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Phenotypic diversity of indigenous goat (Capra hircus L.) in Dire Dawa Administration, Ethiopia

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Abstract

Ethiopia has about 52.5 million goats, mostly local breed and hence the characterisation of these populations is crucial in providing information on goat types and feature improvement programs. This study assessed the phenotypic diversity of indigenous goats in Dire Dawa Administration, with the objective of describing the morphological characterization of the indigenous goat breed. Data were, collected from 384 goats using purposive and stratified random sampling techniques to select two clustered each contained two Kebeles and farmers goat in the study area, respectively. Qualitative traits data were collected by field visual observation whereas, quantitative traits were measured by plastic tape and suspended spring balance. The age of the animal was estimated by recall and dentition methods. Multivariate analytical technique (Principal Component Analysis) and the General Linear Model procedures of Statistical Analysis System were used for statistical analysis.The genetic and phenotypic correlations were used for trait selection. The result indicated that smooth coat hair type (82.8%), white coat color alone (28.5%) and its mixture with red (23.9%), and red coat colors alone (21.6%) predominantly observed in both study area of agro-ecologies. Majority of total goats found the study area were beardless (81.6%) and (80.1%) for lowland and highland, respectively. The greater number of goat populations were horned (90.9%) and majority of these horned goats had curved horn shape (39.3%) with horizontal ear shape (46.1%) in midland and in lowland study areas. Agro-ecological location, age, and sex significantly influenced body weight and body measurements. Three principal components were extracted for all the breeds found in pooled data. The finding showed that the majority of goats were dairy types. The result showed that a considerable variability was sufficient to differentiate phenotypically diverse groups in the local goat populations of lowland and midland agroecologies. The majority of goats were dairy types that may possess adaptive features for sustainable genetic improvement potential to assist in food security and sustainable utilization. To utilize this resources sufficient and integrated information at molecular level is also important in the future.

Key words/Phrases: Correlation; Dire Dawa Administration; indigenous goat; multivariate analysis; qualitative; quantitative

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1. *Introduction*

According to CSA, (2021) number of goats in Ethiopia increased to 52.5 million head and nearly all of them are of local breeds. They are widely distributed across different agro-ecological zones of Ethiopia (Dereje et al., 2019). Goats have comparative advantage over other small ruminants, that they are browsers and thus it enables them to thrive on sparse bushes and shrubs, they also have broad feeding habits and short reproductive cycle (Gurmessa, 2011). In Ethiopia, goats kept in different parts the country for the purpose of food source, income generation, socio-cultural wealth and source of other valuable non-food products used as raw materials for various traditional household products manufactured in local cottage industries (Hailu et al., 2019). Goats in the lowlands of the country kept both for milk and meat production, whereas in the highlands, mainly kept for meat and income generation (Aschalew, 2000).

Despite the wide distribution and large size of goat population in the country, the productivity per unit of goat and the contribution sectors to national economy is relatively low (Ameha, 2008). According to Tesfaye (2009) and LMP (2015) lack of appropriate breeding strategies, poor nutrition and poor understanding of the production system are some of the factor that leads to reduce the production and productivity of goat. Many interrelated factors including absence of sustainable goat genetic improvement program and lack of documentation on their phenotypic characters and their variation have identified as important constraints (Kosgey and Okeyo, 2007). To plan such program, a good understanding of physical characteristics of goats under their production systems is required (FAO, 2012).

Genetic improvement is one way to increase the productivity of goats. Studies on characterization of goat is essential for planning improvement, documentation and identification of breed, sustainable utilization and conservation of a breed at local, regional, national and global levels (FAO, 2012). Systematic description of goat types should considered as pre-requisite for planning the rational use of indigenous goat resources (Seada, 2018). Additionally, breed characterization is the first step in the urgent task of genetic resources conservation (FAO, 2011). Various research and development activities have been carried out in the past (Gebreyesus, 2010; Tigabu, 2015; Hailu, 2019; Getahun et al., 2020 and Mohammed et al., 2021). However, Dire Dawa City Administration is less focused area on goat diversity studies conducted to describe the genetic potentials of indigenous goat populations rather than

Grum (2010). Additionally, genetic improvement programs in goats have mainly focused on crossbreeding with exotic breeds regarded to be superior rather than selective breeding or utilizing the available variations within the local populations for improvement (Hiemstra et al., 2006). In crossbreeding, favorable breed combinations and complementarities are essential for hybrid vigor. However, for most indigenous goat populations, this strategy has done without plans on how to maintain pure breeds for future use and without enough consideration of environmental effects for production and farmers' preferences (Monau et al., 2018). The data on body dimension is the premise for the establishment of superior breeds from the indigenous breeding stocks. Body measurements are an indicator which reflects the conformational fluctuations happening for the duration of the existence span of goats to the arid and semi-arid tropical climatic situations (Philipsson et al., 2011). Therefore, the objective of this study was to assess the phenotypic diversity of the indigenous goat population of Dire Dawa City Administration based on their qualitative and quantitative traits.

2. Materials and Methods

2.1. Description of the study area

The study was conducted around Dire Dawa Administration (DDA) which is geographically located between 9° 27` to 9° 49' N and 41° 38 ' to 42° 19' E longitude and found in the eastern part of Ethiopia at about 515 km away from the capital city, Addis Ababa and 330 km to the west of the Republic of Djibouti (IDP, 2006). The north eastern part of DDA is relatively sparsely populated lowland exhibiting pastoral and agro-pastoral (AP) farming system and the south eastern part of the administration comprises of escarpment with mixed crop livestock farming system (DDAC, 2004). Dire Dawa has an average high and low temperature of 31.8℃ and 17.9 ℃, respectively. The annual average precipitation is 612 mm and annual rainfall 604 mm. The Administration divided into two clusters that comprise 38 rural and 9 urban kebeles. Estimated numbers of livestock in DDA region are 67,364 cattle, 65,462 sheep, 258,629 goat, 10, 572 camel and 129,575 poultry (CSA, 2020). Goats and camels are the most dominant livestock's species in the study sites kept under pastoral and agro pastoral production system.

2.2. Study Design, Sample Size and sampling methods

A cross sectional study was conducted to assess phenotypic diversity of goat population in DDA using RCBD design, and sex, location and age group of the goats was fixed (independent) variables, while body weight and linear body measurements was fitted as response (dependent) variables. The sample size of indigenous goats determined by the formula given by Cochran's (1977) as well as FAO (2012) recommendation for phenotypic characterization. Hence, 384 indigenous goats (of which 90% of them were females) were used for collecting data of qualitative and quantitative traits. Purposive sampling technique was used to select two clusters, Jaldessa cluster and Wahil cluster of the study area and agro-ecologies. Then two kebeles (Mudi Anano and Harla) were selected from each cluster. To determine the sample size in both agro-ecologies the proportional allocation method (Bowley, 1926) was used and finally stratified random sampling of the two kebeles goat populations implemented to select 228 for lowland and 156 for midland agro-ecologies. The study excluded castrated goats, pregnant doe, buck kids and doe kids to increase accuracy for quantitative traits and to represent the adult goat population.

2.3 Data Collection

Data from qualitative and quantitative traits were obtained according to FAO (2012) descriptor list from a total of goats' sample. Qualitative traits like coat color, hair coat, ear shape, presence or absence of horn, horn shape, head profile, rump profile, presence or absence of wattle, and presence or absence of beard were collected through visual observation. Linear body measurements like heart girth, body length, withers height, rump height, ear length, horn length, body depth, bicoastal diameter, chest width, rump width, head width, rump length, head length, cannon bone circumference, muzzle diameter were made using plastic tape, while body weight of goat was measured using suspended weight balance. Due to lack of birth records of the goats, mature ones was identified and sampled through a combination of information provided by the farmers with information acquired by inspecting the dentition of the animals and those goats with one pair of permanent incisors (PPI) to 4 Pair Permanent Incisors PPI were used in the study. Adult goats were classified into four age group; 1PPI (one pair permanent incisor or 1 years old), 2PPI (2 pair permanent incisor or 2 years old), 3PPI (3 pair permanent incisor or 3 years old), 4PPI (four pair permanent incisor or 4 years old) based on the description of African goat (Solomon, 2009). From the measurements, nine conformation indices were calculated as employed by Jesuyon et al. (2019) and Amsale et al. (2020). Secondary data like climatic data (temperature and rainfall), and livestock demography were collected from the city administrative office and the office of livestock and fishery resources written documents.

2.4 Data Analysis

Statistical analyses were carried out using the SAS version 9.4 (2012). Basic statistics for the quantitative traits and qualitative traits were obtained using the PROC UNIVARIATE and PROC FREQ. A general linear model procedure (PROC GLM) of the Statistical Analysis System (SAS) was used for quantitative variables. Additionally, DUNCAN's multiple range test was performed on all area means affecting body measure traits using PROC GLM to detect statistical differences among sample goat's populations. The model employed for analyses of body weight and other linear body measurements was:

$$Yijk = \mu + di + sj + AK + eijk.$$

Where, yijk= the observed body weight and linear measurements; μ= overall mean; di= is the effect of i^{th} locations, (midland and low land) sj= is the effect j^{th} of sex (does and bucks); AK= is the effect k^{th} of age group (1PPI, 2PPI, 3PPI, and 4PPI), and eijk= is the random residual error. Genetic and phenotypic correlations of live body weight with different body measurement were computed by using SAS CANDISC procedure. Genetic (rg) and phenotypic correlation (rp) between body weight and other traits were estimated from variance and covariance components using the formula (Hossein-Zadeh and Ghahremani, 2018).

3. Results and discussions

3.1 Phenotypic diversity

A significant levels of diversity of qualitative characters such as coat color types, coat hair type and horn condition of indigenous goat population distributions (Table 1). The results of the study showed that coat color hair, horn type, horn shape, head profile, beard, wattle, back profile, rump profile and ear shape were observed in both agro ecologies that showed phenotypic variation. The result uncovered the nearness of relatively more number of female goats sampled than male goats. This could be attributed to the truth that female goats are ordinarily held in herds for generation while the males are more regularly put up for deal and more vitally butchered for nourishment more regularly (Oumer et al., 2019). With the exception of the dominant phenotypes characters for wattle, black, gray, glossy, hornless convex, dipped etc. were found to segregate at very low frequencies in both lowland and midland indicating the need to conserve and preserve these important traits for future utilization.

3.1.1 Coat Color Types

In the study area the most dominant coat color type was white (28.5%), followed by red with white (23.9%) and red (21.6%) which was in line with the finding of Amsale et al. (2020) and Abele (2020). The most dominant coat color type in midland of the current study area was red with white (24.6) and white alone (24.6%) followed by red (21.8%) which is a bit disagree with the result of Birhane et al. (2019) where most coat color type in Tigray goat was red (34%) followed by red with white (20%). As indicated, Coat color pattern has found to be associated with adaptation and heat regulation in the living environment. Dark coat color is associated with adaptation in the humid tropics and light colored common in arid and hot weather condition (Robertshaw, 2006; Hagan et al., 2012). White colored goats are predominant in areas with high temperature as light colored goats more adaptable to the hot environments (Hansen, 1990; Tekle**,** 2016).

3.1.2 Coat Hair Type

The total most dominant coat hair type is smooth hair type (82.8%) in the study area. Most of goats in lowlands (81.1%) and mid lands (85.3%) have smooth hair type which is in agreement with Teramaj and Maticha (2020); Alebel et al. (2020) and Getahun et al. (2020) studied in Arsi, South Gondor and East Gojjam respectively.

3.1.3. Horn Condition

Most of indigenous goat in the current study area was horned (90.9%) with curved shape particularly in lowland area. The results concur with the similar study of Mohammed et al. (2021) in west Hararge. Presence of horn in local goat is advantageous for defensive purpose, to fight against predation (Katangole, 1996) and for drainage of blood through cavernous sinus as control mechanism for thermoregulation (Robertshow, 2006) and better for reproductive performance (Idow, 2018). Majority of goats in the current study area had curved horn shape (39.3%) followed by straight shape (39.1%).

Table 1. Frequency of qualitative traits of goats in the study area

		Lowland			Midland			
Traits	Level	Female N (%)	Male N (%)	Total N (%)	Female N (%)	Male N (%)	Total N (%)	Overall
Coat Color	White	63(30.7)	8(34.7)	71(31.1)	35(28.6)	3(18.7)	38(24.6)	109(28.5)
	Black	7(3.4)	-	7(3.3)	1(0.7)	2(12.5)	3(1.9)	10(2.6)
	Red	45(21.9)	4(17.4)	49(21.5)	31(22.2)	3(18.7)	34(21.8)	83(21.6)
	Gray	20(9.8)	2(8.7)	22(9.6)	14(10)	2(12.3)	16(10.3)	38(9.9)
	White +black	20(9.8)	5(21.7)	25(10.9)	24(17.1)	3(18.7)	27(17.3)	52(13.5)
	Red+white	50(24.4)	4(17.4)	54(23.6)	35(21.4)	3(18.7)	38(24.6)	92(23.9)
Hair Type	Smooth	170(82.9)	15(65.2)	185(81.1)	120(85.7)	13(81.30	133(85.3)	318(82.8)
	Glossy	35(17.1)	8(35.8)	43(18.9)	20(14.3)	3(18.9)	23(14.9)	66(17.2)
Horn	Present	180(87.8)	23(100)	203(89)	130(92.9)	16(100)	146(93.6)	349(90.9)
	Absent	25(12.2)	-	25(11)	10(7.1)	-	10(6.4)	35(9.1)
Horn Shape	Straight	75(36.6)	8(34.8)	83(36.4)	60(42.9)	7(43.7)	67(43)	150(39.1)
	Curved	85(41.5)	10(43.5)	95(41.6)	50(35.7)	6(37.6)	56(35.9)	151(39.3)
	Spiral	45(21.9)	5(21.7)	50(22)	30(21.4)	3(18.7)	33(21.1)	83(21.6)
Head Profile	Straight	115(56.1)	14(60.9)	129(56.6)	90(64.3)	8(50)	98(62.8)	227(59)
	Concave	70(34.1)	6(26.1)	76(33.3)	40(28.6)	6(37.5)	46(29.5)	122(31.8)
	Convex	20(9.8)	3(13)	23(10.10	10(7.1)	2912.5	129(7.7)	35(9.1)
Beard	Present	23(11.2)	19(82.6)	42(18.4)	18(12.9)	13(81.3)	31(19.9)	73(19.1)
	Absent	182(88.8)	4(17.4)	186(81.6)	122(87.1)	3(18.7)	125(80.1)	311(81.9)
Wattle	Present	20(9.8)	2(8.7)	22(9.6)	18(12.8)	2(12.5)	20(12.8)	42(10.9)
	Absent	185(90.2)	21(91.3)	206(90.4)	122(87.1)	14(87.5)	136(137.2)	342(89.1)
Back Profile	Dipped	20(9.8)	4(17.4)	24(10.5)	30(21.4)	6(37.5)	36(23.1)	60(15.6)
	Straight	185(90.2)	19(82.6)	204(89.5)	110(78.6)	10(62.5)	120(76.9)	324(84.4)
Rump Profile	Slopping	180(87.8)	19(82.6)	199(87.3)	130(92.9)	12(75)	142(91.1)	341(88.8)
	Straight	25(12.2)	4(17.4)	29(12.7)	29(12.7)	10(7.1)	14(8.9)	43(11.2)
Ear shape	Erect	30(14.6)	3(13)	33(14.5)	15(10.7)	2(12.5)	17(10.9)	50(13)
	Pendulous	86(41.9)	8(34.8)	94(41.2)	55(39.3)	8(50)	63(40.4)	157(40.4)
	Horizontal	86(43.4)	12(52.2)	101(40.4)	70(50)	6(37.5)	76(48.7)	177(46.1)

3.1.1 **Presence or Absence of Beard and Wattle**

The current study discovered low prevalence of beard among the goat populations (19.1%). This observation agrees with the earlier reports by Dossa et al. (2007), Traore et al. (2008), Hagan et al. (2012) and Halima et al. (2012) for indigenous goat population in Bennin, Burkina Faso, Ghana and Ethiopia respectively. Beardness is sex influenced trait and secondary sexual traits are under control of arousal, and hence the possession of beard in both female and males might influence reproductive functions during breeding (Ofori et al., 2021). It was realized that majority of goats in the study area did not possess wattle (89.1%) which was in agreement with earlier reports by Birhane et al. (2019) on their similar study in Tigray region. However, such trait could be associated with high milk yield, high litter size and high fertility index and conception rate need to give due attention in improvement program (Yukubu, 2010). Considering the numerous advantages of the presence of the wattle gene especially in female animals; with the low frequency of the trait observed in the goat population in the current study (both in lowland and midland ecology), there is the need to conserve the few wattled goats for future use (Tekle, 2016).

3.1.2 **Head profile, Buck profile, Rump profile and Ear shape**

The dominant head profile in the study area was (59%) straight, which is in line with the study of Getahun (2020) on his study of indigenous goat in east Gojjam but the result is inconsistent with the work of Alebel et al. (2020) studied in south Gondar Zone. There is also variability in back profile and rump profile where majority of the goats had slopped rump profile (88.8%) and straight back profile (84.4). This is similar with the study results of Birhane et al. (2019). Majority of goats in the current study had pendulous ear shape in lowland (41.2%) and midland (40.4%) ecologies.

3.2 Variation in Body Weight and Linear Measurements

3.3.1 **Age effect**

Live body weight and the other body measurements were significantly (P<0.05) affected by age group of the indigenous goats (Table 2). Live body weight and other linear measurements were increasing with the age. This was in agreement with the report of Inthujaa et al. (2018). With the exceptions for age classes of 1PPI, 2PPI, 3PPI and 4PPI for HOL, HW and MD; and 3PPI and 4PPI for RH, HG, BD, RL, HL, EL, and CC, there were significant increases in BW and other LBMs as the age increased from the youngest (1PPI) to the oldest (4PPI) age group. The results clearly indicated that BW and LBMs increase proportionately with the advancement of age. This situation is however, expected since the size and shape of animals change as the age increases. In the current study, body weight (BW) had significant difference (P<0.05) in all age (dentition) groups and the same was true for most linear body measurements which increased as animal advances with age (1PPI to 4PPI) (Table 2).

Moreover, a steady increase in live body weight with age indicates the absence of critical feed shortage in the study area. The different factors such as nutrition, shortage of grazing areas, and erratic rainfall in the site could be implicated. The farming system is depending on extensive grazing without supplementation, the incidence of disease, the size and productivity of the grazing land can be taken as the main factors affecting livestock productivity in the study area. In addition to this, differences in genetic makeup of the animal and semi-dry environmental condition may be the possible factors.

Table 2. Mean (± SE) of body weight (kg) and linear body measurement (cm) of goats by age

Traits	1PPI (1yrsold)	2PPI (2yrs old)	3PPI (3yrs old)	4PPI (4yrsold)
BW	27.74±0.71^{d}	29.30±0.73^{c}	32.00±0.76^{b}	33.70±0.70^{a}
BL	57.82±0.96^{d}	60.78±0.61^{c}	62.93±0.83^{b}	64.10 ±1.09^{a}
BC	13.83±0.80^{d}	15.27±0.72^{c}	18.23±0.50^{b}	19.45±0.6^{a}
CD	29.73±0.46^{d}	31.77±0.72^{c}	34.77±0.72^{b}	36.77±0.72^{a}
WH	62.34±0.87^{d}	63.60±0.56^{c}	67.48±0.89^{b}	69.43±0.7^{a}
RH	65.86 ±0.64^{c}	70.84±0.86^{b}	72.27±1.25^{a}	72.48±1.19^{a}
CW	10.82±0.38^{d}	13.03±0.39^{c}	15.30±0.29^{b}	16.55±0.3^{a}
HG	68.38 ±0.50^{c}	71.68± 0.63^{b}	73.17±0.79^{a}	73.11±0.57^{a}
BD	26.10± 0.60^{d}	28.14±0.87^{c}	29.66±0.72^{a}	30.44±0.7^{a}
RL	13.60 ±0.28^{c}	14.83±0.38^{b}	16.25±0.37^{a}	16.05±0.14^{a}
HOL	9.88± 0.16^{b}	10.83±0.29^{b}	13.21±0.54^{a}	13.58±0.62^{a}
RW	14.85± 0.46^{d}	16.57±0.36^{c}	18.23±0.64^{b}	19.42 0.57^{a}
HL	14.55± 0.31^{c}	16.43±0.29^{b}	18.54±0.31^{a}	18.21±0.3^{a}
HW	9 .96± 0.52^{b}	10.55±0.55^{b}	12.00±0.74^{a}	12.92±1.1^{a}
EL	11.46 ±0.39^{c}	13.47±0.20^{b}	14.29±0.20^{a}	14.80±0.3^{a}
CC	6.00± 0.33^{b}	7.40±0.33^{a}	7.70±0.35^{a}	7.41±0.32^{a}
MD	22.92± 0.13^{b}	23.05±0.37^{b}	24.42±0.28^{a}	24.76±0.83^{a}

abcd means, on the same row with different superscripts within the specified age group are significantly different (P<0.05). (BW= Body Weight. BL=Body Length. HG= Heart Girth. WH= Wither height. RH= Rump Height. HoL=Horn Length. EL= Ear Length. CD = chest depth. BD = body depth. BC = bicostal diameter. RL = rump length. CC = cannon bone circumference. HW = head width. HL = head length. RW = rump width. MD = muzzle diameter. CW = chest width. 1PPI = 1 Pair of Permanent Incisors, 2PPI = 2 Pair of Permanent Incisors, 3PPI = 3 Pairs of Permanent Incisors; 4PPI = 4 Pairs of Permanent Incisor

3.2.2. Effect of Sex by Agro-ecology Interaction

The interactions between sex and agro-ecology were also significant (P < 0.05), on most quantitative trait such as HG, WH, BL, RH, CD, and BW (Table 3). In both agro-ecology, body weight and other linear body measurements showed that males had significantly higher values than females except in EL, RL, HL, HoL, and CC in midland and muzzle diameter in both lowland and highland. These results were in agreement with the finding of Gelana and Belete, (2016) studied on indigenous goats of Bale Zone, South East Ethiopia. The different value of quantitative trait between male and female in different agro-ecology is due to hormonal difference between males and females, management system and agro- ecologies which were also in agreement with the finding of Gelana and Belete, (2016) in their study of indigenous goats of Sinana District, Bale Zone South East Ethiopia.

Table 3. Effect of Sex by Agro-ecology Interaction between lowland and midland

	Lowland		Midland	
Traits	Male	Female	Male	Female
BW	32.18±0.65^{a}	28.53±0.72^{b}	31.33±0.63^{a}	29.19±0.59^{b}
BL	63.23±0.54^{a}	58.90±0.44^{b}	62.42±0.49^{a}	60.08±0.53^{b}
BC	17.67±0.29^{a}	14.26±0.43^{b}	16.82±0.25^{a}	14.93±0.37^{b}
CD	34.49±0.46^{a}	30.84±0.10^{b}	33.64±0.48^{a}	31.81±0.12^{b}
WH	67.63±0.45^{a}	64.31±0.37^{b}	66.76±0.46^{a}	64.15±0.57^{b}
RH	73.62±0.76^{a}	69.09±0.34^{b}	72.70±0.72^{a}	69.78±0.25^{b}
CW	14.18±0.16^{a}	12.32±0.26^{b}	13.35±0.13^{a}	12.88±0.11^{b}
HG	73.15±0.45^{a}	70.13±0.34^{b}	72.39±0.44^{a}	70.66±0.27^{b}
BD	31.02±0.39^{a}	27.43±0.35^{b}	30.13±0.42^{a}	27.93±0.15^{b}
RL	15.30±0.49^{a}	14.15±0.30^{b}	14.45±0.50^{a}	14.83±0.16^{a}
HOL	13.86±0.60^{a}	11.85±0.06^{b}	13.01±0.53^{a}	12.52±0.11^{a}
RW	18.12±0.66^{a}	16.43±0.27^{b}	18.31±0.43^{a}	17.10±0.19^{b}
HL	18.15±0.33^{a}	16.36±0.25^{b}	17.39±0.30^{a}	17.01±0.14^{a}
HW	12.78±0.63^{a}	9.05±0.16^{b}	11.95±0.64^{a}	10.67±0.71^{b}
EL	14.35± 0.57^{a}	13.28±0.24^{b}	13.50±0.60^{a}	14.07±0.20^{a}
CC	8.27±0.18^{a}	6.49±0.21^{b}	7.55±0.19^{a}	7.26±0.18^{a}
MD	23.11±0.27^{a}	22.42±0.22^{a}	23.34±0.17^{a}	24.09±0.9^{a}

abcd means, on the same row with different superscripts within the specified age group are significantly different (P<0.05). (BW= Body Weight. BL=Body Length. HG= Heart Girth. WH= Wither height. RH= Rump Height. HoL=Horn Length. EL= Ear Length. CD = chest depth. BD = body depth. BC = bicostal diameter. RL = rump length. CC = cannon bone circumference. HW = head width. HL = head length. RW = rump width. MD = muzzle diameter. CW = chest width

3.2.3. Sex Effect

The study showed that males had 31.76 kg higher the body weight (p<0.05) compared to female (28.53 Kg) (Table 4) which is in good agreement with that of Said et al. (2016) and

Dereje et al. (2019) who reported similar findings in goats reared in Western highland (Wollega Zone) and Southern lowland (Gamo Zone) parts of the country, respectively. In contrary, Gelana and Belete (2016) established that female goats raised in Eastern Ethiopia had higher BW than those of bucks. These inconsistencies might have attributed to age differences of both sexes and some other environmental factors influenced during data collection. Moreover, such conflicting results might be because of negative selection practiced by the farmers as fast growing male kids were, sold at earlier age. Males had higher values for most of linear body measurements ($p<0.05$) than female. This indicated that, sexual dimorphism was, observed in most of quantitative traits which is common in all mammalian species (Ghafouri-Kesbi and Notter, 2016; Rotimi et al., 2017).

3.2.4 Effect of Agro ecology

Agro ecology had significant effect on some morphometric traits such as BW, CW and BL (Table 4).

Table 4. Comparison between total male, female, and lowland highland agro-ecologies of DDA

Traits	Male	Female	Lowland	Midland
BW	31.76±0.30[a]	28.53±0.23[b]	29.71±1.14[b]	33.75±1.30[a]
BL	62.83±0.30[a]	58.90±0.42[b]	60.66±1.76[b]	62.19±1.56[a]
BC	17.25±0.31[a]	14.26±0.24[b]	15.60±1.23[a]	15.88±0.95[a]
CD	34.07±0.33[a]	30.84±0.34[b]	32.10±1.26[a]	32.59±0.78[a]
WH	67.20±0.29[a]	64.31±0.06[b]	65.54±1.23[a]	65.46±1.31[a]
RH	73.16±0.27[a]	69.09±0.24[b]	71.02±1.93[a]	71.90±1.46[a]
CW	13.77±0.31[a]	12.32±0.20[a]	12.84±0.52[b]	14.08±0.05[a]
HG	72.77±0.30[a]	70.13±0.19[b]	71.26±1.13[a]	71.53±0.87[a]
BD	30.58±0.30[a]	27.43±0.18[b]	28.78±1.35[a]	29.56±0.95[a]
RL	14.88±0.07[a]	14.15±0.24[a]	14.30±0.15[a]	14.89±0.05[a]
HoL	13.44±0.27[a]	11.85±0.24[b]	12.43±0.58[b]	13.77±0.25[a]
RW	18.22±0.29[a]	16.43±0.24[b]	17.37±0.94[a]	17.71±0.60[a]
HL	17.77±0.30[a]	16.36±0.23[a]	16.88±0.52[a]	17.90±0.02[a]
HW	12.37±0.25[a]	9.05±0.57[b]	10.50±1.45[b]	11.71±0.64[a]
EL	13.93±0.27[a]	13.28±0.28[a]	13.42±0.09[a]	13.79±0.29[a]
CC	7.91±0.27[a]	6.49±0.27[a]	7.02±0.53[a]	7.41±0.15[a]
MD	23.73±0.27[a]	22.42±0.59[a]	22.98±0.36[a]	23.72±0.38[a]

abcd means, on the same row with different superscripts within the specified age group are significantly different ($P<0.05$). BW= Body Weight. BL=Body Length. HG= Heart Girth. WH= Wither height. RH= Rump Height.

HoL=Horn Length. EL= Ear Length. CD = chest depth. BD = body depth. BC = bicostal diameter. RL = rump length. CC = cannon bone circumference. HW = head width. HL = head length. RW = rump width. MD = muzzle diameter. CW = chest width.

Accordingly, midland goats had higher ($p<0.05$) BW and BL, than those of lowland. The results pertaining to the BL and BW as among the goats in the study are in accordance with those reported by Mellese et al. (2021) in their study of goats' population found in Sidama regional state. Such variation in quantitative traits might be due to difference in the management practices among the communities and availability of feed, environmental condition such as temperature and water resources. The value of linear body measurement except BW, CW and BL is location independent which is in agreement with the result of Tigabu (2015).

3.2.5 Effect of Sex by Age Interaction

The interactions between sex and age groups was, also significant ($P < 0.05$) on heart girth, height at wither, rump height, chest depth, rump width, and live body weight of goat population (Table 5). The body length and height at any given time reflects the animal's skeletal size and body conditions. Thus, long body usually has enough body capacity and uterine capacity for the fetal development (Mekete, 2016). The hearth girth (HG) as observed in the study was higher than that reported by Dereje et al. (2013). It has reported by Mwacharo et al., (2006) that the animal with higher HG have higher capacity to accommodate some of the vital organs like heart and liver. Findings by Banerjee (2015) have indicated that animals with high withers, rump and long legs have good grazing ability especially in hot climates. High withers also ensure that all the vital organs are well above the blazing heat of the ground and therefore are well adapted to the lowlands agro-ecologies as stated by Moshood, (2015).

The study also indicated that, with wide the rump width (RW) and long rump length (RL) usually have high capacity for uterine and fetal development ensuring low abortion and dystocia (Mekete, 2016). In each age group males showed significantly ($p<0.05$) higher measurements than females except, EL, CC, HW, RL, RW, CW which was in agreement with Yaekob et al. (2015), Alubel (2015) who reported that the interaction of sex and age group was significant for body weight and all other linear body measurements on Central Highland, Abergelle goat and in west Gojjam respectively except ear length, and horn length.

The current result of body weight is higher than that of Getahun et al (2020), for males, but not for females. The BW of male and female goats increased as dentition class increased from 1PPI to age group 4PPI. Such changes are, explained by the skeletal muscle development as the age of the animal advances. Sex is an important source of variation for live body weight and linear body measurements at all age groups. The sex related differences might be partly a function of the sex differential hormonal effect on growth and to sexual dimorphism (Semakula et al., 2010). 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.

Table 5. Effect of Sex by age interaction

	Males				**Females**			
Traits	1PPI	2PPI	3PPI	4PPI	1PPI	2PPI	3PPI	4PPI
BW	29.73±0.28[c]	31.65±0.30[b]	32.48±0.33[a]	33.14±0.33[a]	26.77±0.38[c]	28.90±0.32[b]	29.51±0.05[a]	30.62±0.18[a]
BL	58.70±0.26[c]	61.93±0.26[b]	63.55±0.29[a]	64.12±0.34[a]	57.94±0.30[a]	59.64±0.34[b]	61.31±0.25[c]	62.08±0.76[c]
BC	15.30.±0.2[c]	17.66±0.30[b]	19.17±0.28[a]	19.88±0.35[a]	11.28±0.28[d]	13.67±0.36[c]	15.29±0.21[b]	17.16±0.11[a]
CD	29.52±0.34[c]	32.14±0.23[b]	34.89±0.32[a]	35.72±0.31[a]	30.50±0.31[c]	31.39±0.33[c]	34.45±0.38[b]	36.00±0.35[a]
WH	64.02±0.25[c]	64.61±0.42[c]	66.24±0.28[b]	68.90±0.28[a]	62.66±0.34[c]	63.58±0.25[c]	65.73±0.11[b]	67.00±0.04[a]
RH	70.09±0.29[c]	72.48±0.31[b]	74.26±0.36[a]	74.83±0.34[a]	68±0.24[c]	70.20±0.41[b]	72.79±0.22[a]	72.00±0.10[a]
CW	10.44±0.31[c]	13.70±0.21[b]	15.21±0.34[a]	16.70±0.32[a]	10.20±0.30[c]	13.35±0.22[b]	14.73±0.05[a]	15.00±0.08[a]
HG	70.33±0.23[c]	72.82±0.37[b]	72.00±0.25[ab]	73.22±0.24[a]	68.43±0.21[c]	70.53±0.35[b]	71.62±0.21[b]	72.13±0.00[a]
BD	27.20±0.35[c]	30.80±0.33[b]	33.06±0.28[a]	34.23±0.30[a]	27.00±0.32[d]	29.00±0.35[c]	32.25±0.02[b]	33.43±0.01[a]
RL	12.25±0.34[c]	14.38±0.25[b]	16.89±0.30[a]	16.97±0.26[a]	12.94±0.29[b]	14.27±0.46[a]	15.62±0.11[a]	15.13±0.09[a]
HoL	11.79±0.20[c]	13.03±0.32[b]	14.21±0.35[a]	14.73±0.34[a]	11.98±0.23[b]	12.12±0.28[b]	13.21±0.24[a]	15.43±0.30[a]
RW	15.67±0.26[b]	18.01±0.26[b]	19.46±0.31[a]	19.73±0.34[a]	16.03±0.31[b]	16.91±0.37[b]	19.11±0.19[a]	19.00±0.08[a]
HL	14.00±0.26[c]	17.52±0.24[b]	18.82±0.27[a]	18.74±0.31[a]	16.10±0.35[b]	17.28±0.00[b]	18.77±0.14[a]	19.00±0.08[a]
HW	10.95±0.27[c]	11.53±0.35[c]	12.72±0.27[b]	14.25±0.28[a]	8.99±0.27[b]	9.58±0.34[b]	11.29±1.26[b]	12.60±0.42[a]
EL	11.95±0.34[b]	14.18±0.30[a]	14.93±0.30[a]	14.64±0.25[a]	11.10±0.29[b]	13.52±0.32[a]	14.01±0.45[a]	14.08±0.05[a]
CC	7.32±0.25[b]	7.91±0.30[ab]	8.23±0.28[a]	8.18±0.18[a]	6.26±0.30[a]	6.88±0.30[a]	7.18±0.35[a]	7.20±0.14[a]
MD	23.10±016[a]	23.60±0.28[a]	23.87±0.28[a]	24.32±0.36[a]	22.35±0.36[c]	22.40±0.40[c]	23.98±0.20[b]	25.22±1.57[a]

abcd means, on the same row with different superscripts within the specified age group are significantly different (P<0.05). (BW= Body Weight. BL=Body Length. HG= Heart Girth.WH= Wither height. RH= Rump Height. HoL=Horn Length. EL= Ear Length. CD = chest depth. BD = body depth. BC = bicostal diameter. RL = rump length. CC = cannon bone Circumference. HW = head width. HL = head length. RW = rump width. MD = muzzle diameter. CW = chest width. 1PPI = 1Pair of Permanent Incisors, 2PPI = 2 Pair of Permanent Incisors, 3PPI = 3 Pairs of Permanent Incisors, 4PPI = 4 Pairs of Permanent Incisors.

3.4 Genetic and Phenotypic Correlation

The phenotypic (rp) and genetic correlation coefficients (rg) of studied goat population in the study area obtained between the live body weight and other linear body measurements are, presented in Table 6. Genotypic correlation coefficients provide a measure of the genotypic association between characters and give an indication of the characters that may be useful as indicators for selection traits in the improvement programs. Generally, genotypic correlations were higher than the corresponding phenotypic ones implying that majority of the traits under consideration were genetically controlled. Body weight had positive and highly significant ($P<0.01$), and significant ($p=0.05$) correlation with majority of continuous traits of both phenotypic and genetic correlation of goats' traits (Table 6). The genetic correlation between body weight and morphometric traits were positive and ranged from 0.41-0.93 (cannon bone circumference to hearth girth). Positive and highly strong genotypic association were found between BW and HG (r=0.93), rump height (r=90) and wither height (r=0.89), BL (R=0.88), bicoastal diameter (r=0.88), chest depth (r=0.88) and Chest width (r=0.84) suggest that these characters contributed positively towards body weight and should be considered when selecting for high live body weight or genetic gain in goat as it has been reported elsewhere (Jafari and Hashemi, 2014; Hossein-Zadeh, and Ghahremani, 2018). This may be because HG and BW are both tissue-related measurements while BL and WH are skeletal-related measurements (Salako, 2006; Josiane *et al.*, 2019). This finding is also in agreement with the report of Oliveria and Paz (2021). The observed genotypic and phenotypic correlation coefficient variation in all the traits considered in this study have been enhanced the setting of selection criteria for the genetic improvement of the indigenous goat for the characters with higher correlation coefficient.

Table 6. Phenotypic correlation (above diagonal) and genetic correlation (below diagonal) of goats in the study area.

	BW	BL	BC	CD	WH	RH	CW	HG	BD	RL	HoL	RW	HL	HW	EL	CC	MD
BW	1	0.56*	0.44	0.56*	0.53*	0.54*	0.65**	0.55*	0.54*	0.55*	0.65**	0.53*	0.67**	0.67**	0.45	0.69**	0.50*
BL	0.88**	1	0.56*	0.55*	0.53*	0.55*	0.39	0.56*	0.55*	0.57*	0.67**	0.56*	0.69**	0.64**	0.39	0.72**	0.55*
BC	0.88**	0.94**	1	0.52*	0.54*	0.55*	0.67**	0.56*	0.55*	0.80**	0.67**	0.55*	0.46	0.63**	0.47	0.72**	0.53*
CD	0.88**	0.94**	0.92**	1	0.53*	0.56*	0.68**	0.57*	0.56*	0.88**	0.69**	0.56*	0.71**	0.70**	0.51*	0.74**	0.55*
WH	0.89**	0.95**	0.92**	0.91**	1	0.53*	0.61*	0.54*	0.53*	0.64**	0.61**	0.50*	0.62**	0.56*	0.34	0.63**	0.35
RH	0.90**	0.95**	0.89**	0.97**	0.95**	1	0.64**	0.54*	0.54*	0.73**	0.31	0.54*	0.65**	0.60*	0.42	0.67**	0.46
CW	0.84**	0.88**	0.90**	0.88**	0.84**	0.86**	1	0.69*	0.65**	0.89**	0.86**	0.61**	0.88**	0.76**	0.81**	0.91**	0.80**
HG	0.93**	0.93**	0.94**	0.97**	0.96**	0.97**	0.89**	1	0.55*	0.79**	0.67**	0.54*	0.67**	0.61**	0.46	0.69**	0.50*
BD	0.88**	0.92**	0.96**	0.97**	0.93**	0.95**	0.92**	0.97**	1	0.76**	0.67**	0.53*	0.67**	0.60*	0.43	0.69**	0.47
RL	0.77**	0.52*	0.54*	0.63**	0.55*	0.60*	0.61*	0.70**	0.62**	1	0.95**	0.99**	0.97**	0.54*	-0.83**	-0.71**	-0.55*
HoL	0.88**	0.84**	0.74**	0.88**	0.79**	0.90**	0.76**	0.86**	0.81**	0.73**	1	0.63**	0.87**	0.77**	0.82**	0.92**	0.86**
RW	0.65**	0.69**	0.66**	0.71**	0.72**	0.70**	0.54*	0.76**	0.67**	0.52*	0.54*	1	0.64**	0.61**	0.38	0.67**	0.52*
HL	0.66**	0.63**	0.65**	0.63**	0.60*	0.60*	0.53*	0.69**	0.60*	0.59*	0.53*	0.87**	1	0.79**	0.87**	0.97**	0.92**
HW	0.81**	0.90**	0.83**	0.87**	0.81**	0.87**	0.76**	0.83**	0.82**	0.49*	0.85**	0.57*	0.66**	1	0.78**	0.84**	0.78**
EL	0.57*	0.45	0.56*	0.49*	0.54*	0.47	0.57*	0.63**	0.55*	0.66**	0.34	0.72**	0.76**	0.35	1	0.95**	0.71**
CC	0.41	-0.13	-0.05	-0.25	-0.14	0.22	-0.04	0.26	-0.11	0.71**	-0.4	0.42	0.54*	0.24	0.43	1	0.99**
MD	0.56*	0.32	0.17	0.31	-0.06	0.26	0.83**	0.17	0.33	0.89**	0.49*	0.28	0.85**	0.47	0.94**	0.62**	1

** = highly significant at p = 0.01, *= significant at P<0.05, BW= Body Weight; BL=Body Length; HG= Heart Girth; WH= Wither height; RH= Rump Height; HoL=Horn Length; EL= Ear Length; CD = chest depth, BD = body depth, BC = bicostal diameter, RL = rump length, CC = cannon bone circumference, HW = head width, HL = head length, RW = rump width, CW = chest width

3.4. Structural and Functional Body Indices

The results pertaining to the structural indices of the Does and Bucks in the study areas are presented in Tables 7.

3.4.1. Proportionality index

Proportionality index value of female, lowland and midland reported in this study was greater than 100, which is higher than those reported Mezgebu *et al.* (2020) for east Gojjam Zone goats, but lower for males. A proportionality index value less than 1.00, or 100% indicated, that the breed's body tends to be rectangular characteristic in meat type. A value greater than 1.00, or 100% denotes that the shape of the animal tends to be square which is a characteristic of dairy phenotype (Bravo and Sepúlveda, 2010; Barragán, 2017).

3.4.2. Weight Index

The average weight of goats in the current study area was below 35 kg, thus they are, classified as a small or elipometric type, which is in line with Gutu *et al.*, (2020) studied in Jimma Zone. Weight above 45kg corresponds to large or hypermetric animals, between 35 and 45 kg medium or eumetric animals, and less than 35kg, small or elipometric animals. However, the result disagrees to the respective weight index of goat populations in Arba Minch Zuria and Mirab Abaya which was 44.7 and 35.9 kg (Dereje *et al.*, 2019).

3.4.3. Relative Depth of Thorax Index

The relative depth of thorax index (RDI) (50.62, 48.87, 49.50 and 50) indicates that goats reared in the study area are characterized by relatively long leg that is far from the ground. This may suggest to their high adaptation to heat radiation compared with report of Gutu *et al.*, (2020) that relative depth of thorax index of goats in the Jimma Zone as 45.9. According to Chacón *et al.* (2011) relative depth of thorax index indicates a relationship between chest depths and wither height and serves as an indirect measure of leg length, whereby higher indices for this trait corresponds to animals with longer legs.

4.4.4. Relative Body Index

The relative body or length index of the goat in the current study area 93.64, 92.62, 92.55 and 92.30 which is lower than the finding of Mezgebu (2020). He reported that the relative body or length indices of goats in the East Gojjam Zone of Amhara region were 96.60±5.72 (0.96) and 92.90±4.86 (0.92) for does and bucks, respectively. Relative body index or length index is more appropriate for the assessment of the type for which the breed was developed. The relative body index and balance indices indicated the carcass yield capacity of live animals

(Salako, 2006). Generally, the lower value of the relative body index of a goat shows that the carcass yield of a goat expected to be lower and vice versa.

4.4.5. Dactyl Thorax Index

The dactyl thorax index of goats in the area were 10.60, 10.50, 10.70 and 10.80 that classified them as intermediary (medium animal used for both meat and dairy) type animals. The results were in agreement with Gutu *et al.*, (2020). The result indicated that the format or shape of the animal through creating relationships between the pectoral mass and limbs, classifying the goats as hypermetric (large format), eumetric (medium format), elipometric (small format), being <10 and >11 in dairy and meat goats, respectively. In light goats, its value is equal to or less than 10.5; in medium goats' b/n 10.5 and 10.8 and in heavy meat type goats, it is 11.5 or above as stated by Barragan (2017).

4.4.6. Conformation Index

The current finding for both sexes and both location (78.80 and 77.14) and (77.87 and 80.20) were lower than conformation index values of goat reported by Khargharia *et al.* (2015) for Assam Hill goat in India (93.18±2.86) and Chacon *et al.*, (2011) for Cuban Creole (97.01±3.96) and Cuban Creole Crossed (105.37±10.15) does. It indicates the overall body shape of an animal. The greater the conformation index, the more vigorous the animal breed would be (Dereje *et al.*, 2019).

4.4.7. Compact Index

The compact index indicates how compact the animal is and Meat type animals have values above 3.15; Dual-purpose animals have values close to 2.75 and Values close to 2.60 indicate that animals are more suitable for milk (goats and cattle). The compact index values for both does and buck (0.004) and lowland and midland (0.005) were very far below 2.60, consistent with the study done in the East Gojjam Zone of Ethiopia by Mezgebu (2020). He reported that the compact index values for both does (0.005±0.00) and bucks (0.004±0.001). The author also stated that these lower compact index values could be due to the age, breed, feed, and feeding practices of goats. It is a useful indicator of the overall value of the animals because it combines morphology and structure; and provides an accurate picture of the type and function of livestock breeds (Chiemela *et al.*, 2016).

4.4.8. Depth Index

Depth index is indexes given by dividing chest depth by height at wither. Depth index values of indigenous goats in the study area were 0.51, 0.48, 0.50 and 0.51. As stated by Chacon *et al.*, (2011) such goats have a very good lung capacity and thus can graze for longer distances without getting tired and this is especial under strenuous conditions.

4.4.9. Areal Index

Areal index values of goats in this finding were 4225.5, 3821, 4028 and 4198. This shows that goats in this area have a larger body surface area relative to their body mass, enabling them to withstand heat stress effectively by dissipating excess heat from their body surface. Khargharia *et al.*, (2015), in support of this reported that the Indian Assam Hill goat and Katjang does' (3394.46) had lower value of area index 3355. The variations between goat types on areal index values are, explained by the type and function of goats, environmental factors, and management conditions employed for goats in different production environments as stated by Mezgebu (2020).

Table 7. Structural and functional body indices of goats in the study area

Body indices	Male	Female	lowland	midland
Proportionality index (PrI)	106.81^{b}	108^{a}	108.50^{a}	108.40^{a}
Weight index (WI2)	26.52^{a}	24.68^{b}	25.40^{a}	25.56^{a}
Balance index (BI)	0.60^{a}	0.60^{a}	0.61^{a}	0.54^{a}
Relative depth of thorax index(RDTI)	50.62^{a}	48.87^{b}	49.50^{a}	50^{a}
Dactyl thorax index (DTI)	10.60^{a}	10.50^{b}	10.70^{a}	10.80^{a}
Crevat and boron index (CBI)	78.80^{a}	77.14^{b}	77.87^{b}	80.20^{a}
Compact index (CI)	0.004^{a}	0.004^{a}	0.005^{a}	0.005^{a}
Depth index (DI)	0.51^{a}	0.48^{a}	0.50^{a}	0.51^{a}
Area index (AI)	4225.5^{a}	3821^{b}	4028^{a}	4198^{b}

a-b, Means with different superscript letters across the column within a group are significant

4.5. Multivariate Analysis

4.5.1. Principal Component Analysis

From the 17 principal components, three components were extracted to determine the number of components based on the eigenvalues greater than 1 (12.495), (2.005) and (1.080) (Table 8). The identified three components explained 91.648% of the variation. First component accounted for 73.501% of the variation (Yakubu *et al.*, 2009; Magaço and Felimone, 2020) indicating that the indigenous goats in DDA have large body measures. It was represented by positive high loading of height at wither, BW, BL, WH, BC, CD, RH, HG, RW, HW, CC, BD and HOL indicating that these traits used in the improvement program as they have common genomic positions for their genetic control in the study area (Tolenkhomba *et al.***,** 2013; Khargharai *et al.*, 2015). The second component explained 11.792 % variation and represented by positive high loading of CD and HL and MD and third component explained 6.355% of variation and represented by positive high loading of RL, HoL and EL.

Table 8. Eigenvalues, total variance and communalities for linear body measurements for pooled midland and lowland goat breeds

Variables	PCA1	PCA2	PCA3	Communality
Body weight	**0.629**	0.593	0.366	0.88
Body length	**0.85**	0.486	0.105	0.969
Bicoastal diameter	**0.932**	0.192	0.056	0.908
Chest depth	**0.87**	0.116	0.233	0.824
Wither height	**0.938**	0.118	0.115	0.908
Rump height	**0.868**	0.32	0.314	0.954
Chest width	0.379	**0.847**	0.296	0.949
Hearth girth	**0.926**	0.138	0.296	0.965
Body depth	**0.851**	0.421	0.262	0.969
Rump length	0.282	0.378	**0.841**	0.93
Horn length	**0.668**	0.245	**0.616**	0.886
Rump width	**0.909**	0.176	0.311	0.954
Head length	0.473	**0.697**	0.456	0.918
Head width	**0.809**	0.227	0.304	**0.798**
Ear length	0.177	0.199	**0.953**	**0.979**
Cannon bone circumference	**0.792**	0.359	0.401	0.917
Muzzle diameter	0.033	**0.922**	0.151	0.873
Eigen value	12.495	2.005	1.08	
Percentage of variance (%)	73.50%	11.79%	6.36%	
Total variance			**91.65%**	

4. Conclusion and Recommendations

The current study indicates the genetic variation existing among existing indigenous goat genotypes in DDA. Therefore, Dire Dawa Administration region goat types may possess adaptive features that are useful in designing sustainable goat genetic improvement programs. The study showed that there are possibilities for within breed selection among the goats reared across the studied areas. The possible reason for the variation might be due to the difference of location or agro ecology, age and sex. Results of descriptive analysis, and multivariate analysis, showed consistency about diversity distribution within this population. The results obtained with principal component analysis of PC1, PC2 and PC3 in the pooled breeds allowed for better understanding of the complex correlations among the traits and reduced the number of traits along with high communalities, without loss of information. Phenotypic traits such as BW, BL, WH, BC, CD, RH, HG, RW, HW, CC, BD and HOL showed high variation among the genotypes and will help in breeding programs for body weight improvement. To provide sufficient information and to identify the existing goat breeds in this study area, characterizing at molecular level is important. Further studies are, recommended to validate their milk production and prolific potentials under a controlled environment.

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6. Conflict of Interest

There is no any conflict of interest.

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