Morphological characterization and production performance of begait sheep breed in Tigrai, Ethiopia

Abstract

This study was conducted in two districts of Tigray region, northern Ethiopia in 510 animals from 144 small holder farmers aimed to estimate morphological parameters and evaluate production traits, and inbreeding levels in Begait sheep. Data were collected between 2019 and 2022 and analyzed using descriptive statistics of SPSS V20 and GLM of SAS V9.1 for the qualitative data and linear body measurements respectively. Large muscular body frame, long thin tail, markedly convex facial profile were distinctive features of Begait sheep population with predominantly patchy (49.80%) coat color followed by plain (44.51%) and spotted (5.69 %) of various colors. Of the total Begait sheep, white with black patchy (49.00%) was the most frequent coat color followed by white (33.33%), light red (7.45%) and fawn (4.31%). The population has relatively heavy live body weight and large body size with a mean live body weight of 55.76 ±0.70kg and 42.40 ±0.36kg for males and females respectively, which indicates the potential of the population for meat production. GLM revealed almost all the morphometric measurements were significantly ($p < 0.05$) different among districts, sexes and age groups of Sheep. The higher body weights (49.22 ±1.09 kg) and most other linear body measurements were also recorded in the age group of three pair of permanent incisors (3PPI), whereas the lower values (41.49 ±0.85 kg for body weight) were recorded in the age group of one pair of permanent incisors (1PPI) and Body weight was significantly correlated ($P<0.01$) with linear body measurements with the correlation coefficients ranging from 0.069 - 0.768. Begait sheep are known as early maturing and prolific breed with Twin (39.66%) and triple (0.98%) births. To concluded Begait sheep may possess unique adaptive features that should be useful and considered in designing and implementing a sustainable sheep improvement program.

Key words: Begait sheep, Breed, Morphological characteristics, *Phenotype,* Tigrai

INTRODUCTION

Thousands of farm animal breeds have been developed in the past thousands of years to thrive under specific conditions and nearly 20% of the documented breeds were considered to be under the risk of extinction (FAO, 2000). Among the total 7600 breeds so far documented in the global

databank Animal Genetic Resource (AnGR), 11% of them got extinct and only 38% were out of the risk of extinction. Astonishingly, approximately 35% are not yet properly described (FAO, 2007) and it is feared that they may get extinct before they are attempted for identification. Many nations of the world are losing their genetic heritage, which could be critical for both food security and sustainable development. The primary task for those concerned with the conservation and maintenance of farm genetic diversity is to understand, collate and make useable all available information on agricultural genetic resources. Among the major principles as Javis et al. (2000), included collecting baseline and the morphological features of the populations, production system characterization and performance evaluation. Although the scope of morphological characterization of population is limited yet it is the first step for any population to be identified and brought into further promotion (FAO 2007).

Ethiopia is believed to be one of the major gateways for domestic sheep migration from Asia into Africa (Solomon, 2008). With 30.70 million sheep (CSA, 2017) and 14 traditional populations, there are highly diversified indigenous sheep types which are parallel to the diversity in ecology, ethnic communities and production systems in the country (Gizaw et al., 2007). Evidence indicates that breeds and populations that have evolved over the centuries in diverse, stressful, tropical environments have a range of unique adaptive traits (e.g. resistance to diseases, adaptation to heat and solar radiation, tolerance to water scarcity, ability to use low quality feed, etc.) (Solomon et al., 2013).

According to Solomon et al. (2010), Ethiopian sheep breeds are categorized in to five clusters. However, the Begait sheep population has not been mentioned in these clusters. According to the previous study, all Tigrai sheep breeds were classified as Sekota breed which in fact was not. According to Zelealem and Anal (2014), Begait sheep is a local breed reared in the North West and Western zone of Tigrai regional state of Ethiopia, distributed from Sudan extending eastwards to Eritrea and westwards to Chad. It is among the sub types of north Sudan desert sheep. The Begait sheep population has not been well characterized as to its genetic component. Therefore, this study was undertaken to address the information gap about the Begait sheep population by morphologically characterize the population in north western and western zones of Tigrai, Ethiopia as a prerequisite to sustainable breed improvement, utilization and conservation.

MATERIALS AND METHOD

Description of the study area

The study was conducted in north western and western zones of Tigray regional State, Northern part of Ethiopia in two closely connected districts, namely Tahtayadyabo and Kaftahumera (Fig.1) which are located some 1300 km northeast of the capital city of the country, Addis Ababa and at about 450 km northeast of Mekelle, the regional capital city. Its geographical location lies within the co-ordinates of 13^0 59'-14^0 43' north latitude and 36^0 26'-37^0 48' east longitude. The altitude of the study area ranges from 675 to 1262 meter above sea level. It has unimodal rainfall pattern with 80 to 85% of the rain falling during summer season. The study districts are found within the lowland part and share the mean annual rainfall and mean annual temperature of 448.8mm and 25ºC respectively (OARD 2018).

These two districts were selected based on the potential habitat of the Begait breed, the breed is adapted to the lowland areas of western and northwestern Tigrai region. These districts are believed to be the home tracts for Begait sheep population and the farming system practiced in the study area is mixed crop-livestock production system. Sesame, sorghum, and cotton are the most common crops produced. Livestock are the valuable components of the farming system contributing enormously towards ensuring food security in the study area and it consists of different livestock composition. According to CSA (2017), the study zones had 187685 Cattle, 238950 Sheep, 216341 Goats, 256530 Donkeys, 2144 Mules, 2059194 Poultry, 23262 Camel for north western zone and the corresponding values for western zone were 885100, 117398, 666913, 70469, 1369, 703748 and 9101 respectively.

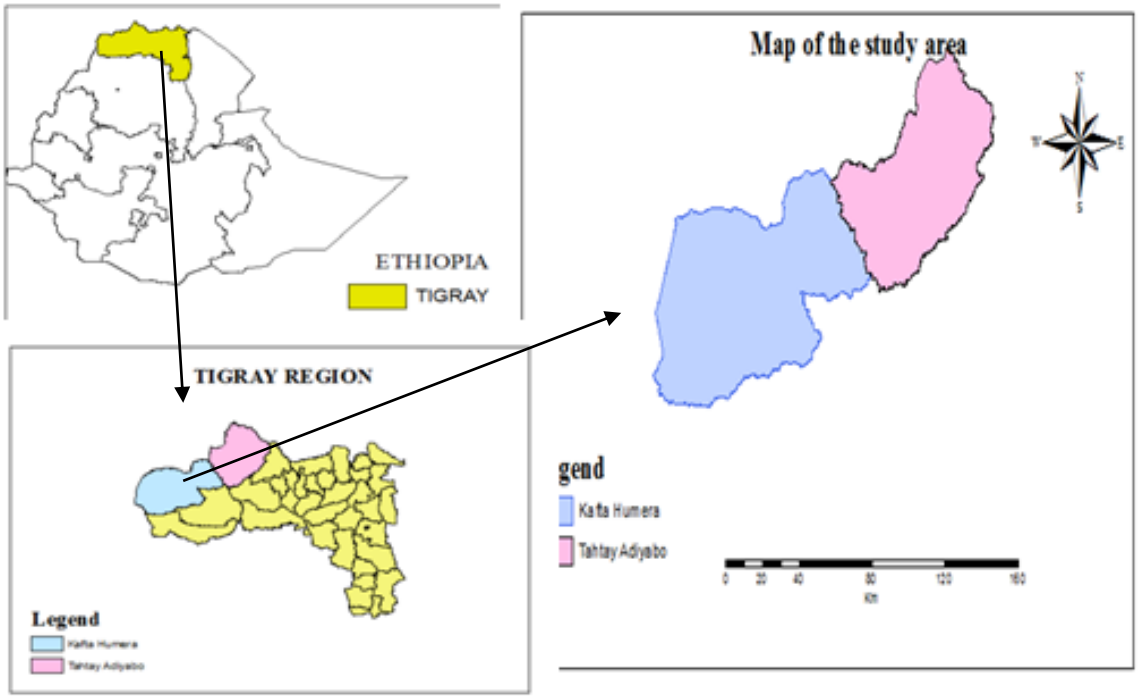

Fig1. Map of study area

Data collection procedures

Data on morphological traits were collected using guidance of FAO (2011) and Metric traits measured with the help of hanging animal weighing scale and measuring tape from 510 adult animals (210 female and 45 males from each district) for characterization. The qualitative data were collected using monitoring and observation of animals, whereas the quantitative data for performance evaluation were gathered from field measurements from both sexes of different ages in 72 different flocks from each district. Measured animals were divided into four age categories as, 1PPI (one pair of permanent incisors), 2PPI (two pairs of permanent incisors), 3PPI (three pairs of permanent incisors) and ≥4PPI (four and above pairs of permanent incisors). The mature age groups of 3PPI and ≥4PPI were used for morphological measurements and all the four age categories were used to understand growth trend.

Data analysis

Non-parametric data were analyzed using chi-squared statistic and the continuous data through GLM. Least square means were computed for variables that have significant difference in the analysis. This had been done for both sexes separately to avoid confounding effect due to sex.

Metric traits were analyzed using a linear model having effects of location (1-2), sex (1-2), age (1- 4) and interaction of sex and age. Mathematical form of the model is as under

$Yijk = \mu + Ai + Sj + Lk + eijk$

Where: Yijk = the observation of body measurements and body weight

μ = overall mean

Ai= the effect of i^{th} age group (i = 1, 2, 3, 4)

Sj= the effect of j^{th} sex (j = female, male)

Lk= the effect of K^{th} location (k = Tahtayadyabo, Kaftahumera)

eijk= random residual error associated with the $[ijk]^{th}$ observation.

The mode for scrotal circumference was:

$Yij = \mu + Ai + Lj + eij$

Where: Yij = scrotal circumstance of the jth age group of the ith district

μ = over all mean

Ai = the effect of i^{th} age group (I = 1, 2, 3, 4)

Lj = the effect of j^{th} location (j = Tahtayadyabo, Kaftahumera)

eij= random residual error associated with the $[ij]^{th}$ observation.

RESULTS

Morphological Characteristics

Morphological characteristics and morphometric traits were taken from a total 510 sheep of both sexes (90 rams and 420 ewes) with equal sample distribution between the two districts. The results showed that the coat color patterns of Begait sheep populations varied among the districts (Table 1) with predominantly patchy (49.80%) followed by plain (44.51%) and spotted (5.69 %) of various colors. Of the total sampled Begait sheep in the study area, white with black patchy

(49.00%) was the most frequent coat color followed by white (33.33%), light red (7.45%) and fawn (4.31%).

In Tahtayadyabo district white (32.16%) was the predominant coat color followed by white with light red patch (16.86%), while in Kaftahumera district white (34.51%) was the predominant coat color followed by white with black patch (30.20%). There were three Begait sheep sub-populations (locally known as Gerj, Barka and Hassan) in the area with equal ratio of sample distribution in the study and each sub-population possesses identified morphological features. White coat color with black spot in the terminal body parts specifically in mouth, ears and legs were the typical features of Gerej sheep type whereas, white and light red colors were for Barka and Hassan sheep types respectively. In general, white coats with or without patches or spots were the predominant color of Begait sheep breed.

Majority of Begait sheep had smoothed and short hair type with few numbers of coarse hair type sheep. In Begait sheep populations the presence of ruff and horn was not observed but wattle was observed in rare cases (0.20%) from the total sampled sheep. All the Begait male and female sheep populations were polled. The majority of Begait sheep population was characterized by medium to long sized pendulous ear orientation followed by semi pendulous ear.

Large muscular body frame, long thin tail and markedly convex facial profile were distinctive features of Begait sheep population and the profile is expressed mainly in males than females (Fig.2, 3). From the total sampled Begait sheep, majority of them had markedly convex facial profile but there was significant amount of convex facial profile animals, and this might be because of breed admixture with other than Begait sheep from the neighboring sites. Regarding tail type, almost all Begait in both sexes were long thin with straight tip tail.

Table 1. Summary of the qualitative traits in the female and male Begait sheep population.

Traits	Attributes	Tahtayadyabo				Kaftahumera				Overall			
		Male		Female		Male		Female		Male		Female	
		N	%	N	%	N	%	N	%	N	%	N	%
Coat pattern	Plain	13	28.89	97	46.19	26	57.78	91	43.33	39	43.33	188	44.76
	Patchy	29	64.44	111	52.86	16	35.56	98	46.67	45	50.00	209	49.76
	Spotty	3	6.67	2	0.95	3	6.67	21	10.00	6.	6.67	23	5.48
χ2-value													
Coat color type	White	10	22.22	72	34.29	16	35.56	72	34.29	26	28.89	144	34.29
	Black	-	-	4	1.90	1	2.22	7	3.33	1	1.11	11	2.62
	Light Red	4	8.89	17	8.10	6	13.33	2	0.95	10	11.11	28	6.67
	Fawn	-	-	20	9.52	2	4.44	11	5.24	2	2.22	20	4.76
	White black patchy	7	15.56	33	15.71	10	22.22	67	31.90	17	18.89	100	23.81
	White red patchy	13	28.89	30	14.29	6	13.33	27	12.86	19	21.11	56	13.33
	White fawn patchy	9	20.00	29	13.81	3	6.67	20	9.52	12	13.33	51	12.14
	mixed colors	2	4.44	5	2.38	1	2.22	6	2.86	3	3.33	10	2.38
χ2-value													
44.94**													

Hair	Hairy	44	97.78	206	98.10	44	97.78	205	97.62	88	97.78	411	97.86
type	Coarse wool	1	2.22	4	1.90	1	2.22	5	2.38	2	2.22	9	2.14
	Wool	-	-	-	-	-	-	-	-	-	-	-	-
χ2-value													
Ear	Pendulous	28	62.22	159	75.71	45	100.00	206	98.10	73	81.11	365	86.90
orientati	semi	17	37.78	51	24.29		-	4	1.90	17	18.89	55	13.10
χ2-value													
Facial	Convex	6	13.33	40	19.05		-	10	4.76	6	6.67	50	11.90
	Markedlyconv	39	86.67	170	80.95	45	100.00	200	95.24	84	93.33	370	88.10
profile	ex												
	concave	-	-	-	-	-	-	-	-	-	-	-	-
χ2-value													
25.12**													
Horns	Present	-	-	-	-	-	-	-	-	-	-	-	-
	Absent	45	100.00	210	100.00	45	100.00	210	100.00	90	100.00	420	100.00
Tail type	Thin	45	100.00	210	100.00	45	100.00	210	100.00	90	100.00	420	100.00
Tail	Straight tip	45	100.00	210	100.00	45	100.00	210	100.00	90	100.00	420	100.00
form													

N=Number of sheep exhibiting a qualitative character; *χ2*=Pearson chi-square; **p<0.01; NS = not significant.

Fig2. Typical Begait ram

Fig3. Typical Begait ewe

Linear (Quantitative) Body Measurements

The result of this study indicated that, the mean live body weight in male and female were 55.76 ±0.70 kg and 42.40 ±0.36 kg, respectively and the overall minimum mean live body weight (41.49 ±0.85kg) for both male and female was recorded at one pair of permanent incisors (1PPI) teeth age. The higher body weight (49.22 ±1.09 kg) and most other linear body measurements were recorded in the age group of three pair of permanent incisors (3PPI). The mean value of morphometric measurements of Begait sheep (Table 2) were increasing with age in first three age groups (1PPI, 2PPI and 3PPI group), and this increase in size was profound in most of body measurements but not for the last age group (4PPI) and above. Except ear length (EL), pin bone width (PBW) and tail length (TL), all the body measurements were significantly different ($p < 0.05$) in different age group animals and most of the body measurements increased with age up to the three pair of permanent incisor stage (3PPI).

The interaction between district and sex was significant ($p < 0.05$) for head length (HL), head width (HW), heart girth (HG), body length (BL), rump length (RL), rump width (RW), pine bone width (PBW), rump height (RH) and body weight (BW) measures.

Table 2. Least squares mean ± standard error, and the level of significance for the effects of sex of Sheep, location, age group and the interaction of location X sex on body measurements (cm) and body weight (kg)

Effect and level	N	HL	HW	EL	SW	WH	HG	BL	PW
		LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE
Overall	510	24.92 ±0.15	16.04 ±0.11	18.22 ±0.18	22.20 ±0.22	78.30 ±0.38	85.68 ±0.41	69.82 ±0.40	19.88 ±0.19
CV		6.95	8.00	11.12	12.15	5.51	5.67	6.58	10.65
Sex		**	**	NS	**	**	**	**	**
Male	90	27.06 ±0.18	17.19 ±0.14	17.92 ±0.22	24.17 ±0.29	82.28 ±0.46	88.53 ±0.51	72.92 ±0.49	20.77 ±0.23
Female	420	23.96 ±0.09	15.34 ±0.07	18.23 ±0.11	21.18 ±0.15	76.14 ±0.24	82.37 ±0.26	67.90 ±0.25	19.55 ±0.12
District		NS	**	**	**	**	NS	*	**
Tahtayadyabo	255	25.12 ±0.14	15.60 ±0.11	17.64 ±0.17	21.78 ±0.23	77.36 ±0.32	84.24 ±0.41	70.16 ±0.39	18.73 ±0.18
Kaftahumera	255	25.90 ±0.14	16.98 ±0.10	18.51 ±0.17	23.57 ±0.22	81.07 ±0.35	86.66 ±0.39	70.66 ±0.38	21.59 ±0.17
Age group		**	**	NS	**	**	**	**	**
1PPI	89	24.41 ±0.21	15.49 ±0.18	17.83 ±0.25	21.22 ±0.28	75.74 ±0.51	81.11 ±0.54	67.98 ±0.53	19.22 ±0.24

2PPI	82	24.37 ± 0.23	15.70 ±0.15	18.45 ±0.16	21.74 ±0.32	77.40 ±0.51	82.66 ±0.50	68.37 ±0.47	20.34 ±0.25
3PPI	102	24.84 ±0.23	15.92 ±0.16	18.23 ±0.20	22.33 ±0.34	79.06 ±0.51	85.32 ±0.64	69.67 ±0.52	20.21 ±0.29
≥4PPI	237	24.95 ±0.13	16.09 ±0.09	18.22 ±0.13	22.14 ±0.19	77.98 ±0.35	85.84 ±0.34	69.88 ±0.33	19.74 ±0.18
District*Sex		**	**	NS	NS	NS	**	**	NS

Effect and level	N	RL LSM ± SE	RW LSM ± SE	PBW LSM ± SE	RH LSM ± SE	TL LSM ± SE	SC LSM ± SE	BW LSM ± SE
Overall	510	24.15 ±0.16	12.86 ±0.13	10.83 ±0.12	78.29 ±0.34	53.59 ±0.55	33.53 ±0.39	47.70 ±0.52
CV		7.78	11.32	13.16	4.96	11.49	7.68	14.07
Sex		**	**	NS	**	**	NA	**
Male	90	25.43 ±0.20	13.30 ±0.15	10.93 ±0.15	81.55 ±0.42	60.34 ±0.68	31.77 ±0.32	55.76 ±0.70
Female	420	23.46 ±0.10	12.34 ±0.08	10.83 ±0.08	76.59 ±0.21	52.22 ±0.34	NA	42.40 ±0.36
District		**	NS	**	**	**	NS	**
Tahtayadyabo	255	22.66 ±0.18	12.65 ±0.12	9.57 ±0.12	77.03 ±0.33	51.72 ±0.53	31.66 ±0.42	44.37 ±0.55
Kaftahumera	255	26.66 ±0.16	12.99 ±0.12	12.19 ±0.12	81.11 ±0.32	60.84 ±0.51	32.75 ±0.37	53.79 ±0.53
Age group		**	**	NS	**	NS	**	**
1PPI	89	23.34 ±0.23	11.98 ±0.13	10.7 9 ±0.16	76.53 ±0.50	54.40 ±0.95	29.72 ±0.31	41.49 ±0.85
2PPI	82	23.92 ±0.28	12.44 ±0.14	11.15 ±0.17	77.65 ±0.44	54.62 ±0.87	32.57 ±0.93	44.03 ±0.93

3PPI	102	24.57 ±0.26	12.97 ±0.15	10.84 ±0.20	78.57 ±0.46	54.53 ±0.83	33.37 ±0.56	49.22 ±1.09
≥4PPI	237	23.97 ±0.17	12.81 ±0.11	10.82 ±0.13	78.17 ±0.30	53.19 ±0.55	33.68 ±0.56	47.04 ±0.54
District*Sex		**	**	**	**	NS	NA	**

N = number of observations; HL= head length; HW = head width; EL = ear length; SW = shoulder width; WH = wither height; HG = heart girth; BL = body length; PW = pelvic width; RL = rump length; RW = rump width; PBW = pin bone width ; RH = rump height; TL = tail length ; SC = scrotal circumference; BW = body weight; 1PPI = 1pair of permanent incisors; 2PPI = 2 pairs of permanent incisors; 3PPI = 3 pairs of permanent incisors; 4PPI = 4 pairs of permanent incisors; NA = not applicable; NS: Non significant ($p>0.05$); *$p<0.05$; **$p<0.01$.

Phenotypic Correlation of body weight and body measurements

Table 3 presents Pearson's coefficients of correlation among various morphometric variables. Body weight was significantly correlated ($P<0.01$) with linear body measurements with correlation coefficient ranging from 0.069 for ear length to 0.768 for heart girth. Phenotypic correlations of body weight with other body measurements, pin bone width (PBW), rump width (RW) and tail length (TL) were medium and ranged from 0.412 to 0.481 whereas with the other body measurements values were high and ranged from 0.522 to 0.768. The existence of significant positive correlations between the large numbers of the studied parameters indicates the breed has been adapted to the environmental conditions through the process of evolution.

Table 3. Pearson's correlation coefficients (r) between selected body measurements and body weight of Begait sheep

	BW	HL	HW	EL	SW	WH	HG	BL	PW	RL	RW	PBW	RH	TL
BW														
HL	0.628**													
HW	0.654**	0.553**												
EL	0.069	0.044	0.144**											
SW	0.579**	0.508**	0.474**	0.049										
WH	0.682**	0.549**	0.632**	0.149**	0.444**									
HG	0.768**	0.646**	0.542**	0.032	0.542**	0.575**								
BL	0.522**	0.536**	0.489**	0.039	0.392**	0.456**	0.526**							
PW	0.556**	0.372**	0.467**	0.187**	0.575**	0.458**	0.357**	0.301**						
RL	0.627**	0.368**	0.562**	0.179**	0.521**	0.549**	0.452**	0.348**	0.590**					
RW	0.412**	0.272**	0.317**	0.135**	0.155**	0.420**	0.363**	0.304**	0.144**	0.205**				
PBW	0.410**	0.274**	0.354**	0.124**	0.414**	0.288**	0.251**	0.187**	0.613**	0.476**	0.042			
RH	0.664**	0.571**	0.586**	0.217**	0.480**	0.747**	0.605**	0.465**	0.464**	0.565**	0.346**	0.376*		
TL	0.481**	0.251**	0.473**	0.213**	0.294**	0.562**	0.227**	0.172**	0.491**	0.512**	0.201**	0.405*	0.529*	

BW = body weight, HL = head length, HW = head width, EL = ear length, SW = shoulder width, WH = wither height, HG = heart girth, BL = body length, PW = pelvic width, RL = rump length, RW = rump width, PBW = pine bone width, RH = rump height, TL = tail length, **. Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

Productive and reproductive performance of Begait sheep breed

The productive and reproductive performance of Begait sheep population in the study area is shown in Table 4. The study reveals the potential of the breed early maturing and prolific with overall averages of age at first mating 6.90 ±2.24 and 7.31 ±2.42 months for males and females respectively. The overall average age at first lambing and lambing interval was 12.40 ±1.61 and 6.94 ±1.32 months respectively. This performance of Begait sheep under farmer management indicated that in better nutrition and management it could be possible to attain two lambings in a year and can exploit the full reproductive potential.

In Begait sheep there was observed 39.66, 0.98 and 0.07% twin, triple and quadruple births respectively with a significant difference($P<0.001$) between districts in twin and triple births but not in quadruple birth rates. The average reproductive life span for Begait sheep ewe was 8.28 ±1.88 years and on average it delivers 16.28 ±3.92 lambs in her life time with significant difference ($P<001$) among districts. The average market age of Begait sheep was 7.33 ±3.12 and 9.24 ±3.56 months for male and female sheep respectively with no significant difference ($P>0.05$) among districts and sheep sex.

Table 4. productive and reproductive performance of Begait sheep

Characters	District			Test	
	Tahtayadyabo Mean ±SD	Kaftahumera Mean ±SD	Over all Mean ±SD	F value	P value
Male age at first mating (in months)	7.63[a] ±2.59	6.17[b] ±1.52	6.90 ±2.24	17.02	<.0001
Female Age at first mating (in months)	7.82[a] ±2.69	6.79[b] ±1.99	7.31 ±2.42	6.78	0.0102
Male market age (in months)	7.81[a] ±2.98	6.86[a] ±3.20	7.33 ±3.12	3.36	0.0690
Female market age (in months)	9.44[a] ±3.00	9.03[a] ±4.06	9.24 ±3.56	0.49	0.4849
Age at first lambing (in months)	12.57[a] ±1.81	12.24[a] ±1.38	12.40 ±1.61	1.54	0.2165
Lambing interval (in months)	6.94[a] ±2.63	6.94[a] ±1.32	6.94 ±2.07	0.00	1.0000
Single birth (%)	84.49 [a]	53.72 [b]	59.29	18.54	<.0001
Twin birth (%)	14.84 [b]	45.13 [a]	39.66	48.74	<.0001
Triple birth (%)	0.67 [b]	1.06 [a]	0.98	12.45	0.0006
Quadruple birth (%)	0 [a]	0.09 [a]	0.07	2.73	0.1006
Number of Lambs life crop (No)	14.19[b] ±2.63	18.37[a] ±4.32	16.28 ±3.92	29.46	<.0001
Ram culling age from breeding (in years)	5.22[a] ±1.37	4.86[a] ±1.41	5.04 ±1.39	2.44	0.1204
Average ewe reproductive life time (in years)	8.19[a] ±1.85	8.38[a] ±1.92	8.28±1.88	0.33	0.5662

Means within row with different subscripts vary at $\alpha = 0.05$

DISCUSSION

Variations were observed in coat color and pattern of Begait sheep ecotype between and within districts which might be resulted due to percentage of sub-population with in breed and geographical differences but it was similar between the two sexes. From the farmer's discussion and visual observation white coat color with black spot in the terminal body parts specifically in mouth, ear and leg were the typical feature of Gerej sheep sub-population type whereas, white and light red colors in their tips were for Barka and Hassan sheep sub-population types respectively.

In general, white coats with or without patches or spots were the distinctive coat colors in Begait sheep breed. The probable reason for the dominancy of white coat color in the sheep population is that white color can reflect direct sun-light which gives a mechanism to cool the body temperature of livestock in most arid semi-arid environments. Hence, from the farmers color preference, black coat had the least preference among the wide ranges of coat colors and this was confirmed by small proportions of animals exhibiting black coat color in the sampled population and itthat shows farmers prefer adaptive animal like nature.

The majority of Begait sheep breed were characterized by medium to long sized pendulous ear orientation followed by semi pendulous ear. This is one of the morphological adaptive characters of domestic animals in arid and semi arid environment. Through this long pendulous ear animals can sweet to cool the body. Most of the Begait sheep populations were characterized by convex facial profile while the remaining portion 11.90% female and 6.67% male were concave facial profile and this might be because of breed admixture with other than Begait sheep from the neighboring sites.

The result of this study on mature body weight was larger than the recent study Fsahatsion et al. (2018) reported the body weight of mature ram and ewe sheep were 29.38 and 25.13 kg respectively in Gamo-Gofa zone southern Ethiopia. Similarly, the average measurement of chest girth, body length and wither height of sheep in the current study were 78.30 ±0.38cm, 85.68 ±0.41cm, 69.82 ±0.40cm respectively. This result was much higher than the Fsahatsion et al. (2018) reported average linear measurement of chest girth, body length and wither height for mature sheep of both sex with 76.72 cm, 66.24 cm, and 58.90 cm respectively. The current study result on body weight obtained for male Begait sheep was higher than that of Washera ram (28.3 kg) and Bonga ram (27.7 ± 0.17 kg) as reported by Mengistie (2008) and Tesfaye (2008),

respectively. Another earlier study Solomon et al. (2008) indicated that Horro sheep breed was the heaviest breed in the country with an average weight of 35.4 ±0.8 kg at mature age and it is found in the central western part of Ethiopia. This shows that the breed is featured with heavy live body weight and large body size compared to other sheep breeds in the country.

Hence, the live body weight for Begait sheep at 1 PPI (41.49 ±0.85 kg) was an indicator for improvement with a little bit management improvement and could achieve more than the recommended body weight at yearling age of 25 – 30 kg (Terefe et al., 2013) for export market demand. This result of weight at 1PPI was larger than the study Ayele et al. (2015) from on station research described that pure Dorper and Dorper x Menz 50% weight at yearling 34.43 and 31.33 kg respectively. The higher body weight and body measurement values in males than females observed in this study might be due to the hormonal differences in growth. This was supported by Mengistie et al. (2011) that the superiority in the weight of males over females could be a result of the hormonal differences in their endocrinal and physiological functions. Contrastingly majority of the body measurements were significantly different in the two districts which was higher in Kaftahumera than Tahtayadyabo. The main reason for the variation of body measurements in the two districts might be the difference in management system and genetic purity in the Begait sheep breed for the two districts. In support of this the study Kunenne et al. (2007) explained that the variation in linear body measurement (LBM) was influenced by the location where an animal was raised and by its age. The better husbandry practices of farmers to Begait sheep were observed in Kaftahumera district compared to Tahtayadyabo district specifically in supplementation of concentrate feed stuffs in drought season and as goes from Tahtayadyabo district to western zone through Kaftahumera districts, the breed dilution due to breed admixture decreases and the breed potential increases.

Significant difference was observed between interaction of districts and sex with some linear body measurements (head length, head width, body length, rump length, rump width, pine bone width, rump height and body weight. This is because most of the above-mentioned linear measurements are skeletal measurements and may not affected by environment. In this regard, Kununne et al. (2007) described that linear measurements can be classified as skeletal and tissue measurements and the former measurement is less liable for environmental effect than the latter. Rather the natural character or genetic makeup of the sheep populations in the two districts could affect most

of their linear body measurements. In group discussion with key informants in the two districts described that there was a variation in the proportion of the three different Begait sheep strains or sub-populations (namely Barka, Gerej and Hassan) distribution between districts and this may be one of the causes for variation of linear body measurements between districts. Weight of an animal is influenced by the differences in the linear body measurements. The presence of dimorphism in sheep is another cause for variation in the two sexes for different linear measurements. In support of this the study Jakub and Daniel (2009) indicated that the slope of the allometric relationship between male and female body size is higher than one (i.e. larger species tend to exhibit higher ratios of male to female body size than do smaller species). This striking relationship is consistent with the hypothesis that the evolution of female body size is more constrained than that of male size (Fairbairn, 1997).

The study reveals, market age with ≥30 Kg body weight of Begait sheep was 7.33 ±3.12 months and 9.24 ±3.56 months for male and female sheep respectively and no significant difference ($P>0.05$) among districts in both sexes. This shows that the Begait sheep breed has higher body weight gain compared with the known Ethiopian sheep breeds and earlier age than the average market age of Ethiopian sheep breeds which is 9.69 ±2.01 and 11.31 ±1.92 months for male and female sheep, respectively (Solomon et al., 2007). This breed of Sheep is renowned for its adaptation to hot and humid environments, high fertility and prolificacy with overall averages of age at first mating were 6.90 ±2.24 and 7.31 ±2.42 months for males and females respectively which were in close agreement with age at puberty reported for local sheep in Gumz female sheep (7.21 ± 1.75 months) and Alaba sheep (6.7 and 6.9 months for male and female respectively) by Zelalem (2016) and age at first mating in highland sheep in north Ethiopia which is 6.7±1.7 months and 7.4±1.8 months for male and female respectively (Weldeyesus et al., 2016). The figure also comparable with Zohara et al. (2014) finding in Bangladesh, which is 6.22± 1.31 months.

The mean age at first lambing for Begait sheep breeds in both districts was shorter than the average age at first lambing in northern Ethiopian sheep breeds, which is 16.4±0.3 (range, 13.9– 19.5 months) (Zelealem and Anal 2014). This could be attributed to the differences in genotype and management factors especially feeding systems.

In support of Taye et al. (2011) Twinning rate, a combination of ovulation rate, fertility and embryo survival, is an important trait in small flock production to which sale of lambs is an objective, in Begait sheep it was observed 39.66, 0.98 and 0.07% twin birth, triple birth and Quadruple birth rates respectively with a significant difference ($P<0.001$) between districts in twin and triple births but not in Quadruple birth rates. On account of its contributions to household income and food security in western and northwestern Tigrai, there is the need for a detailed phenotypic and genetic characterization as well as the design of breeding strategies for its conservation through sustainable utilization as economic important and the predominant sheep breeds raised by resource-limited households in the area

Conclusions and recommendation

Large muscular body frame, long thin tail and markedly convex facial profile were distinctive features of Begait sheep population and these profiles were expressed mainly in males. The breed was dominantly white patchy and spotted in coat color with high preference by the producers and have shown superior performance in body weight and other linear body measurements as compared to the other sheep breeds in the country. Details were provided on trait-level information relating to qualitative, morphological, and reproductive and growth characters of the breed and these findings will be useful to help further explore Critical steps in the design of a communal genetic improvement scheme for Begait sheep on community-based genetic resources management to improve the sheep production for the benefit of sheep farmers in the region. Therefore, attention should be given for their conservation, breeding management and for proper utilization. Besides, further exploration should be undertaken to exploit and improve the potential of this genetic material through selection and better breeding and husbandry practices.

Ethical approval: All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

Data Availability statement

As per the willingness of the main author

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