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Phenotypic Characterization of Indigenous Goat Types in Kellem Wollega Zone of Oromia Region, Ethiopia

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Abstract

The current study was conducted to phenotypically characterize goat types found at Sayo, Gawo Qebe and Dale Wabara districts of Kellem Wollega zone, Oromia region. The study districts were selected purposively based on goat population potential. Three PAs from Gawo Qebe, three PAs from Sayo and two PAs from Dale Wabara were selected purposively based on targeted indigenous goat population potential and agro-ecology. A total of 468 mature goats (332 females &136 males) were identified and used in the current study. Body weight, linear body measurements and field observation were used to capture data. Data were analyzed by using the General Linear Model (GLM) procedure of the Statistical Analysis System (SAS). The primary reason for keeping goats in all districts was income generation followed by meat for home consumption. Appearance, growth rate, and coat color were the most preferred attributes in breeding buck selection. Feed shortage, predator and disease were the main goat production constraints in the areas. The overall mean dominant coat color type in the current study areas was grey (22.6%) followed by black (21.8%). The most common head profiles obtained were straight (75%), concave (14.7%) and convex (10.3%) for males. About 78.3% and 78.2% of male and female goats had semi-pendulous ear orientation, respectively. The highest positive correlation (r=0.89) was observed between body weight and chest girth; indicating that chest girth can be the best trait to predict body weight. In general, the study's breeding goals must be taken into account for genetic improvement, and constraints identified must be addressed. Additionally, molecular characterization is required to clearly understand the genetic relationship of goats in the study areas.

Key words: Characterization; linear body measurement; Indigenous goat

Introduction

Ethiopia is endowed with huge and diversified goat's eco-types/breeds. Genetic diversity provides basic information for breed improvement in livestock rearing to adapt to changing environments and demands. Information on the origin and history of animal genetic resources (AnGR) is essential to design strategies for sustainable livestock management (Felius *et al.* 2015). The country owns about 52 million goats (CSA, 2021) and 14 identified breeds. Of the total 52 million head of goats' population Ethiopia owns, about 70.6% are females and about 29.4% are males (CSA, 2021). Goats have significant role in the livelihood of resource-poor farmers. They are mainly kept for immediate cash sources, milk, meat, wool, manure and saving or risk aversion (Matawork, 2016). Dhaba *et al*. (2012) also reported that they also serve as a risk mitigation security, investment, saving and socio-economic and cultural functions. According to Matawork (2016), goats have various social and cultural functions that vary among different cultures, socio-economies, agro-ecologies and locations in tropical and subtropical Africa. Goats provide about 12% of the total livestock products consumed and 48% of the family income generated at farm level. In Ethiopia, goats are accountable for about 25% of the domestic meat consumption and 35% of the national annual hide and skin production (CSA, 2013). However, when compared with their population, production and productivity from goats are very low and need improvement intervention.

In Ethiopia, the demand for animal products is increasing due to the rapidly growing population, increasing urbanization and rising incomes. According to Shapiro *et al*. (2015), improvement of productivity of local breeds for meat and milk can be achieved through investments in genetic selection (recording schemes, etc.) and in animal health to reduce young and adult stock mortality, and by implementing critical vaccinations and parasite control programs. In sheep and goat, a 20% live weight gain, a three-percentage point increase in dressing percentage, a four-percentage point increase in parturition rate and an annual increase of the adult off-take rate from 4-5% were attained in the past 20 years (Shapiro *et al*., 2015). For any genetic improvement, characterization is a pre-requisite as it helps to obtain better knowledge of farm animal genetic resources including their present and potential future uses for food and agriculture in defined environments, and their current state as distinct breed populations (Rege and Lipner, 1992).

Characterization of Farm Animal Genetic Resources (FAGR) encompasses all activities associated with the identification, quantitative and qualitative description and documentation of breed populations and the natural habitats and production systems to which they are or are not adapted (Solomon *et al*. 2011). The process also includes the systematic documentation of the indigenous knowledge around them as well as the information gathered so as to allow easy access and sustainable management (FAO, 2012). The initial step in characterization is identification of distinct populations using information on their geographic and ecological isolation, traditional nomenclatures (traditionally recognized populations), phenotypic distinctness and the level of genetic differentiation among the populations. Identification of distinct populations or groups could be done using tools ranging from simple significant morphological characters to molecular data (Solomon *et al*. 2011).

In developing regions, populations of livestock of the same species, especially if they are geographically isolated and recognized by ethnic owners as being distinct from others around them, are traditionally recognized/considered as distinct eco-types or breeds (Solomon *et al*. 2011). Thus, characterization studies are essential for planning improvement, sustainable utilization and conservation strategies of a breed at local, national, regional and global levels (FAO, 2012). In the absence of baseline characterization information, some breed populations and unique characteristics they contain may decline significantly, or be lost, before their value is recognized and measures taken to conserve them. In Ethiopia, various goat characterization studies for different goat populations had been executed (Hassen *et al*. 2012).

Kellem Wollega zone has high goat population consisting 285,326 (KWLDFO, 2021). From livestock species goat is more favored in the area because, they have short kidding interval, better browser and erect in to fear from predators and rain than sheep with the exiting situations, and depend on marginal feeds. In the area, goat are used as a source of food, cash, prestige, and means of storing wealth. However, despite their significant contribution, the development and research interventions carried out for goat populations found in Kellem Wollega zone is scarce concerning their phenotypic description. Therefore, the current study was conducted to characterize indigenous goat types/population found in Kellem Wollega zone for the purpose of developing conservation and utilization programs.

Materials and Methods

Study area

The study was conducted in Kellem Wollega Zone which is one of the 20 zones of Oromia Regional state, Ethiopia. The administrative town of Kellem Wollega zone, Dambi Dollo, is situated at a distance of 652km from Addis Ababa to the west direction. It extends from 8º10’ to 9º21’ N latitude and 34º07’ to 35º26’ E longitude. The altitude of the zone ranges from 500 to 1500 m. a.s.l. With regard to agro-ecological zones, about 0.2% land area of Kellem Wollega zone is categorized as highland, 20.35% midland and 79.45% lowland. The annual temperature of this zone ranges from 15 - 25ºC; whereas the mean annual rainfall ranges from 1200mm to 1600mm. Kellem Wollega zone’s livestock population include cattle, sheep, goats, horse, mules, donkey and chickens that are estimated as 933,197, 455,141, 285,326, 28,787, 27,829, 88,495 and 976,580, respectively (KWLDO, 2021).

Site selection and sampling techniques

A rapid informal field survey was made at Kellem Wollega zone Livestock Development office. During the informal survey, discussion was held with experts of the zone livestock development office to know the distribution of the targeted goat populations in study areas. Based on the outcome of the rapid informal field survey and discussion, three districts and eight peasant associations (PA) were selected purposefully by considering their representativeness, potential they have with the indigenous goat production. The three districts were Gawo Qebe, Sayo and Dale Wabara. A total of eight peasant associations (PAs), three PAs each from Gawo Qebe and Sayo districts and two PAs from Dale Wabara were selected. During the selection of PAs, the distribution and density of goat population were considered. A total of 152 households (HHS) were selected. Those households having at least two adult does and a minimum of one year experience in goat husbandry practices were considered in the study. The total number of the households considered for the interview was estimated according to Yamane (1967) with 92% confidence level. After the total number of HHs having two or more does with one or more year of experiences in goat production were determined, selection of goat producers was done randomly based on the following criteria.

n = N/1+N (e) 2.

Where:

n = sample size
N = total number of households
1 = probability the event occurring and
e = maximum variability or margin of error =8 (0.08)

All goats which have been randomly measured were greater or equal to one pair of permanent incisors (1PPI, 2PPI, 3PPI &4PPI) but pregnant females and castrated males were not included to avoid inaccuracy on body weight and linear body measurements (LBMs). A total of 468 animals (332 female &136 male) were used for the body weight and linear body measurements as detailed in Table 1.

Table 1. Summary of the sampling details

District	PAs	Sampled animals for linear body measurements			Sampled HHs for the survey	Number of group discussions held
		Male	Female	Total		
	Shogo	8	28	36	11	1
Sayo	Yengi	13	39	52	18	1
	Kero baha	21	47	68	20	1
	Joge walwalo	8	29	37	16	1
Gawo Qebe	Ilu gonde	15	40	55	23	1
	Qumbabe	20	44	64	26	1
Dale wabara	Omo walensu	21	46	67	18	1
	Foge kombolcha	30	59	89	20	1
Total		**136**	**332**	**468**	**152**	**8**

Data collection procedures

Visual observation was made and morphological features were recorded based on breed morphological characteristics descriptor list of FAO (2012) for phenotypic characterization. Each animal was identified by its sex, dentition and sampling site. Dentition (1PPI, 2PPI, 3PPI &4PPI) record was included, as this was the only reliable means to estimate the approximate age of an animal. Coat color pattern, coat color type, head profile, rump profile, beard presence, horn presence and its orientation, ear orientation, horn shape and wattles presence were some of the traits investigated in the current study.

Quantitative trait data collection: Linear body measurements such as body length (BL), height at withers (HW), chest girth (CG), chest width (CW), pelvic width (PW), head length (HL), face length (FL), rump length (RL) and ear length (EL) were measured using a plastic measuring tape, while body weight of animals was recorded using a suspended spring balance. The measurements were made on animals that are classified based on sex and age group (1PPI, 2PPI, 3PPI &4PPI) estimated from dentition.

Data analysis

Qualitative and quantitative body measurement data were first entered into Excel 2007 computer software and analyzed using statistical analysis system (SAS version 9.2, 2008). Qualitative data were analyzed using the frequency procedure of SAS, 2008 while quantitative data were analyzed using the Generalized Linear Model (GLM) procedure of SAS. Sex, district and age group were fitted as fixed effects while linear body measurements were fitted as dependent variables. When analysis of variance declares significance, least square means were separated. Pearson's correlation coefficients were estimated among body weight and linear body measurements and between linear body measurements for females and males (SAS, 2008).

Indices were calculated to investigate goat producers' preferences about the different attributes of goats and to rank major constraints of goat production in the study areas, purpose of keeping goat, feed resources, types of disease, classes of goats to be sold first when cash income is needed and selection criteria of females and males according to the following formula: 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 or criteria divided by the sum of (3 X number of household ranked first + 2X number of household ranked second + 1 X number of household ranked third) for overall reasons or criteria.(Kosgey, I.S., 2004)

The model employed for analyses of body weight and other linear body measurements except SC was:-

$Y_{ijkl} = \mu + A_i + S_j + D_k + K_n + A_i*S_j + A*D + + e_{ijkl}$

Where:-

Y_{ijkl} = the observed l (body weight or LBMs) in the ith age group, jth sex, kth and nth district,

μ = overall mean,

A_i = effect of ith age group (i = 1, 2, 3 and 4 PPI),

S_j = effect of jth sex (j = female or male),
D_k = effect of Kth district (K = Sayo, Gawo Qebe and Dale Wabara),
K_n = effect of agro ecology (n=lowland, highland, midland),
A_i*S_j = age by sex interaction,
A_i*D_k= age by district interaction,
e_{ijkl} = random residual error.

Model fitted to analyze scrotal circumference (SC) are: $Y_{ikl} = \mu + A_i + D_k + e_{ijk}$, Where: Y_{ikl} = the observed l (SC) in the ith age group and kth district, μ = overall mean, A_i = the effect of ith age group (i =1, 2, 3and 4) PPI, D_k = the effect of kth district (k = Sayo, Gawo Qebe and Dale Wabara), e_{ikl}= random residual error.

Results and Discussion

Purpose of goat production

The major purpose of goat keeping in the study areas is income generation which is mainly meant for emergency cases, school fees, and purchase of agricultural inputs and for other household expenses. Meat production and manure are the 2nd and 3rd reasons for goat production in Sayo district, respectively. The 2nd and 3rd reasons for goat production in Gawo Qebe and Dale Wabara districts are meat and milk production, respectively. Analogous to the current study, different researchers (Zergaw et al. 2016; Solomon, 2014) reported that goat producers in the different parts of Ethiopia primarily rear goats for income generation. With regard to meat production, other scholars (Feki and Berhanu, 2016; Zergaw et al. 2016) also reported that goats are produced for meat and milk production (home consumption) and by products such as manure and skin.

Table 2: Purpose of goat production in the study area

Purpose of keeping	District											
	Sayo				Gawo Qebe				Dale Wabara			
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index
Cash income	41	5	3	0.46	49	11	5	0.446	31	6	1	0.46
Meat	8	31	10	0.33	13	43	9	0.34	5	29	4	0.338
Milk	0	1	2	0.014	3	7	13	0.09	2	0	11	0.07
Manure	3	8	39	0.25	1	4	13	0.061	0	3	0	0.026
Skin	1	3	5	0.048	0	0	0	0	0	0	0	0

R1, R2 and R3 = rank 1, 2and 3, respectively. 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 purpose of goat keeping 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 goat.

Feeding management

Herding is the most common feeding management practice (71.7%) followed by tethering (21.7%) in the study area. Goats are herded to prevent them from damaging crops and from theft and predators. In the study areas, the majority of goat producers (53.3%) herd their own flock separately. Conversely, though, about 38.2% of respondents in the study area indicated that goats are herded with sheep. Similar to the current report different researchers (Abraham et al. 2017, Yeshareg et al., 2024) were also reported that goats mostly herded with sheep in open fields. Every kind of goat is herded together in the study areas, except newly born kids that are unable to run with flocks (Table 3). This may have negative consequence with regard to inbreeding and unwanted breeding. Inferior and mediocre bucks may have a chance of mating breeding females. The majority of respondents (69.7%) of respondents stated that a goat producer herds their own flock separately. However, about 30.3% of respondents indicated that more than two or more flocks of neighboring households' are herded together. The current report was in line with the report of Yeshareg et al. (2024), who reported that goats herded as goats of more than one household run as a flock

Table 3.Herding practices reported by households in the study areas

Way of herding	District (N and %)							
	Sayo		Gawo Qebe		Dale Wabara		Over all	
	Number	%	Number	%	Number	%	Number	%
Goat flock is herded								
Together with cattle	0	0	0	0	0	0	0	0
Together with sheep	23	46.9	14	36.8	14	36.8	58	38.2
Together with calves	3	6.1	1	2.6	1	2.6	13	8.6
Goat herded separately	23	46.9	23	60.5	23	60.5	81	53.3
Way of herding								
Household run as flock	36	73.5	41	63.1	29	76.3	106	69.7
More than 1 household run as flock	13	26.5	24	36.9	9	23.7	46	30.3

Housing management

Goat housing systems practiced in the study area is presented in Table 4 and some of type of houses used for goats is indicated in Figure 1. Good housing system is required for productivity improvement, protecting the flock from predator, disease hazards and to make management easier (Tsigabu, 2015). The majority of respondents (56.6%) reported that they house their goats in separate house. However, about 38.2% and 5.3% of respondents indicated that they use family house and veranda, respectively. In contrast with the current study result Mahilet (2012) reported that about 79.88% of goat producers in east Hararghe, east Oromia share the main family house with their goats. In the current study, about 76.9 to 100% of respondents the three districts indicated that the kids housed with adult in the current finding are in agreement with findings of Mahilet (2012) who reported that all sex and age group of goats were housed together at night, except new born kids. The majority of respondents (95%) in all the three districts reported that they construct goat's house from locally available materials such as wood and grasses for wall and roof, respectively.

Figure 1. Housing of goats left Dale wabara middle Sayo right Gawo Qebe

Table 4.Housing and housing materials for goats in the study area

Housing and housing materials	Districts (%)							
	Sayo		Gawo Qebe		Dale Wabara		Overall	
	Number	%	Number	%	Number	%	Number	%
Type of housing for adult goat								
In family house	16	32.7	23	35.4	19	50	58	38.2
Separate house	32	65.3	39	60	15	39.5	86	56.6
Verenda	1	2	3	4.6	4	10.5	8	5.3
Type of material for roof								
Iron sheet	15	30.6	24	36.9	22	57.9	61	40.1
Grass/bushes	34	69.4	41	63.1	16	42.1	91	59.9
Type of material for wall								
Iron sheet	1	2	3	4.6	2	5.3	6	3.9
Wood	48	98	62	95.4	36	94.7	146	96.1
Type of material for floor								
Mud/earth	39	79.6	56	86.2	32	84.2	127	83.6
Wood	10	20.4	9	13.8	6	15.8	25	16.4
Are kids housed with adult								
Yes	49	100	50	76.9	36	94.7	135	88.8
No	0	0	15	23.1	2	5.3	17	11.2
Are goat housed with sheep								
Yes	17	34.7	36	55.4	20	52.6	73	48
No	32	65.3	29	44.6	18	47.4	79	52

Breeding management

Breeding management practices in the study areas is presented in Table 5. Most of the respondents (92.8% & 88.2%) reported practicing the selection of breeding male and female goats, respectively. This result was in line with Yeshareg et al. (2024), who indicated a majority of the respondents practiced the selection of male and female goats in North Wollo zone, Amhara region.

Most of the respondents (77.6%) in the study areas had their own breeding buck/s in their flocks, but a small number of the respondents (22.44%) do not have their own breeding buck. Those who did not have breeding bucks in their flocks use breeding bucks of their neighbor. In line with the current results, Duguma et al (2009) and Solomon et al (2014) indicated that farmers who have not their own breeding bucks use breeding bucks from their neighbor flocks and at communal grazing areas and watering points. Free roaming in the dry season and joining of different flocks in the communal grazing areas and watering points might alleviate likely risks of inbreeding that might encountered due to mating of related animals from same flocks. Even the selection practiced based on appearance, coat color and horn is not supported with proper mating system where one decides which selected males are mated with which selected females. Similarly, Ahmed et al. (2015) reported that the majority of goat farmers allowed their does to be served by any buck when does show signs of heat in Horro Guduru Wollega zone of Oromia region. This might increase the rate of inbreeding.

Table 5. Breeding practices of farmers in the study area

	District (N %)									
	Sayo		Gawo Qebe		Dale Wabara		Over all		X^2	p-value
	N	%	N	%		%	N	%		
Do you have breeding buck									39.88	0.374
Yes	41	83.7	50	76.9	27	71.1	118	77.6		
No	8	16.3	15	23.1	11	28.9	34	22.4		
Source of buck									71.16	0.792
Born in the flock	29	59.2	37	56.9	21	55.3	87	57.2		
Purchase from market	10	20.4	12	18.5	6	15.8	28	18.4		
From neighbor	10	20.4	16	24.6	11	28.9	37	24.3		
Do you give special mgmt. for breeding buck									0.11	0.051
Yes	12	24.5	10	15.4	2	5.3	24	15.8		
No	37	75.5	55	84.6	36	94.7	128	84.2		
Practice selection for breeding male									111.18	0.211
Yes	43	87.8	61	93.8	37	97.4	141	92.8		
No	6	12.2	4	6.2	1	2.6	11	7.2		
Practice selection for breeding female									88.53	0.324
Yes	45	91.8	58	89.2	31	81.6	134	88.2		
No	4	8.2	7	10.8	7	4.6	18	11.8		
Do you allow buck to mate its relatives									0.95	0.018
Yes	29	59.2	40	61.5	13	34.2	85	53.9		
No	20	40.8	25	38.5	25	65.8	70	46.1		
Do you allow another buck to mate your flock									148.03	0.515
Yes	49	100	64	98.5	38	100	151	99.3		
No	0	0	1	1.5	0	0	1	0.7		
Use of identification									13.92	0.278
Yes	20	40.8	18	27.7	15	39.5	53	34.9		
No	29	59.2	47	72.3	23	60.5	99	65.1		

N: Number

Selection criteria for breeding bucks

Selection criteria for breeding bucks are given in Table 6. Appearance, coat color and horn were ranked as 1st, 2nd and 3rd preferred criteria for buck selection in Sayo, Gawo Qebe and Dale Wabara with index values of 0.41, 0.27 and 0.16 0.36, 0.32 and 0.19 and 0.37, 0.36 and 0.14, respectively. All the respondents in the area do not prefer black colour goats. Tesema et al. (2024) also noted the importance of these traits for Central Highland goats. This study further confirmed the importance of considering traits like coat colour type, which shows the social acceptance of some colors in designing sustainable breed improvement strategies. Generally, body size/appearance and coat color were the most rated selection criteria for breeding buck. Different studies in Ethiopia with regard to selection criteria for breeding buck indicated that appearance and coat color are the two most important criteria widely used for breeding buck selection by goat keepers (Belete, 2013). The purpose of goat rearing and selection criteria defined in this study could be used as input for genetic improvement through selection.

Figure 2: Breeding buck left Sayo middle Gawo Qebe and the right Dale Wabara

Table 6. Selection criteria's of a breeding buck in the study area.

Selection criteria	District											
	Sayo				Gawo Qebe				Dale Wabara			
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index
Appearance	29	14	6	0.41	26	23	16	0.36	17	13	8	0.37
Coat color	3	27	17	0.27	18	22	25	0.32	12	19	7	0.36
Character	0	0	7	0.02	0	0	0	0	0	0	0	0
Growth	4	3	3	0.07	4	7	9	0.09	3	4	9	0.11
Testicular	0	0	0	0	0	0	0	0	0	0	0	0
Better sexual ability	0	0	0	0	0	0	0	0	0	0	0	0
Family story	3	2	5	0.06	2	3	7	0.05	1	0	2	0.02
Horn absence	10	3	11	0.16	15	10	8	0.19	5	2	12	0.14

R1, R2 and R3 = rank 1, 2and 3, respectively. 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 for breeding buck 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 breeding buck

Selection criteria for breeding doe

The selection criteria for breeding does in the study area are summarized in Table 7. The body appearance was the first preferred selection criteria for does in all the districts with index values of 0.49, 0.48and 0.49 in Sayo, Gawo Qebe and Dale

Wabara districts, respectively. In agreement with the current study results, Tsigabu (2015) in Nuer zone (Jikawe and Lare districts) of Gambella Regional and Belete (2013) in Bale zone reported that appearance was ranked as the 1st criteria for breeding doe selection. Tesema et al. (2024) also noted that the most important traits for the selections through a participatory approach were body size and coat color. Twining ability was the third selection criterion in the study area. This result did not agree with Alemu (2015), who noted that the first preferred criterion for does was milk yield.

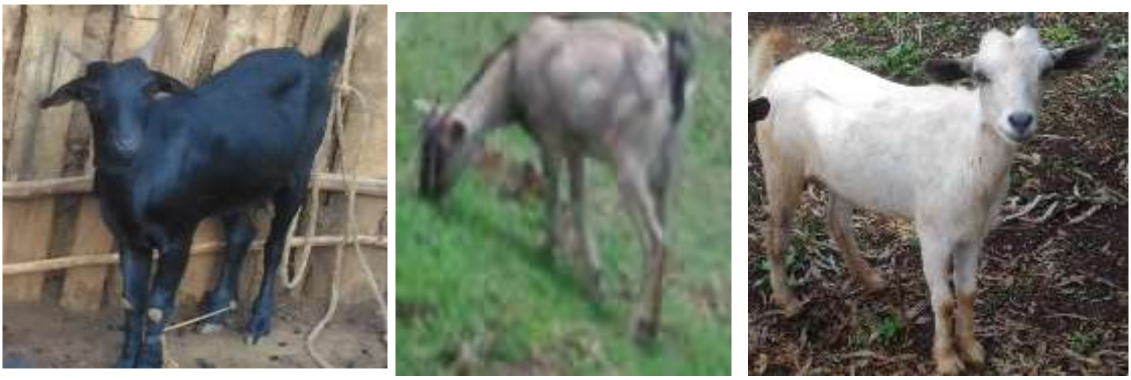

Figure 3: Breeding doe left Dale Wabara middle Sayo and the right Gawo Qebe

Table 7. Selection criteria of a breeding doe in the study area.

Selection criteria	District											
	Sayo				Gawo Qebe				Dale Wabara			
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index
Appearance	45	4	0	0.49	59	6	0	0.48	36	2	0	0.49
Coat color	4	30	15	0.3	6	47	5	0.3	2	35	1	0.34
Mother ability	0	0	0	0	0	0	0	0	0	0	0	0
Kid survival	0	0	0	0	0	0	0	0	0	0	0	0
Kid growth	0	0	0	0	0	0	0	0	0	1	0	0.01
Short kidding interval	0	5	8	0.06	0	0	0	0	0	0	0	0
Twining ability	0	7	11	0.09	0	9	8	0.07	0	0	13	0.06
Better milk yield	0	0	0	0	0	0	10	0.03	0	0	0	0

R1, R2 and R3 = rank 1, 2 and 3, respectively. 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 for breeding doe 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 breeding doe

Goat production constraints

Some of the major goat production constraints identified in the study areas are presented in Table 8. As reported by respondents, feed shortage was the primary constraint flowed by diseases with index values of 0.4, 0.42 and 0.39 and 0.37, 0.39 and 0.37 for Sayo, Gawo Qebe and Dale Wabara districts, respectively. Predator was the 3rd most important constraint in all the three districts. The 1st ranked constraint, feed shortage, is not experienced throughout a year but seasonal. The seasonal availability of feeds is mainly caused by variation in total annual precipitation and the distribution of rainfall (Duguma, 2001). Similarly, Solomon et al. (2011) reported that feed shortage, seasonal fluctuations and poor quality of the available feeds, and prevalence of different diseases and predator were reported as major constraints for goat production in particular and livestock production in general in different parts of Ethiopia. Even though with regard to problem of marketing goats in the studied district are not as such serious issues. Distance to marketing points and fluctuation of price were also considered as additional problems.

Table 8. Major goat production constraints in the study area

Constraints	Districts											
	Sayo				Gawo Qebe				Dale Wabara			
	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index
Labor shortage	0	0	0	0	0	0	0	0	0	0	2	0.01
Feed shortage	25	19	5	0.4	34	29	2	0.42	15	19	5	0.39
Water shortage	0	0	0	0	1	3	11	0.05	0	0	0	0
Disease	21	17	11	0.37	28	30	7	0.39	18	13	5	0.37
Drought	0	0	0	0	0	0	0	0	0	0	0	0
Market problem	0	2	5	0.04	0	0	8	0.02	0	2	3	0.03
Genotype	1	5	15	0.09	0	1	13	0.04	0	1	4	0.03
Predator	2	6	13	0.1	2	2	19	0.07	5	3	17	0.17
E. service	0	0	0	0	0	0	2	0.01	0	0	0	0

Genotype=lack of improved genotype; E. service = lack of extension service.
R1, R2 and R3 = rank 1, 2 and 3, respectively. I= index: Index= sum of (3 X number of households ranked first + 2 X number of households ranked second + 1 X number of households ranked third) give for each constraint divided by sum of (3 X number of households ranked first + 2 X number of households ranked second + 1 X number of households ranked third) for all constraint.

Characterization of qualitative traits

The frequency and the percentage of qualitative traits of goat population in the study areas for both male and female are presented in Table 9. Out of the 468 total goats sampled in the study areas, about 63.3%, 26.9% and 9.8% had plain, patchy and spotty coat color. In Sayo district, about 68.6%, 21.8% and 9.6 of the sampled goats were plain, patchy and spotted, respectively. About 61.5%, 29.5% and 9.0% of the sampled goats at Gawo Qebe district and about 59.6%, 29.5% and 10.9% at Dale Wabara district were plain, patchy and spotted, respectively. Coat color patterns reported in the current study were agreed with the findings reported by Dereje et al. (2013) who reported that about 70.3% of coat color pattern of goats in Daro Labu district, West Hararghe zone of Oromia region was plain.

There was no significant difference (P>0.05) among districts with regard to coat color types. The overall mean dominant coat color type in the current study areas was grey 22.6% followed by black 21.8%. Black color was more dominant (36.5%) in Sayo district followed by grey (21.8%) and brown (17.3%). On the other hand, in Gawo Qebe grey was the dominant color type (21.8%) followed by brown (19.2%), white and brown mixture (14.7%). and in Dale Wabara districts grey (24.4%), white (16.7%) and black (16%) were some of the most dominant color types investigated in the current study. In Daru Labu district of east Oromia the two most dominant coat color types reported by Dereje *et al.* (2013) were brown (34.5%) and white (26.2%). In their extensive review with regard to genetics of adaptation in domestic farm animals, Mirkena *et al*. (2010) indicated that coat color types may be considered as adaptation mechanism. The authors reported that animals with white color were shown to be better adapted to higher environmental temperatures. Given the strong demand for these kinds of animals on the local market, grey and brown coat colors were the most popular choices across all three districts. Because it was not in high demand, black was the least preferred color for coats. However, black color was the second most common coat color type that the respondents mentioned. This could be because there is not a breeding system in place for the desired traits that have been chosen. Therefore, in order to ensure proper selection and mating system in the study area, scientific intervention through training and extension services are crucial.

With regard to head profile male and female goats of the study districts are attributed as straight, concaves and convex head profiles in their respective order. About 75%, 14.7% and 10.3% of the sampled indigenous male goat population had straight head profile, concaves and convex, respectively. The corresponding values for female goats of the study districts were 74.7%, 15.7% and 9.6%, respectively. Amongst the sampled goat population, about 85.9%, 86.5% and 77.6% were horned in Sayo, Gawo Qebe and Dale Wabara districts, respectively. No significant difference ($p > 0.05$) with regard to the presence of horn and horn orientation among the districts. With regard to horn orientation, horns of about 74.3% and 84% of the sampled animals were oblique upward for males and females, respectively. The corresponding horn of about 25.7% and 16.0% of the sampled male and female goats were directed/oriented back ward.

The most dominant ear orientation observed in in the current study was semi-pendulous for male (78.3%) and females (78.2%), respectively. The 2nd and the 3rd ear orientations were pendulous erect (Table 5). The majority of goats in the study areas, about 87.2%, 89.7% and 92.9% of the sampled goats in Sayo, Gawo Qebe and Dale Wabara districts, did not have wattles, respectively. No significant difference ($p > 0.05$) was observed among the districts with regard to wattles. However, significance difference ($p<0.05$) was observed in ruff. About 68.6%, 58.3% and 46.8% of the sampled goats had no ruff at Sayo Gawo Qebe and Dale Wabara districts, respectively. The remaining 31.4%, 41.7% and 53.2% had ruff in the present study, respectively. Dereje *et al.* (2013) reported that only about 0.9% of goats found in Daro Labu district had ruff. In Shabelle zone of the Somali region also only about 8.23% male goats had ruff (Alefe, 2014). The likely explanation for the difference may be due to breed differences. About 51.9% of the sampled male goats in the present study had beard while about 42.9% of them did not have beards.

Quantitative Characters of the Sampled Goat Population

Correlation between Body Weight and Linear Body Measurements

Correlation values among various body measurements of goats in the study areas are presented in Table 10. In females positive and strong association were found between body weight and chest girth (r = 0.91), body length (r = 0.82), face length (r = 0.77) wither height (r = 0.7), where as in males body weight and body length (r = 0.85), scrotal circumference (r=0.8), chest girth c (r=0.75) and wither height (0.6). The high correlation of these linear body measurements with body weight implies that the measurements can be used as indirect selection criteria to improve live weight (Solomon et al., 2008) or could be used to predict body weight (Afolayan et al., 2006). The highest positive correlation was observed between body weight and chest girth in both sexes in the study areas. Therefore, chest girth can be the best predictor to estimate body weight for the current goat flocks. In line with the current study results, different scholars also recommended chest girth as the best estimator of body weight (Yaekob et al., 2015)

Table 9: Qualitative traits of goats in the study area by sex and district

Traits/ attributes	Districts																		p-value
	Sayo						Gawo Qebe						Dale Wabara						
	M		F		Mean		M		F		Mean		M		F		Mean		
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
Coat color pattern																			0.392
Plain	32	66.7	75	69.4	107	68.6	28	60.9	68	62	96	61.5	25	59.5	68	59.6	93	59.6	
Patchy	12	25	22	20.4	34	21.8	13	28.3	33	30	46	29.5	13	31	33	28.9	46	29.5	
Spotty	4	8.3	11	10.2	15	9.6	5	10.9	9	8.2	14	9	4	9.5	13	11.4	17	10.9	
Coat color type																			0.497
Brown	8	16.7	19	17.6	27	17.3	7	15.2	23	21	30	19.2	7	16.7	16	14	23	14.7	
White	3	6.3	5	4.6	8	5.1	8	17.4	13	12	21	13.5	8	19	18	15.8	26	16.7	
White & black	4	8.3	8	7.4	12	7.7	4	8.7	13	12	17	10.9	4	9.5	12	10.5	16	10.3	
White & red	1	2.1	2	1.9	3	1.9	1	2.2	7	6.4	8	5.1	2	4.8	2	1.8	4	2.6	
Grey	91	18.8	25	23.1	34	21.9	10	21.7	24	22	34	21.8	6	14.3	32	28.1	38	24.4	
Black	17	35.4	40	37	57	57	6	13	14	13	20	12.8	8	19	17	14.9	25	16	
White & grey	3	6.3	6	5.6	9	5.8	0	0	1	0.9	1	0.6	2	4.8	5	4.4	7	4.5	
Red	1	2.1	0	0	1	0.6	1	2.2	1	0.9	2	1.3	2	4.8	5	4.4	7	4.5	
White & brown	2	4.2	3	2.8	5	3.2	9	19.6	14	13	23	14.7	3	7.1	7	6.1	10	6.4	
Head profile																			0.937
Straight	37	77.1	80	74.1	117	75	34	73.9	82	75	116	74.4	31	73.8	86	75.4	117	75	
Concave	7	14.6	17	15.7	24	15.4	7	15.2	16	14.5	23	14.7	6	14.3	19	16.7	25	16	
Convex	4	8.3	11	10.2	15	9.6	5	10.9	12	10.9	17	10.9	5	11.9	9	7.9	14	9	
Presence or absence of horn																			0.060
Horned	39	81.3	95	88	134	85.6	40	87	95	86.4	135	86.5	32	76.2	89	78.1	121	77.6	
Polled	9	18.8	13	12	22	14.1	6	13	15	13.6	21	13.5	10	23.8	25	21.9	35	22.4	
Horn shape																			0.145
Straight	36	75	60	55.6	96	61.5	32	69.9	78	70.8	110	70.5	25	59.5	65	57	90	57.7	
Curved	6	12.5	26	24.1	32	20.5	8	17.4	17	15.5	25	16	10	23.8	31	27.2	41	26.3	
Spiral	6	12.5	22	20.4	28	17.9	6	13	15	13.6	21	13.5	7	16.9	18	15.8	25	16	
Horn orientation																			0.597
Oblique up ward	39	81.3	84	77.8	123	78.8	32	69.6	98	89.1	130	83.3	30	71.4	97	85.1	127	81.6	
Back ward	9	18.8	24	22.2	33	21.2	14	30.4	12	10.9	26	16.7	12	28.6	17	14.9	29	18.6	
Ear orientation																			0.836
Erect	3	6.3	8	7.4	11	7.1	4	8.7	11	10	15	9.6	4	9.5	7	6.1	11	7.1	

Pendulous	6	12.5	16	14.8	22	14.1	5	10.9	10	9.1	15	9.6	8	19	20	17.5	28	17.9	
Semi-pendulous	39	81.3	84	77.8	123	78.8	37	80.4	89	80.9	126	80.8	30	71.4	87	76.3	117	75	
Wattles																			0.237
Presence	7	14.6	13	12	20	12.8	5	10.9	11	10	16	10.3	3	7.1	8	7	11	7.1	
Absence	41	85.4	95	88	136	87.2	41	89.1	99	90	140	89.7	39	92.9	106	93	145	92.6	
Ruff																			0.000
Presence	15	31.3	34	31.5	49	31.4	20	43.5	45	40.9	65	41.7	30	71.4	53	46.5	83	53.2	
Absence	33	68.8	74	68.5	107	68.6	26	56.5	65	59.1	91	58.3	12	28.6	61	53.5	73	46.8	
Beard																			0.495
Presence	22	45.8	64	59.3	86	55.1	28	60.9	67	60.9	95	60.9	24	57.1	62	54.4	86	55.1	
Absence	26	54.2	44	40.7	70	44.9	18	39.1	43	39.1	61	39.1	18	42.9	52	45.6	70	44.9	

Table 10. Correlation coefficients among body weight and linear measurements of Kellem Wollega goat types (values above the diagonal are for females and below the diagonal are for males)

	BW	BL	CG	WH	CW	PW	FL	HL	RL	EL
BW	1	0.82**	0.91**	0.70**	0.62**	0.64**	0.77**	0.18**	0.68**	0.65**
BL	0.85**	1	0.86**	0.56**	0.62**	0.56**	0.50**	0.14*	0.57**	0.57**
CG	0.75**	0.71**	1	0.72**	0.63**	0.61**	0.75**	0.19**	0.65**	0.68**
WH	0.60**	0.51**	0.62**	1	0.46**	0.57**	0.63**	0.16**	0.59**	0.54**
CW	0.57**	0.46**	0.43**	0.33**	1	0.53**	0.50**	0.91**	0.50**	0.45**
PW	0.44**	0.37**	0.36**	0.32**	0.38**	1	0.65**	0.10**	0.58**	0.55**
FL	0.51**	0.46**	0.51**	0.48**	0.27**	0.36**	1	0.19**	0.56**	0.64**
HL	0.31**	0.33**	0.24**	0.18**	0.17**	0.27**	0.22**	1	0.16**	0.14*
RL	0.40**	0.47**	0.47**	0.47**	0.30**	0.44**	0.37**	0.20**	1	0.63**
EL	0.46**	0.44**	0.49**	0.41**	0.25**	0.37**	0.40**	0.21**	0.50**	1
SC	0.80**	0.60**	0.60**	0.50**	0.48**	0.48**	0.47*	0.35**	0.46**	0.49**

BW=body weight; BL= Body length; CG= chest girth; WH= Wither height; CW= Chest Width; Pelvic width (PW); FL= face length; HL=head length; RL= Rump length; EL= Ear length; SC= Scrotal circumference

*=p<0.05; **=p<0.01; Total number of female goats = 332 and males=136

Live body weight and linear measurement

The average live body weights, chest circumference, wither height, and scrotal circumferences in the research area were 26.9 kg, 69.6 cm, 66.3 cm, 22.87 cm, and 26.10 cm, respectively. When choosing genetically superior animals for production and reproduction, data on the body and testicle sizes of a particular breed of goat at a given age is crucial. Physical linear traits are important for efficient selection because they are well associated with BW and have medium-to-high heritability (Magnabosco et al., 2002).

Location effect: There was significant difference (p<0.01) in body weight and all linear body measurements, with the exception of WH and RL. The majority of the linear body measurements assessed and body weight values of the goat population in the Sayo district were greater. The Sayo district's higher live body weights and other linear body measurements could be initiated by the area’s comparatively better management system and availability of feed. The body weight of the sampled goat was found to be similar to that of Gatew (2015) for Somali goats with short ears, although it was lower than the population of Borena goats, which weighed 24.67±028 kg and 33.97±0.49 kg, respectively.

Sex effect: Body weight (BW) and all of the linear body measurements were significantly affected by sex (P<0.05), except head length and ear length (p>0.05). In line with the current findings, Alefe (2014) and Gebrekiros (2014) also reported that sex had significant effect (P<0.05) on the body weight and linear measurements. In species having sexual dimorphism, the two sexes may vary in color, size, or some other traits (Isaac, 2005). The same was true in this study where males were superior than females in body weight, body length, chest girth, wither height, chest width and pelvic width. The sex related differences might be partly a function of the sex differential hormonal effect on growth (Semakula et al., 2010).

Age effect: In the present study, age has direct association (P< 0.05) with body weight and linear body measurements considered. Values of body weight and the linear body measurements have increased as the age of goats advances from 1PPI to 4PPI (23.05kg to 34.09kg). Maximum value was observed in age class of three and four as compared to one and two. The size of scrotal circumference increases as age increase from one pair of permanent incisors to fourth pair of permanent incisors. Similar trend was reported for different indigenous goat population’s in previous works (Gelana and Belete, 2016; Dereje et. al., 2013).

Sex by Age group: -The interaction of sex and age group was not significantly (p>0.05) different for body weight and other body measurements except body weight, body length and rump length. The value of scrotal circumference for intact male was increased as dentition class increased from age group 1PPI to 3PPI. The ability of domestic animals to produce sperm and expand their testicles is directly correlated with the scrotal circumference, a significant characteristic. Larger testes, possibly able to produce more spermatozoa, would arise from selecting males based on their scrotal circumference (Daudu, 1984). In all age groups, male goats performed higher than female goats. Similarly, Grum (2010) observed from Dire Dawa that Somali male goats with short ears outperformed their female counterparts in performance.

Table 11. Least square means (± =SE) for fixed effects of district sex, age group and Sex by age group on body weight (kg) and LBMs (cm) for indigenous goats in the study areas

Effect level		N	BW(468) LSM±SE	BL(468)) LSM±SE	CG(468)) LSM±SE	WH(468)) LSM±SE	CW(468)) LSM±SE	PW(468)) LSM±SE
Overall		468	26.88±4.18	57.34±4.35	69.57±4.47	66.31±3.43	14.92±0.98	14.89±0.78
CV		468	4.36	3.16	2.94	3.77	5.05	4.11
R^2		468	0.91	0.82	0.79	0.48	0.43	0.41
District			**	**	**	NS	**	**
	Sayo	156	28.78±0.12^{a}	61.27±0.19^{a}	72.07±0.19^{a}	67.70±0.21	15.44±0.07^{a}	15.25±0.05^{a}
	Gawo Qebe	156	27.63±0.12^{c}	57.27±0.18^{b}	70.25±0.18^{b}	67.02±0.21	14.89±0.07^{b}	15.09±0.06^{ab}
	Dale Wabara	156	28.05±0.13^{b}	57.14±0.21^{b}	70.37±0.21^{b}	67.92±0.24	15.06±0.08^{b}	15.03±0.06^{b}
Agro-Ecology			**	**	**	**	NS	**
	Highland	73	27.84±0.17^{b}	57.73±0.27^{b}	70.53±0.27^{b}	67.51±0.31^{ab}	15.23±0.10	15.24±0.08^{a}
	Midland	174	28.02±0.12^{b}	58.91±0.18^{a}	70.85±0.18^{ab}	67.02±0.20^{b}	14.98±0.07	14.96±0.06^{b}
	Lowland	221	28.60±0.10^{a}	58.87±0.16^{a}	71.32±0.16^{a}	67.83±0.18^{a}	15.19±0.06	15.16±0.05^{a}
Sex			**	**	**	**	NS	**
	Intact male	136	29.22±0.13^{a}	59.89±0.21^{a}	72.22±0.21^{a}	68.71±0.24^{a}	15.23±0.08	15.34±0.06^{a}
	Female	332	27.08±0.09^{b}	57.23±0.13^{b}	69.58±0.13^{b}	66.27±0.15^{b}	15.03±0.05	14.91±0.04^{b}
Age			**	**	**	**	**	**
	1PPI	170	23.05±0.11^{d}	53.72±0.18^{d}	65.70±0.18^{d}	64.08±0.21^{c}	14.34±0.07^{c}	14.47±0.05^{c}
	2PPI	113	26.45±0.14^{c}	57.59±0.22^{c}	69.29±0.22^{c}	66.25±0.26^{b}	14.94±0.08^{b}	14.95±0.06^{b}
	3PPI	87	29.02±0.15^{b}	59.53±0.23^{b}	72.70±0.23^{b}	68.62±0.27^{a}	15.33±0.09^{ab}	15.32±0.07$^{a b}$
	4PPI	98	34.09±0.16^{a}	63.39±0.25^{a}	75.91±0.24^{a}	70.01±0.28^{a}	15.88±0.09^{a}	15.76±0.07^{a}
Sex*Age			**	**	NS	NS	NS	NS
	Intact, 1PPI	80	23.76±0.16^{f}	54.38±0.25^{f}	67.07±0.26	65.26±0.29	14.39±0.09	14.67±0.07
	Intact, 2PPI	48	27.64±0.22^{d}	59.34±0.34^{c}	71.54±0.36	67.47±0.41	15.07±0.13	15.04±0.10
	Intact, 3PPI	5	29.75±0.31^{c}	60.90±0.49b^{c}	75.79±0.50	70.48±0.58	15.67±0.18	15.62±0.15
	Intact, 4PPI	3	35.75±0.60^{a}	64.94±0.95^{a}	77.27±0.98	72.75±1.12	16.19±0.36	16.03±0.29
	Female, 1PPI	90	22.33±0.15^{g}	53.05±0.23^{g}	64.36±0.23	62.91±0.27	14.26±0.09	14.24±0.07
	Female, 2PPI	65	25.26±0.17^{e}	55.85±0.27^{e}	67.76±0.28	65.50±0.32	14.78±0.10	14.77±0.08
	Female, 3PPI	82	28.30±0.15^{c}	58.17±0.24^{d}	71.35±0.25	67.46±0.28	15.26±0.09	15.12±0.07
	Female, 4P	95	32.44±0.14^{b}	61.85±0.22^{ab}	74.74±0.23	69.17±0.26	15.72±0.08	15.50±0.07

Table 11 (continued

Overall	468	18.84±1.09	11.18±5.37	14.85±4.6	15.07±0.8	26.01±0.15
CV	468	3.66	17.46	4.31	3.77	4.33

	R2	468	0.61	0.44	0.47	0.52	0.66
District			**	**	NS	**	NS
	Sayo	156	19.32±0.06^{a}	11.29±0.18^{ab}	15.15±0.06	15.36±0.05^{a}	25.83±0.18
	Gawo Qebe	156	19.04±0.06^{b}	10.83±0.17^{b}	15.03±0.06	15.10±0.05^{b}	25.62±0.19
	Dale Wabara	156	18.95±0.07^{b}	11.43±0.20^{a}	14.96±0.06	15.12±0.06^{b}	26.58±0.22
Agro-Ecology			**	NS	**	**	***
	Highland	73	19.08±0.09^{ab}	10.72±0.24	15.18±0.08^{a}	15.34±0.07a	24.88±0.25^{b}
	Midland	221	19.03±0.06^{b}	10.84±0.16	14.89±0.05^{b}	15.04±0.05^{b}	24.63±0.18^{b}
	Lowland	174	19.21±0.05^{a}	10.96±0.15	15.10±0.05^{a}	15.18±0.04^{a}	25.80±0.17^{a}
Sex			**	**	NS	NS	-
	Intact male	136	19.25±0.07^{a}	11.72±0.18^{a}	15.13±0.05	15.23±0.05	25.03±0.15
	Female	332	18.96±0.04^{b}	10.65±0.12^{b}	14.96±0.04	15.21±0.04	-
Age			**	***	**	**	***
	1PPI	170	18.02±0.06^{d}	8.68±0.16^{c}	14.29±0.05^{c}	14.46±0.05^{c}	22.81±0.13^{c}
	2PPI	113	18.56±0.07^{c}	10.57±0.20^{b}	14.77±0.07^{b}	15.01±0.06^{b}	24.66±0.17^{b}
	3PPI	87	19.51±0.08^{b}	12.25±0.21^{a}	15.65±0.07^{a}	15.71±0.06^{a}	27.50±0.24^{a}
	4PPI	98	20.34±0.08^{a}	13.24±0.23^{a}	15.51±0.07^{a}	15.57±0.07^{a}	29.08±0.47^{a}
Sex*Age			NS	NS	**	NS	-
	Intact, 1PPI	80	18.20±0.08	8.70±0.23	14.36±0.08^{d}	14.43±0.07	22.81±0.13
	Intact, 2PPI	48	18.73±0.12	10.62±0.32	14.76±0.11^{c}	15.00±0.09	24.53±0.17
	Intact, 3PPI	5	19.95±0.16	12.21±0.42	16.08±0.15^{ab}	15.74±0.13	26.04±0.24
	Intact, 4PPI	3	21.96±0.32	13.69±0.82	15.36±0.29^{abcd}	16.06±0.26	26.75±0.47
	Female, 1PPI	90	17.92±0.08	8.44±0.23	14.22±0.07^{d}	14.45±0.06	-
	Female, 2PPI	65	18.54±0.09	10.09±0.26	14.78±0.08^{c}	15.08±0.07	-
	Female, 3PPI	82	19.36±0.08	11.91±0.23	15.22±0.07^{b}	15.57±0.07	-
	Female, 4PPI	95	20.05±0.07	12.20±0.21	15.65±0.07^{a}	15.76±0.06	-

BW= body weight; BL=body length; CG=chest girth; WH=wither height; CW=chest width; PW=pelvic width; FL=feet length; HL=head length; RL=rump length; EL=ear length; SC scrotal circumstance; LSM= least square mean; SE=standard error; N= number of sampled animals *= significant, **=highly significant, NS=non-significant, CV=coefficient of variation

Conclusion

Identification, characterization and documentation of the existing goats have paramount importance for genetic improvement. This study was aimed to phenotypically characterize goat types found at Sayo, Gawo Qebe and Dale Wabara districts of Kellem Wollega zone, Oromia region. The present study indicates that, the primary reason for keeping goats in all districts was income generation followed by meat for home consumption. Appearance, growth rate, and coat color were the most preferred attributes by goat producers in the current study, indicating that they need to be considered in undertaking genetic improvement for goat types considered in the area. Feed shortage, predator and disease were the main goat production constraints in the areas.

The overall mean dominant coat color type in the current study areas was grey. The most preferred coat color type was grey and brown, as such type of animals have high local market demand. Black coat color was the least preferred due to its low market demand. However, black color was the second most common coat color type that the respondents mentioned. This could be because there is not a breeding system in place for the desired traits that have been chosen. Therefore, in order to ensure proper selection and mating system in the study area, scientific intervention through training and extension services are crucial. While the majority of goats in the study areas had plain coat color patterns, a variety of coat color patterns were also seen. Most of goats also had oblique upward horn, semi-pendulous and pendulous ear orientation, and straight head profile.

As a result of high and positive correlation coefficients found between body weight and other linear body measurements (chest girth, body length, wither height, chest width, Pelvic width and face length), selection of one or more of these traits may increase live body weight of these goat populations. In general, Molecular characterization is required to identify the genetic relation of goats in the study areas.

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