		0.79	0.48	0.63	0.588	0.45	0.54
Sex		***	***	***	***	***	***
Male	220	26.34±0.21	59.72±0.34	74.37±0.31	68.03±0.29	14.27±0.12	3.17±0.033
Female	590	23.74±0.14	55.64±0.22	70.07±0.20	64.03±0.18	13.68±0.07	2.89±0.021
Age group		***	***	***	***	***	***
0PPI	80	14.40±0.36a	48.66±0.57a	61.58±0.53a	56.83±0.48a	11.11±0.20a	2.44±0.05a
1PPI	136	20.38±0.26b	55.98±0.41b	69.98±0.38b	64.45±0.35b	13.39±0.14b	2.70±0.04b
2PPI	178	27.06±.24c	59.51±0.41c	73.55±0.38c	67.36±0.35c	14.42±0.14c	2.88±0.04c
3PPI	157	30.25±0.26d	61.44±0.50d	76.63±0.46d	70.06±0.42d	15.01±0.17d	3.25±0.05d
4PPI	259	33.11±0.20e	62.81±0.34e	79.37±0.31e	71.42±0.28e	15.94±0.12e	3.88±0.03f
Agro ecology	**	***	***	***	***	**	
Lowland	290	25.31±0.19a	56.05±0.30a	71.17±0.27a	64.73±0.25a	13.44±0.10a	3.08±0.028a
Midland	260	24.74±0.22b	57.46±0.34b	71.44±0.31a	65.54±0.28b	13.73±0.12ab	3.03±0.032a
Highland	260	25.07±0.23a	59.52±0.35c	74.05±0.33b	67.80±0.30c	14.75±0.13b	2.97±0.033b
Sex *Age	***	**	***	**	***	***	
0PPI	M	14.52±0.59b	49.59±0.92b	63.43±0.85b	58.99±0.78b	10.94±0.33a	2.36±0.08a
0PPI	F	13.74±0.43a	47.72±0.68a	59.73±0.62a	54.67±0.57a	11.27±0.24b	2.51±0.06a
1PPI	M	21.12±0.41c	57.82±0.64c	71.57±0.59d	65.84±0.54d	13.70±0.23c	2.76±0.06b
1PPI	F	19.49±0.34bc	54.14±0.54cb	68.40±0.49c	63.05±0.45c	13.09±0.19c	2.64±0.05b
2PPI	M	27.16±0.46d	61.60±0.73d	74.95±0.67e	68.85±0.62e	14.71±0.26d	2.89±0.07c
2PPI	F	26.15±0.26d	57.42±0.41c	72.15±0.38d	65.88±0.35de	14.12±0.14d	2.87±0.04c
3PPI	M	31.37±0.58e	63.70±0.91e	79.03±0.43f	72.34±0.77f	15.15±0.32e	3.42±0.08d
3PPI	F	28.99±0.26ed	59.17±0.41dc	74.23±0.39e	67.78±0.35e	14.87±0.15d	3.09±0.04d
4PPI	M	36.17±0.37f	65.88±0.58f	82.88±0.54f	74.11±0.49f	16.86±0.21f	4.40±0.05e
4PPI	F	31.20±0.22e	59.74±0.34dc	75.86±0.32e	68.74±0.29e	15.01±0.12e	3.35±0.03d
Agro eco*Age	**	**	***	***	***	**	
Lowland	0PPI	14.57±0.50a	46.88±0.79a	58.79±0.73a	54.36±0.67a	10.55±0.28a	2.46±0.07a
	1PPI	21.20±0.44b	53.40±0.69b	67.43±0.63b	62.21±0.58b	12.58±0.24b	2.83±0.06b
	2PPI	26.56±0.40c	57.97±0.63c	73.06±0.58c	66.18±0.53c	14.00±0.22c	2.90±0.06b
	3PPI	30.21±0.43d	60.75±0.67d	77.01±0.62d	69.73±0.57d	14.95±0.24c	3.26±0.06c
	4PPI	33.94±0.33e	61.24±0.52e	79.57±0.48e	71.14±0.44e	15.12±0.18c	3.94±0.05d
Midland	0PPI	13.50±0.61a	47.80±0.90a	58.96±0.89a	54.67±0.81a	10.46±0.34a	2.55±0.09a
	1PPI	19.46±0.47b	55.17±0.74bc	68.95±0.69b	63.85±0.63b	13.18±0.26b	2.64±0.07b
	2PPI	26.25±0.45c	58.96±0.71c	72.67±0.66c	66.74±0.60c	13.82±0.25c	2.87±0.06b
	3PPI	30.41±0.50d	61.36±0.79e	76.7±0.73d	70.60±0.67d	14.75±0.28c	3.29±0.07c
	4PPI	34.36±0.32e	64.02±0.51f	79.95±0.47e	71.86±0.43e	16.46±0.18d	3.79±0.04d
Highland	0PPI	14.33±0.73a	51.30±0.15ab	67.00±0.66b	61.45±0.97b	12.31±0.41b	2.29±0.11a
	1PPI	20.25±0.45b	59.36±0.71d	73.57±0.65c	67.29±0.60c	14.43±0.25c	2.62±0.06b
	2PPI	27.15±0.40c	61.60±0.63e	74.91±0.58cd	69.17±0.53d	15.34±0.22cd	2.86±0.06b
	3PPI	29.93±0.48d	62.21±0.75ef	76.19±0.69d	69.84±0.63d	15.43±0.26cd	3.21±0.07c
	4PPI	32.74±0.37e	63.16±0.59f	78.59±0.54e	71.26±0.50e	16.22±0.21d	3.90±0.05d

a,b,c,d,e,f 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; 0PPI = 0 Pair of Permanent Incisors, 1PPI =1 Pair of permanent Incisors; 2 PPI = 2Pairs of Permanent Incisors; 3PPI = 3 Pairs of Permanent Incisors; 4PPI = 4 Pairs of Permanent Incisors; AE =agro ecology; CV=Coefficient of Variation, R= coefficient of determination

Table 3: (Continued)

Effects and levels	N	Pelvic Width LSM±SE	Rump height LSM±SE	Rump Length LSM±SE	Ear Length LSM±SE	Horn Length LSM±SE	SC (N=220) LSM±SE
Overall	810	13.21±1.46	66.67±3.94	12.53±1.80	13.81±1.19	12.48±2.24	16.56±2.77
CV		11.07	5.91	14.41	8.66	17.94	16.74
R --square		0.56	0.57	0.45	0.28	0.53	0.29
Sex		***	***	***	***	****	
Male	220	13.00±0.10	68.10±0.28	12.52±0.13	13.86±0.08	12.99±0.16	
Female	590	12.47±0.06	64.23±0.18	11.90±0.08	13.45±0.05	11.19±0.14	
Age group		***	***	***	***	***	***
0PPI	80	9.83±0.17a	57.31±0.48a	9.70±0.21a	12.12±0.14a	7.38±0.27a	14.10±0.44a
1PPI	136	11.62±0.12b	64.76±0.34b	10.98±0.15b	13.39±0.10b	10.96±0.19b	15.40±0.30b
2PPI	178	13.25±0.13c	67.42±0.34c	12.36±0.16c	13.84±0.10bc	12.97±0.20c	16.95±0.40c
3PPI	157	14.01±0.15c	70.02±0.42cd	13.94±0.19d	14.34±0.12c	14.33±0.23d	17.29±0.50d
4PPI	259	14.95±0.10c	71.32±0.28d	14.07±0.13d	14.60±0.08c	14.80±0.16d	18.50±0.34e
Agro ecology	***	***	***	Ns	***	Ns	
Lowland	290	12.51±0.09a	64.57±0.25a	12.56±0.11a	13.74±0.07	12.00±0.14	15.86±0.29
Midland	260	12.61±0.10a	65.87±0.28b	12.57±0.12a	13.61±0.08	11.16±0.16	16.74±0.34
Highland	260	13.09±0.11b	68.05±0.29c	11.50±0.13b	13.62±0.08	12.86±0.16	16.75±0.44
Age*Sex	**	***	***	**	**		
0PPI	M	9.95±0.28a	59.04±0.77b	9.54±0.35a	12.13±0.23a	8.32±0.43b	
0PPI	F	9.71±0.21a	55.58±0.56a	9.86±0.26a	12.10±0.17a	6.44±0.32a	
1PPI	M	11.93±0.19b	65.92±0.53c	11.08±0.24b	13.49±0.16b	11.55±0.30c	
1PPI	F	11.31±0.16b	63.61±0.45c	10.86±0.20b	13.29±0.13b	10.38±0.25c	
2PPI	M	13.50±0.22c	68.84±0.61d	12.42±0.28c	13.93±0.18c	13.55±0.34d	
2PPI	F	13.00±0.12c	65.99±0.34c	12.30±0.15c	13.75±0.10c	12.40±0.19cd	
3PPI	M	13.98±0.28d	72.60±0.76e	14.36±0.34d	14.69±0.23d	15.53±0.43e	
3PPI	F	14.07±0.13d	67.43±0.35d	13.53±0.16d	13.99±0.10c	13.14±0.19d	
4PPI	M	15.63±0.18f	74.12±0.49f	15.19±0.22e	15.09±0.14e	15.99±0.27e	
4PPI	F	14.28±0.10d	68.52±0.29d	12.94±0.13cd	14.10±0.08d	13.62±0.16d	
Agro eco*Age	***	***	***	**	Ns	Ns	
Lowland	0PPI	9.67±0.24a	54.61±0.66a	10.31±0.30a	12.19±0.20a	6.82±0.37	13.30±0.70
	1PPI	11.50±0.21b	62.20±0.57b	11.57±0.26b	13.13±0.17b	10.66±0.32	14.56±0.55
	2PPI	12.99±0.19c	65.87±0.52c	12.86±0.24c	13.94±0.16b	13.11±0.30	16.22±0.58
	3PPI	13.95±0.20d	69.27±0.56d	14.68±0.25d	14.67±0.17c	14.38±0.32	17.18±0.83
	4PPI	14.44±0.16d	70.90±0.44e	13.37±0.20cd	14.79±0.13c	15.01±0.25	18.03±0.53
Midland	0PPI	9.51±0.29a	55.83±0.80a	9.86±0.36a	12.04±0.24a	6.37±0.45	14.00±0.34
	1PPI	11.05±0.23b	64.49±0.62c	10.57±0.28a	13.29±0.18b	10.32±0.35	15.15±0.63
	2PPI	12.93±0.22c	67.03±0.59d	12.32±0.27bc	13.68±0.18b	12.09±0.33	16.40±0.63
	3PPI	14.12±0.24d	70.43±0.65e	14.79±0.30d	14.34±0.20c	13.94±0.37	18.00±0.87
	4PPI	15.42±0.15d	71.58±0.42e	15.30±0.19e	14.69±0.12c	14.33±0.24	19.57±0.60
Highland	0PPI	10.32±0.32a	61.49±0.96b	8.93±0.44a	12.12±0.29a	8.94±0.54	14.00±0.60
	1PPI	12.30±0.21c	67.61±0.60d	10.78±0.27a	13.76±0.17b	11.92±0.33	16.50±0.83
	2PPI	13.83±0.19d	69.35±0.52d	11.90±0.24b	13.89±0.16b	13.72±0.30	16.63±0.46
	3PPI	13.97±0.23d	70.34±0.62e	12.35±0.28bc	14.02±0.19c	14.69±0.35	17.89±0.40
	4PPI	15.00±0.18e	71.48±0.50e	13.53±0.22cd	14.31±0.14c	15.07±0.27	18.71±0.47

a,b,c,d,e,f 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; 0PPI = 0 Pair of Permanent Incisors, 1PPI =1 Pair of permanent Incisors; 2 PPI = 2Pairs of Permanent Incisors; 3PPI = 3 Pairs of Permanent Incisors; 4PPI = 4 Pairs of Permanent Incisors; AE =agro ecology; CV=Coefficient of Variation, R= coefficient of determination, N=Numbers of goat, SC = Scrotal circumference

Table 4: Coefficients of correlation (r) between body weight and other body measurements within sex and age groups

		Body weights									
		Female					Male				
		Age groups					Age Groups				
Measurements		0PPI	1PPI	2PPI	3PPI	4PPI	0PPI	1PPI	2PPI	3PPI	4PPI
BL	rN	0.58**51	0.51**80	0.30**135	0.46**130	0.64**194	0.49**29	0.26*56	0.44**43	0.76**27	0.45**65
BCS	rN	0.13NS51	0.23*80	0.05NS135	0.68**130	0.44**194	0.63**29	0.15NS56	0.46**43	0.31**27	0.37*65
HG	rN	0.26NS51	0.80**80	0.83**135	0.53**130	0.86**194	0.71**29	0.81**56	0.83**43	0.79**27	0.88**65
HtW	rN	0.29*51	0.43**80	0.37**135	0.44**130	0.36**194	0.80**29	0.48**56	0.65**43	0.38*27	0.62**65
RH	rN	0.22NS51	0.40**80	0.29**135	0.39**130	0.31**194	0.75**29	0.48**56	0.65**43	0.37*27	0.62**65
RL	rN	0.63**51	0.65**80	0.15NS135	0.48**130	0.13NS194	0.49*29	0.40*56	0.41**43	0.12NS27	0.40*65
CW	rN	0.27*51	0.28*80	0.15NS135	0.27**130	0.43**194	0.49*29	0.23*56	0.37**43	0.31*27	0.40*65
PW	rN	0.84**51	0.54**80	0.53**135	0.36**130	0.23**194	0.82**29	0.43**56	0.51**43	0.26*27	0.51**65
EL	rN	0.06NS51	0.26*80	0.19*135	0.31**130	0.13NS194	0.25NS29	0.24NS56	0.22NS43	0.24NS27	0.17NS65
HL	rN	0.63**51	0.70**80	0.50**135	0.40**130	0.24**194	0.6829	0.45**56	0.60**43	0.45*27	0.18NS65
SC	rN	NA	NA	NA	NA	NA	0.35NS29	0.31*56	0.33**43	0.37*27	0.24*65

*P<0.05; ** P<0.01; 1PPI = 1 Pair of Permanent Incisors; 2 PPI = 2 Pair of Permanent Incisors; 3PPI = 3 Pair of Permanent Incisors; 4PPI = 4 Pair of Permanent Incisors; BL =Body Length; BCS = Body condition score, HG= Heart Girth, HtW=Height at wither, RH=Rump Height, RL= Rump Length, CW= Chest Width, PW=Pelvic width, EL=Ear Length, HL=Horn Length, SC=Scrotal circumference; NS = non-significant; NA = Not -available; N= number of observation ; r=coefficient of correlation

Table 5a: Live weight prediction equations at different age groups in female

Age group	Equation	β0	β1	β2	β3	β4	β5	β6	R2	R2 change	MSE
1PPI	HG	-36.94	0.82						0.64	0.000	2.87
	HG+RH	-63.42	0.73	0.52					0.75	0.003	2.23
	HG+RH+PW	-52.9	0.58	0.38	0.74				0.84	0.004	1.67
2PPI	HG	-25.60	0.72						0.65	0.000	2.22
	HG+RH	-45.23	0.54	0.49					0.71	0.005	1.89
	HG+RH+PW	-38.21	0.47	0.38	0.44				0.76	0.005	1.66
	HG+RH+PW+CW	-38.11	0.43	0.34	0.39	0.41			0.83	0.007	1.53
3PPI	HG	-20.02	0.66						0.28	0.000	2.56
	HG+BC	-18.80	0.62	0.57					0.44	0.006	2.13
	HG+BC+PW	-22.13	0.55	0.43	0.63				0.59	0.01	1.55
	HG+BC+PW+HW	-57.72	0.44	0.36	0.53	0.67			0.68	0.001	1.43
	HG+BC+PW+HtW+BL	-38.66	0.34	0.33	0.43	0.24	0.32		0.81	0.006	1.16
4PPI	HG	-28.33	0.78						0.74	0.000	3.18
	HG+BC	-25.73	0.72	0.68					0.81	0.001	2.24
0-4PPI	HG	-28.20	0.74						0.68	000	3.51
	HG+PW	-23.80	0.44	1.34					0.75	0.07	2.62
	HG+PW+BC	-16.39	0.34	1.19	0.53				0.78	0.001	2.48
	HG+PW+BC+RH	-55.22	0.32	0.98	0.46	0.67			0.84	0.001	2.22
	HG+PW+BC+RH+HtW	-76.44	0.30	0.96	0.39	0.57	0.46		0.88	0.001	2.13
	HG+PW+BC+RH+HtW+RL	-70.59	0.26	0.89	0.32	0.54	0.43	0.16	0.94	0.005	1.60

BL= Body length; HG = Heart Girth; CW = Chest width HW = Height Wither; PW = Pelvic Width; RH= Rump height, RL=Rump length; EL= ear length, BC = Body Condition Score; 0PPI = 0 Pair of Permanent Incisors, 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 5b: Live weight prediction equations at different age groups in male goat

Age group	Equation	β0	β1	β2	β3	β4	β5	β6	R2	R2 change	MSE
0PPI	HG	-28.1	0.68						0.50	0.000	2.66
	HG+PW	-29.55	0.61	0.57					0.68	0.005	1.93
	HG+PW+HtW	-30.9	0.48	0.32	0.21				0.77	0.003	1.45
1PPI	HG	-6.02	0.38						0.66	0.000	2.11
	HG+RL	-5.60	0.34	0.42					0.69	0.002	1.56
2PPI	HG	-10.33	0.50						0.69	0.000	2.68
	HG+BC	-9.70	0.46	0.85					0.73	0.001	2.42
	HG+BC+PW	-9.81	0.37	0.71	0.54				0.78	0.001	2.02
	HG+BC+PW+BL	-37.51	0.33	0.63	0.46	0.52			0.80	0.002	1.85
3PPI	HG	-19.20	0.64						0.62	0.000	2.33
	HG+RH	-48.86	0.51	0.55					0.71	0.001	1.89
	HG+RH+HtW	-68.82	0.46	0.53	0.35				0.78	0.003	1.64
	HG+RH+HtW+PW	-58.02	0.42	0.44	0.28	0.26			0.88	0.004	2.14
	HG+RH+HtW+PW+BL	-55.45	0.41	0.32	0.24	0.23	0.16		0.93	0.005	2.44
4PPI	HG	-17.14	0. 64						0.77	0.000	1.65
	HG+PW	-12.84	0.54	0.26					0.86	0.001	1.44
0-4PPI	HG	-39.12	0.88						0.78	0.000	2.44
	HG+BC	-17.48	0.55	0.92					0.80	0.001	2.34
	HG+ BC + PW	-15.28	0.36	0.70	0.97				0.83	0.002	1.66
	HG+ BC + PW +RL	-35.20	0.34	0.67	0.74	0.44			0.94	0.002	1.33
	HG+ BC + PW +RL+HtW	-30.13	0.32	0.53	0.62	0.38	0.26		0.96	0.004	1.24
	HG+ BC + PW +RL+HtW+BL	-33.21	0.26	0.43	0.52	0.23	0.21	0.25	0.97	0.007	1.12

The ear formation showed that long ear were highly predominant (overall average = 97.0%) in population of goats studied. Similar finding were reported by [16].

Quantitative Characteristics

Effect of sex: The Effect of sex was either highly significant ($P < 0.001$) or significant ($P < 0.005$) on body weight and all body measurements. Perusal of least square means (Table 3) showed that body weight and all body measurements in male goats were consistently higher in magnitude than the corresponding values in females. The mean BWT, BCS, BL, HG, HW, CW, PW, RH, RL, EL and HL of females were 23.74±0.14 kg, 2.89±0.021, 55.64±0.22cm, 70.07±0.20 cm, 64.03±0.18 cm, 13.68±0.07cm, 12.47±0.06cm, 64.23±0.18 cm, 11.90±0.08 cm, 13.45±0.05cm and 11.19±0.14cm, respectively. The corresponding values for male counterpart are 26.34±0.21kg, 3.17±0.033, 59.72±0.34cm, 74.37±0.31cm, 68.03±0.05cm, 14.27±0.12cm, 13.00±0.10cm, 68.10±0.12cm, 12.52±0.13cm, 13.86±0.08cm and 12.99±0.16cm, respectively.

The effect of sex in favor of males on body weight and body measurements in present study was in agreement with previous results [15, 17, 18]. The sex related differences might be partly a function of the sex differential hormonal effect on growth. It was reported that, ewes have slower rate of growth and reach maturity at smaller size due to the effect of estrogen in restricting the growth of the long bones of the body [19]. In addition to that, the differentials obtained in the morphological traits of the sexes could be attributed to sexual dimorphism. [20] Reported that most dimorphism developed post-weaning because of faster mass gain by males during the age of 1–2 years. They also suggested that males might have a longer season of mass gain each year throughout their lives, while females divert annual resources into reproduction, rather than body mass.

Effect of Age Groups: The effect of age was highly significant ($P < 0.001$) on body weight and all other body measurements. Perusal of least square means showed that both body weight and linear body measurements have shown a consistent increase with advancement in age from the youngest age (0PPI) to the oldest age (4PPI) in the present study. These results were in agreement with earlier reports of increase in live body weight and linear body measurements with increase in age of animal [17, 18]. The pair wise comparison of least square means showed that there were significant differences among all pairs in all traits studied except in pelvic width, rumph weight, rumph length, ear length and horn length.

Effect of agro-ecology: The effect of agro ecologies was either highly significant ($P < 0.001$) or significant ($P<0.005$) for all traits, studied, except ear length and scrotal circumference. Perusal of least square means showed a consistently ascending trend in the measurements from lowland to highland agro ecologies for BL, HG, HtW, CW, PW and RH. In other traits no such consistent trend was observed. The present finding reflected that there were wide variations among the three agro ecologies which influenced all the quantitative traits studied. The present results were in agreement with earlier study showed that the effects of agro ecologies was significantly affected on body measurements in indigenous goat breeds [18, 21].

Effect of Sex X Age Groups Interaction: The interaction between sex and age groups was either highly significant ($P < 0.001$) or significant ($P < 0.005$) on body weight and all body measurements except scrotal circumference which was not studied. The results (Table 3) showed that the magnitude of values of body weight and all other body measurements were consistently higher in males of different age groups than corresponding values for female of various age groups. The pairwise comparison of means showed variable trends in all the traits studied. The present findings were in agreement with earlier studies which reported significant influence of sex and age interaction on body measurements [22, 23]. Hence, this finding should be considered in improvement program to increase meat yield from goat via sex disintegrated improved management.

Effect of agro ecology by age group interaction: The interaction between agro ecologies and age groups was either highly significant ($P < 0.001$) or significant ($P < 0.005$) on body weight and all body measurements except horn length and scrotal circumference. These results indicated that effect of agro ecologies was different in different age groups and thus variation in the agro ecologies has a strong effect on quantitative traits.

Correlation Between Body Weight and Body Measurements: Heart girth had the highest correlation with body weight at various ages and in both sexes compared with other parameters, except in females of zero dentition was not significant correlated. The high correlation between body weight and heart girth, observed in majority of age groups, in present study suggested that heart girth could be used to obtain more reliable prediction estimate of body weight for the population. The present results were in agreement with earlier reports where found that heart girth was best parameter for estimating body weight due to high correlation estimates [21, 23-25].

Multiple Regression Analysis: Perusal of results revealed that heart girth (HG) has been selected across four age groups in female (1PPI, 2PPI, 3PPI and 4PPI), five age groups in male (0PPI, 1PPI, 2PPI, 3PPI and 4PPI) and pooled overall age groups in both sexes as the first regressor because of its high contribution in terms of R^2 values.

The regression equation for pooled overall age groups was estimated as **$Y= (- 28.20) + 0.74 X$**; (where X stands for HG), with **R^2** value of **0.68** for female and **$Y= (- 39.12) + 0.88 X$**; (where X stands for HG), with **R^2** value of **0.78** for male goat in the present study. This finding showed that an increase of one cm of HG resulted in an increase of 0.74 and 0.78 kg of live weight in female and male goats, respectively. The role of other body measurements' in predicting live body weight differed in different age groups across the two sexes vis-à-vis their order in these equations. Thus it seems that body measurements other than HG may not possibly be used in general prediction equations. However the parameter estimates in multiple linear regression models showed that subsequent inclusions of other body measurements together with heart girth (First variable in all equatuions) kept the R^2 values improving although the change had a pattern of diminishing marginal rate. This suggested that body weight could be more accurately predicted by combinations of two or more measurements than heart girth alone. The earlier reports have also shown improvement in R^2 values with subsequent addition of more linear measurements [6, 27, 28]. Nevertheless, measurement of traits also has cost implications and it will be impractical to consider many traits under farmer's conditions. Under such conditions, the most practical prediction accuracy may be obtained through the use of heart girth alone.

CONCLUSION AND RECOMMENDATION

Woyto Guji goats are the predominant breeds in the study areas with high preference by the producers. Woyto-Guji goats have shown inferior performance in body weight and other linear body measurements except ear length as compared to the previous study conducted before two decades on the same breeds of goat that might be because of environmental stress, feeding system, prevailing breeding practices, lack of grazing land and

management. Therefore, attention should be given for their improvement, conservation, breeding management and for proper utilization to further explore the potential of this genetic material through improving genetic and husbandry management. A comprehensive scheme for genetic characterization of Woyto-Guji goats in its natural habitat and on station needs to be initiated to validate the present findings of phenotypic variation.

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