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On Farm Phenotypic Characterization of Indigenous Cattle in Bako Tibe and Gobu Sayo Districts of Oromia Region, Ethiopia

Dereje Bekele[1] Kefelegn Kebede[2]
1.Bako Agricultural Research center, Bako, Ethiopia
2.Haramaya University, School of Animal and Range Sciences, Haramaya, Ethiopia

Abstract
The study was conducted in Bako Tibe and Gobu Sayo districts of Oromia Regional State, Ethiopia, from October 2014 to January 2015 with the objective to undertake on-farm phenotypic characterization of indigenous cattle breed (Horro) in the study area. Field studies and collection of data were carried out through semi-structured questionnaire, focus group discussions, key informants, observations and linear body measurements of sample cattle and secondary data collection from different sources. A total of 120 households (60 from each district) were randomly selected for semi structured questionnaire interview and 240 cattle were sampled for morphological description and linear body measurements. SAS and SPSS software were used to analyze the data. The study result revealed that overall cattle herd size was 9.67±3.34 heads per household and was not significantly different ($p<0.05$) between districts. The dominant coat color in both female (45%) and male (75%) was red followed by brown (20%, and 12%) in female and male respectively and followed by black (9.5%) in female and male (5%). The overall Mean heart girth, flank girth, height at withers and horn length were 133.08±6.23,157.2±07.0,107.9±6.93 and 23.05±6.65cm respectively, and significantly different for both sex and district ($p < 0.05$). Body length, rump width and length, canon bone length and circumference of Horro cattle were 100.49±8.14, 8.94±1.04, 19.46±1.92, 24.07±1.32, 12.63±1.27cm, respectively. Moderate and significant ($p<0.001$) positive correlation was found among the linear body measurements. Morphological characteristics of the breed need to be complemented by genetic characterization for fully exploiting the potential of the breed.

1. Introduction
Animal genetic resources (AnGR) for food and agriculture are an essential component and the biological basis for world food security. Hundreds of millions of poor rural people keep livestock and often rely on their animals to provide multiple products and services. In harsh environments where crop production is not reliable, livestock keeping is often the main or only livelihood option available. Livestock currently contribute to about 30 percent of agricultural gross domestic product in developing countries, with a projected increase of about 40 percent by 2030. The World Bank has estimated that it will be necessary to increase meat production by about 80 percent between 2000 and 2030. This will require more efficient animal production systems, careful husbandry of natural resources and measures to reduce waste and environmental pollution (FAO, 2011).

The total number of cattle in all regions of the rural sedentary areas of the country was estimated to be 55.03 million (CSA, 2013/14). Majority of these cattle (98.71 percent) are indigenous breeds which are kept under extensive management. Cross breeds and exotic breeds accounted for about 1.15 percent and 0.14 percent, respectively (CSA, 2013/14). If we include the value of traction services, livestock provided 45% of agricultural GDP in 2008-09 (Behnke, 2010).

The classical description of breeds is based upon phenotype, because an organism's phenotype is principally a manifestation of its genotype that it lends itself to direct measurement on the organism (Workneh *et al*., 2004).

Indigenous livestock breeds in Ethiopia are a valuable source of genetic material because of their adaptation to harsh climatic conditions, their ability to better utilize the limited and poor quality feed resources and their tolerance to a range of diseases found in these regions. Despite the significant contribution of livestock to the country, little attention is given to identify, characterize and conserve the diversity of the various classes of livestock (DAGRIS, 2009). Understanding the diversity, distribution, basic characteristics, comparative performance and the current status of a country's animal genetics resources is essential for their efficient and sustainable use, development and conservation (FAO, 2007). However, only a small number of recognized cattle breed types have a fair description of their physical appearance, indications of their level of production, reproduction and genetic attributes (Workneh *et al.*, 2004).

The objective of the study was to characterize phenotypically indigenous cattle breed (Horro) in the study areas.

2. Materials and Methods
2.1 Description of the Study Areas
2.1.1 Bako Tibe
Bako Tibe district is located in West Shoa Zone of Oromia Regional state at about 250 km west of Addis Ababa

at an average altitude of 1650 m.a.s.l. The area has a hot and sub-humid climate and receives a mean annual rainfall of about 1220 mm, of which more than 80% falls in the months of May to September. Mean monthly minimum and maximum temperatures are about 14°C and 28°C, respectively, with an average of 21°C. The daily mean minimum and maximum temperatures are 9.4°C and 31.3°C, respectively. The total area of Bako Tibe district is about 64,469 hectares of land with animal population of 137,343 cattle, 12,502 sheep, 24,212 goats, 3685 horses, 8415 donkeys, 1023 mule and 96742 Poultry.

2.1.2 Gobu Sayo

Gobu Sayo district is located in the eastern Wollega zone of Oromia Region; western part of Ethiopia, about 263 km from Addis Ababa. It is the mid land area with hot and humid climate. The mean annual temperature of the district ranges between 15ºC to 20ºC whereas the mean annual rain fall may reach to 2000 mm (District Agricultural and Rural Development Office). The district has an altitude range from 1500 to 1750 m.a.s.l. with average altitude of 1625 m.a.s.l. Total area of the Gobu Seyo district is about 33,153 hectares of land with animal population of 226,791 cattle, 9, 5334 sheep, 9283 goats, 72 horses, 3300 donkeys, 601 mule and 24954 poultry.

2.2 Sampling, Data Collection and Analysis

2.2.1 Sampling Technique

A multistage sampling technique was employed to select sample cattle population for linear body measurement and physical descriptions of cattle in the study area. The first stage involved selecting two districts using purposive sampling technique based on availability of cattle population (comparatively), accessibility and randomly selecting three rural *kebeles* from each district. The district Livestock development and health agencies were contacted for brief discussion on traditionally recognized indigenous cattle types and their distribution in the zones and selection of sample rural *Kebeles*, was done together with district experts and development workers to select households or herds and three rural *Kebeles* from each district randomly. In the second stage, sample cattle owners were selected randomly using systematic sampling procedure so as to interview them with semi-structured questionnaire on the above important issues. A total of 120 households were interviewed for the study (60 from each district).

2.2.2 Data Collection

2.2.2.1 Qualitative traits

Visual observation was made and morphological features were recorded based on cattle morphological characteristics descriptor list of FAO (1986), Workneh *et al*. (2004) and FAO (2012), where three experienced individuals set the size of qualitative traits to large, medium or small. Qualitative traits of cattle such as hair type, coat pattern, coat color, horn shape and orientation, ear shape and orientation, rump shape, hump size and position, udder size, and teat size, testicular size, prenuptial sheath size, naval flap size, facial profile, tail length and dewlap size were recorded.

2.2.2.2 Quantitative traits

Morphological measurements in cm were taken using graduated measuring tape with a precision of 0.5 cm. Body measurements were made on adult cattle of both sexes. Adult cattle of both sexes were selected based on dentition technique and age given by farmers. Cattle with wear off two and above pair of teeth or cattle of two years and above old were selected for body measurements. The physical measurements including: heart girth, height at rump, pelvic width, body length, height at wither, flank girth, rump width and length, mouth circumference, neck length, tail length, canon bone length and circumference, ear length, horn length and space, face length, dewlap width, naval flap and prenuptial sheath width, teat length and udder circumference were measured.

The weight of the cattle was estimated from linear regression equation (body weight on heart girth) developed for Horro cattle (OARI, 2002).

Male $Y_m = 85.2 - 2.519x + 0.02448x^2$

Female $Y_f = 2.2 - 0.895x + 0.01743x^2$

Where: Y_m = estimated body weight of mature Horro male cattle

Y_f = estimated body weight of mature Horro female cattle

X = heart girth measurements in centimeter

2.3 Statistical Analysis

2.3.1 GLM Procedure

The SPSS statistical software (SPSS for windows, release 20.0, 2011) was used to analyze the survey data. General linear model (GLM) procedure of SAS (SAS, 2008) was employed for analysis of quantitative variables to detect statistical differences between sample cattle population in the study areas. This was done for both sexes separately to avoid confounding effect due to sex. Taking site and dentition class as main fixed effects, the following model was used.

$Y_{ijk} = \mu + S_i + B_j + e_{ijk}$

Where: Y_{ijk} = observed value of trait of interest

μ = overall mean

S_i = fixed effect of i^{th} site

B_j = fixed effect of j^{th} dentition class (Age)

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

2.3.2 Multivariate Analysis

The quantitative variables from female and male animals were separately subjected to discriminant analysis (PROC DISCRIM) and canonical discriminant analysis (PROC CANDISC) procedures using (SAS, 2008) to ascertain the existence of population level phenotypic differences among the sample cattle populations in the study area. The analysis was undertaken taking individual animals as unit of classification.

Discriminant analysis was done to build a predictive model of group membership based on observed discriminant scores of each case and to derive classification functions.

Qualitative variables taken from females and males were merged and analyzed by non parametric discriminant analysis. The predictive model derived from linear combinations of a set of variables had the following general form.

$Y = A_i + \beta_i x 1 + \beta_i x2 + \ldots + \beta_i xp$

Where: Y = classification score (i.e. linear combination of a set of variables)

A_i = constant for i^{th} group

β_i = weights of corresponding variable for i^{th} group

x = discriminator variable score

p = the number of discriminator variables

Canonical discriminant analysis is a dimension-reduction technique related to principal component analysis. Like discriminant analysis (PROC DISCRIM), there is linear combination of the quantitative variables that provide maximal separation between the classes or groups. Pair wise distance between sample populations and spatial distribution of cattle population on plot of the first two canonical variantes (CAN1 and CAN2) was obtained by running canonical discriminant analysis.

3. Results and Discussion

3.1 Quantitative Traits in Female and Male Horro Cattle

The quantitative traits measured for both sample female and male Horro cattle population in the study are presented in Table 14. In the female Horro cattle sample population, the average measured value for body length, heart girth, flank girth and height at withers were 99.42, 131.53, 156.99 and 107.18 cm, respectively. They have the mean values of 22.67cm for dewlap width, 30.98 cm neck length, 19.54 cm ear length, 23.63cm horn length, 32.39cm pelvic width, 35.24 cm mouth circumference; 38.47cm face length, 101.67cm for tail length and 8.93cm for naval flap width. Fasil and Workneh (2014) reported comparable results for female indigenous cattle of Awi, in East and west Gojam zone of Amahara region, in case of dewlap width of 22.47cm and ear length of 19.68cm but higher value for body length (113.82cm), height at withers (114.52cm) and mouth circumference of 39.63cm. However, they reported lower value for flank (chest) girth (155.35cm) and tail length of (84.04cm).

The male cattle of Horro have average body length of 105.85cm, hearth girth 140.82cm, flank girth of 158.45cm, height at withers 111.55cm, height at rump 115.07cm, neck length of 30.33cm and horn length of 20.18cm. Likewise Horro male cattle have average measured value 19.65cm for ear length, 14.63cm for horn space, 36.43cm for mouth circumference and 24.85cm for cannon bone length.

Heart girth, flank girth and height at withers were significantly different for both sex and districts, but height at rump was significantly different ($p<0.01$) with sex but non-significant with districts, while horn space and ear length were non-significant with both sex and districts. On the other hand mouth circumference, pelvic width, cannon bone length and cannon bone circumference were non-significant for districts but significant for sex effect. Neck length and rump length were non-significant for sex of the cattle but significant for districts effect, but rump width was non-significant for both district and sex effect (Table 1). This difference in quantitative traits; example, there were higher mean value in case of heart girth, flank girth and cannon bone circumferences for Gobu Sayo district than Bako Tibe district, this might attributed to the management difference and availability of feeds which was better in case of Gobu Sayo district.

The research findings of Rege (1999); Zewdu (2004); Takele (2005) and Fasil and Workneh (2014) revealed that the mean value of on-farm morphological traits measurement on local male and female cattle result that males are usually greater than their counter female groups. This can be also due to the hormonal effect which allow male to grow more than female.

As per Table 1, heart girth, flank girth, body length, height at wither, height at rump, horn length, neck length, pelvic width, udder circumference and dewlap width are significantly different ($p < 0.01$) for dentition class and mouth circumference, rump length, rump width cannon bone circumference, cannon bone length, face length, ear length, tail length and Perpetual sheath width are significantly different ($p < 0.05$) for dentition class. This indicates that as the age of cattle increase the size of those quantitative traits also increases.

Phenotypic correlations between quantitative traits in female and male Horro cattle (Table 2) showed low to high positive values. In case of female sample population, the strongest degree of relationship was seen between heart girth and flank girth ($r = 0.727$, $p < 0.0001$) followed by heart girth and height at rump ($r = 0.698$, $p < 0.0001$). There was also strong association between height at rump and height at wither ($r = 0.662$, $p < 0.0001$). The correlations of heart girth with mouth circumference, pelvic width and height at withers were moderate. However, the correlation between height at wither and horn length was weak and non-significant ($r = 0.114$, $p < 0.1087$) and the correlation between heart girth and rump width was low compared to other traits ($r = 0.224$, $p < 0.0014$).

Higher positive correlation between traits has an advantage in the improvement of cattle. Since as one implement selection for the improvement of one trait which is highly positively correlated with other traits there is the possibility to improve both traits at the same time which lead to correlated response.

In case of male Horro cattle the strongest degree of relationship (coefficient of correlation) was observed between height at withers and height at rump ($r= 0.857$, $p < 0.0001$) followed by heart girth and height at rump ($r= 0.713$, $p<0.0001$).There is also strong relationship between flank girth and heart girth ($r= 0.704$, $p<0.0001$).

The correlation among height at rump, heart girth, flank girth, height at wither, body length, pelvic width and cannon bone length showed high to moderate significant value ($p<0.0001$). Whereas, cannon bone circumference was weakly correlated with other linear body measurements.

The current finding of on-farm mean linear body measurement of sampled Horro cattle population are lower than on-station (Bako Agricultural Research Center) linear body measurements reported in DAGRIS (2007) for the same breed. According to DAGRIS (2007) the average body length and height at wither for adult female and male were 103.1 cm, 148.4 cm and 116.6 and 159.5cm, respectively. However, the current result was comparable with that of Jiregna (2007) for height at wither in male and body length in case of female, but heart girth was higher for both sexes in the current study, whereas body length and heart girth in male for the present study were a bit higher than of Jiregna (2007) who reported average height at wither, heart girth and body length for male and female to be 109.0cm,131.5cm and 97.6 cm and 105.8cm, 130.5cm and 97.6 cm, respectively.

Table 1. Summary of linear body measurements in female and male Horro cattle population (cm)

Effects	Heart Girth Mean±SD	Flank Girth Mean±SD	Body length Mean±SD	Height at wither Mean±SD	Height at rump Mean±SD	Horn length Mean±SD	Horn space Mean±SD
Sex	**	**	**	**	**	**	Ns
Female	131.53±5.93^{a}	156.99±10.36^{a}	99.42±8.13^{a}	107.18±7.89^{a}	107.25±6.0^{a}	23.63±6.74^{a}	15.06±1.99^{a}
Male	140.82±8.88^{b}	158.45±4.87^{b}	105.85±7.39^{b}	111.55±4.01^{b}	115.07±3.7^{b}	20.18±6.92^{b}	14.63±2.85^{a}
District	**	**	Ns	*	Ns	**	Ns
Bako Tibe	132.01±7.03^{a}	154.24± 7.42^{a}	100.48 ±9.69^{a}	107.71±4.65^{a}	108.39±4.4^{a}	21.40±6.44^{a}	14.99±2.29^{a}
Gobu Sayo	134.53±6.19^{b}	161.25±13.86^{b}	100.50± 4.89^{a}	108.18±10.27^{b}	108.76±7.7^{a}	25.33±7.27^{b}	14.97±2.0^{a}
DC	**	**	**	**	**	**	Ns
1	127.29±10.06^{a}	148.13±10.47^{a}	96.56±8.19^{a}	104.79±6.26^{a}	105.71±6.9^{a}	15.81±5.75^{a}	15.29±2.29^{a}
2	134.83±8.21^{b}	160.02±7.02^{b}	102.22±5.85^{b}	109.50±5.07^{b}	109.78±8.2^{b}	24.87±7.13^{b}	15.00±2.21^{a}
3	135.63±7.96^{b}	162.28±18.15^{b}	101.71±13.25^{b}	108.43±13.67^{b}	109.47±6.0^{b}	27.98±8.40^{c}	14.59±2.13^{a}
Overall	133.08±6.23	157.20±7.0	100.49±8.14	107.91±6.93	108.55±6.25	23.05±6.65	14.98±2.10
CV	4.68	4.46	8.09	5.48	5.76	28.86	14.02
R^2	0.695	0.796	0.449	0.485	0.527	0.441	0.179

^{a,b,c} Means on the same column with different superscripts within specified class variable, are significantly different, SD = Standard deviation, DC = Dentition class, CV= Coefficient of Variation, R^2= Coefficient of determination, Ns= non significant,** = significant $p<0.01$, * = significant $p<0.05$

Table 1 (continued)

Effects	Neck length Mean±SD	Mouth circumference Mean±SD	Pelvic width Mean±SD	Rump length Mean±SD	Rump width Mean±SD	Canon bone circumference Mean±SD	Canon bone length Mean±SD	Udder circumference Mean±SD
Sex	Ns	*	*	Ns	Ns	*	*	-
Female	30.98±2.47^{a}	35.24±1.22^{a}	32.39±2.0^{a}	19.40±1.78^{a}	8.92±0.89^{a}	12.71±1.28^{a}	23.92±1.23^{a}	24.80±3.33
Male	30.33±2.53^{a}	36.43±11.6^{b}	31.70±2.9^{b}	19.78±1.78^{a}	9.05±1.71^{a}	12.25±1.09^{b}	24.85±2.07^{b}	-
District	*	Ns	**	Ns	Ns	Ns	Ns	Ns
Bako Tibe	31.06± 1.74^{a}	35.22±1.60^{a}	31.22±2.40	19.57±1.8^{a}	9.14± 1.09^{a}	12.68±1.4^{a}	23.97 ±1.29^{a}	24.69±2.21^{a}
Gobu Sayo	30.61±3.31^{b}	35.74±1.32^{a}	33.29±2.31	19.31±2.0^{a}	8.67±1.04^{b}	12.57±1.1^{a}	24.32±1.46^{a}	24.89±2.14^{a}
DC	**	*	**	*	*	*	*	**
1	29.13±2.85^{a}	34.02±1.84^{a}	29.28±2.7^{a}	18.63±1.87^{a}	8.68±1.45^{a}	12.06±1.26^{a}	23.49±1.83^{a}	23.00±3.70^{a}
2	31.28±3.4^{a}	35.85±1.81^{b}	32.91±2.5^{b}	19.78±2.31^{b}	8.92±1.20^{ab}	12.66±1.67^{b}	24.27±1.43^{b}	24.84±3.32^{b}
3	32.10±2.5^{b}	36.29±1.21^{b}	33.79±1.9^{b}	19.79±1.75^{b}	9.29±0.89^{b}	13.26±0.74^{b}	24.40±1.09^{b}	26.11±3.54^{c}
Overall	30.87±2.54	35.44±1.46	32.09±2.38	19.46±1.92	8.94±1.04	12.63±1.27	24.07±1.32	-
CV	8.23	4.08	7.40	9.87	11.68	10.08	5.48	13.45
R^2	0.441	0.481	0.454	0.247	0.324	0.283	0.245	0.232

^{a,b,c} Means on the same column with different superscripts within specified class variable, are significantly different, SD = Standard deviation, DC = Dentition class, CV= Coefficient of Variation, R^2= Coefficient of determination, Ns= non significant,** = significant $p<0.01$, * = significant $p<0.05$

Table 2. Pearson's correlation coefficient (r) for quantitative triats in male (above diagonal line) and female (below diagona line) for sample populations

Traits	HG	FG	BL	HW	HR	HL	EL	NL	MC	PW	RL	RW	CBL	CBC
HG		0.704**	0.514**	0.677**	0.713**	0.402*	0.105ns	0.360*	0.632**	0.510**	0.313*	0.253ns	0.299ns	0.435*
FG	0.727**		0.456**	0.586**	0.556**	0.153ns	0.054ns	0.296ns	0.454*	0.464*	0.244ns	0.096ns	0.197ns	0.368ns
BL	0.370**	0.334**		0.662**	0.470*	0.297ns	0.317ns	0.500*	0.603**	0.547**	0.491*	0.469*	0.472*	0.479*
HW	0.465**	0.406**	0.499**		0.857**	0.315*	0.378*	0.491*	0.689**	0.618**	0.597**	0.220ns	0.452*	0.382ns
HR	0.698**	0.457**	0.311**	0.662**		0.421ns	0.144ns	0.300ns	0.667**	0.475*	0.360*	0.039ns	0.304ns	0.326*
HL	0.399**	0.384**	0.317**	0.114ns	0.285**		0.037ns	0.239ns	0.554**	0.196ns	0.045ns	-0.088ns	0.254ns	0.028ns
EL	0.326**	0.264**	0.172*	0.267**	0.195*	0.183*		0.273ns	0.151ns	0.136ns	0.505**	0.353*	0.320*	0.143ns
NL	0.396**	0.317**	0.265**	0.298**	0.481**	0.305**	0.395**		0.245ns	0.292ns	0.401*	0.365*	0.422*	0.008ns
MC	0.630**	0.561**	0.382**	0.328**	0.514**	0.513**	0.329**	0.354**		0.668**	0.241ns	0.205ns	0.475*	0.441*
PW	0.583**	0.566**	0.424**	0.459**	0.445**	0.409**	0.401**	0.395**	0.606**		0.482*	0.513**	0.495*	0.551**
RL	0.419**	0.199**	0.247**	0.348**	0.490**	0.211*	0.294**	0.410**	0.364**	0.382**		0.422*	0.395*	0.316*
RW	0.224*	0.157ns	0.171*	0.237**	0.265**	0.182*	0.187*	0.344**	0.216*	0.272**	0.342**		0.528**	0.501*
CBC	0.246**	0.214*	0.221*	0.263**	0.173**	0.212*	0.244**	0.331**	0.364**	0.343**	0.203**	0.248**		0.472*
CBL	0.452**	0.326**	0.363**	0.287**	0.288**	0.303**	0.269**	0.303**	0.471**	0.599**	0.327**	0.197*	0.397**	

** and * correlation indicate significance level at $p < 0.01$ and $p < 0.05$ respectively, ns= non significant, HG= Heart girth, FG= Flank girth, BL= Body length, HW= Height at wither, HR= Height at rump, HL= Horn length, EL= Ear length, NL= Neck length, MC= Mouth circumference, PW= pelvic width, RL=Rump length, RW= Rump width, CBC= Cannon bone circumference, CBL= Cannon bone length

3.2 Qualitative Characters of Adult Female and Male Horro Cattle Population

The qualitative characters of female and male Horro cattle are presented in Table 3. In the sample population of Horro Cattle the dominant coat color type in both female (45%) and male (75%) is red followed by brown (20% and 12.5%) in female and male, respectively and then bright red coat color 8.5% in female and 5% in male. The sample populations of Horro cattle have also coat color types like black, white, spotty, roan and other coat color type in different percentages. Coat color is used as one of the means of cattle identification in the study area. In a similar manner, coat color is used as an identification of cattle in most pastoral communities (FAO, 2009). Majority of the sample female populations have small udder (58%) and teat (46%) size. Only about 14% of the female sample populations have large udder and teat size. The naval flap of the female was small (60) and medium (36%). The preputial sheath in male sample population of Horro cattle ranged mainly from small (35.5%) to medium (50%) while their testicular size ranged from medium (55%) to large (42.5%). Majority of the sample Horro cattle population have uniform coat pattern (93%) in female and (95%) in male, and mainly their rump (90%) in female and (82.5%) in male was sloping and only (4.5%) in female and (2.5%) in male was roofy. The dewlap of Horro cattle in sampled population ranged mostly from small (32.5%) to medium (64.5%) in female cattle and small (42.5%) to medium (55%) in male cattle. The hair type of sampled Horro cattle population is mainly sheen (92.5%) in both female and male population and only about (6%) of the sampled population in female Horro cattle have rough hair type. However, no rough hair types were recorded in male sample of Horro cattle population studied.

The sample population of Horro cattle in the study area have flat and straight facial profile (96%) in female and (97.5%) in male and mainly they have medium (18%) in female (17.5%) in male to long (80%) in female and (75%) in male tail length. Their hump is erect and cervico-thoracic in position. The hump size ranged from small (40%, 10.0%) in female and male respectively, and to medium (55%) in female and (80%) in male. Their horn is mainly curved in shape (95.5%) in female and (92.5%) in male and no polled animal were found in both male and female sample population. The horn orientation is mainly upright (59%) in females and (55%) in males (Table 3).

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Table 1. Qualitative traits description for indigenous Horro cattle in BakoTibe and Gobu Sayo districts

Variables	Female		Male		Overall	
	N	%	N	%	N	%
Horn Shape						
Straight	8	4.0	2	5.0	10	4.2
Curved	191	95.5	37	92.5	228	95.0
Spiral	1	0.5	-	-	1	0.40
Lyre-shape	-	-	1	2.5	1	0.40
Horn Orientation						
Forward	41	20.5	4	10.0	45	18.7
Lateral	37	18.5	14	35.0	51	21.3
Upright	118	59.0	22	55.0	140	58.3
Dropping	4	2.0	-	-	4	1.7
Ear shape						
Round	3	1.5	1	2.5	4	1.7
Straight	197	98.5	39	97.5	236	98.3
Ear Orientation						
Lateral	199	99.5	39	97.5	238	99.2
Dropping	1	0.5	1	2.5	2	0.80
Hump Size						
Small	80	40.0	4	10.0	84	35.0
Medium	110	55.0	32	80.0	142	59.2
Large	10	5.0	4	10.0	14	5.8
Hump position						
Cervicothoracic	200	100.0	40	100.0	200	100.0
Hump Shape						
Erect	193	96.5	38	95.0	231	96.25
Dropping	7	3.5	2	5.0	9	3.75
Facial profile						
Flat &straight	192	96.0	39	97.5	231	96.25
Concave	8	4.0	1	2.5	9	3.75
Tail length						
Short	4	2.0	3	7.50	7	2.9
Medium	36	18.0	7	17.5	43	17.9
Long	160	80	30	75.0	190	79.2
Hair type						
Sheen(Shiny& smooth)	185	92.5	37	92.5	222	92.5
Curl	2	1.0	1	2.5	3	1.25
Straight	1	0.5	-	-	1	0.42
Rough	12	6.0	-	-	12	5.0

3.3 Estimated Mature Body Weight of the Sample Population by Sex

The mean estimated mature body weights as calculated from heart girth measurements were 215.92 kg for male and 185.36 kg for female (Table 4).Variations were observed among individuals in the sample population in both sexes ranging from 128.82 to 303.56 kg for males and 114.65 to 286.76 kg for females. The recent result had higher average estimated weight than the report of Jiregna (2007) which was 186.7 kg for male, but had comparable estimated average value for female (183.3 kg). The same author reported different minimum and maximum results for the same breed at Danno district (149.30-224.10 and 156.40-210.20 kg) for male and female, respectively. This result is less than the result mentioned in DAGRIS (2007) with an average weight for females of 225 kg and for males 318 kg. The weight was estimated from linear regression equation (body weight on heart girth) developed for Horro cattle (OARI, 2002).

Table 4. Estimated mature body weight (kg) of sample Horro cattle by sex

Sex	N	Mean	Minimum	Maximum
Male	40	215.92	128.82	303.56
Female	200	185.36	114.65	286.76

N = Number of cattle

3.4 Multivariate Analysis

Multivariate analyses of variance are used for determining which among the many traits measured, are of interests for distinguishing between populations and for assessing the aggregate morphological characteristics needed for grouping (FAO, 2012).

3.5 Discriminant Analysis

The validity of discriminant analysis procedure was assessed by means of reclassification statistics for female and male sampled populations (Tables 5 and 6). Putting equal priority probability levels for all sample populations, the known sample cases were subjected to reclassification separately for female and male sample populations. The overall classification rates (hit rate) of female and male sample populations were 60.98 and 82.72 percent, respectively (Tables 5 and 6).

The overall hit rate was not very high as the hit rates observed for some sites, except Tulu Sangota, were small. This is due to phenotypic similarities observed at this site. For female sample population, the highest hit rate was 78.79% for site 1 (Tulu Sangota) followed by site 5 (Ago lafte) which had 64.71% hit rate while the smallest was for Sombo kejo which was 45.45% (Table 5). In case of male sampled population there was comparable hit rate in all sites and the highest hit rate was observed at site 3 (Gejo Kui) and at site 6 (Sombo Kejo) which was 85.7% followed by site 1(Tulu Sangota), 4 (Ongobo Bakanisa) and site 5 (Ago lafte) which was 83.3%. However, a bit lower hit rate was at site 2 (Dambi Dima) which was 75% (Table 5). Unlike female sample populations, male sample population from site 6 (Sombo Kejo) had larger hit rate as a result of similarly large body size of this population due to better management practices by the farmers.

3.6 Canonical Discriminant Analysis

Canonical discriminate analysis was performed separately for male and female sample populations to obtain distances between sites and sample populations and observe the spatial distribution of sample populations on canonical variates. All squared Mahalanobis' distances obtained between sites for female populations were significant, indicating the existence of measurable differences between female populations of each sites (Table 7). The largest distance was observed between site 5 (Ago lafte) and site 1 (Tulu Sangota) which was 10.43, the smallest distance was observed between sites 1 (Tulu Sangota) and 2 (Dambi Dima) which was 2.56 (Table 7).

As indicated in (Table 8), the squared Mahalanobis' distance between the sites for male sample populations was higher than that of female sample populations. The shortest distance (17.2) was observed between sites 3 (Gajo Kui) and 5 (Sombo Kejo) and the longest distance was between sites 1 (Tulu Sangota) and 3 (Ongobo Bakanisa) with value of 90.4 standard units (Table 8). The distance observed between sample populations is due to distinct phenotypic differences observed between them in quantitative traits. Multivariate tests generated from canonical discriminant analysis confirmed the existence of highly significant differences between male sample populations sampled from different sites.

Table 5. Number of observations and percent (in bracket) correctly classified for female sample populatin using discriminant analysis

From site	Tulu Sangota	Dambi Dima	Gajo Kui	Ongobo Bakanisa	Ago Lafte	Sombo Kejo	Total
Tulu Sangota	26	4	1	1	0	1	33
	(78.79)	(12.12)	(3.03)	(3.03)	(0.00)	(3.03)	(100.0)
Dambi Dima	6	18	1	0	2	5	33
	(18.18)	(54.55)	(6.06)	(0.00)	(6.06)	(15.15)	(100.0)
Gajo Kui	2	3	20	0	3	5	33
	(6.06)	(9.09)	(60.61)	(0.00)	(9.09)	(15.15)	(100.0)
Ongobo	2	0	2	21	5	4	34
Bakanisa	(5.88)	(0.00)	(5.88)	(61.76)	(14.71)	(11.76)	(100.0)
Ago Lafte	0	0	5	3	22	4	34
	(0.00)	(0.00)	(14.71)	(8.82)	(64.71)	(11.76)	(100.0)
Sombo Kejo	3	5	5	2	3	15	33
	(9.09)	(15.15)	(15.15)	(6.06)	(9.09)	(45.45)	(100.0)
Total	39	30	35	27	35	34	200
	(19.50)	(15.00)	(17.50)	(13.00)	(17.50)	(17.00)	(100.0)

Key: Tulu Sangota, Dambi Dima and Gajo Kui are from Bako Tibe district while Ongobo Bakanisa, Ago lafte and Sombo Kejo are from Gobu Sayo district.

Table 6. Number of observations and percent (in bracket) correctly classified for male sample population using discriminant analysis

From site	Tulu Sangota	Dambi Dima	Gajo Kui	Ongobo Bakanisa	Ago Lafte	Sombo Kejo	Total
Tulu Sangota	5 (83.30)	1 (12.50)	0 (0.00)	0 (0.00)	0 (0.00)	1 (14.30)	7 100.00
Dambi Dima	0 (0.00)	6 (75.00)	0 (0.00)	1 16.70	0 (0.00)	0 (0.00)	7 100.00
Gajo Kui	0 (0.00)	0 (0.00)	6 (85.70)	0 (0.00)	1 (16.70)	0 (0.00)	7 100.00
Ongobo Bakanisa	1 (16.70)	0 (0.00)	0 (0.00)	5 (83.30)	0 (0.00)	0 (0.00)	6 100.00
Ago Lafte	0 (0.00)	1 (12.50)	0 (0.00)	0 (0.00)	5 (83.30)	0 (0.00)	6 100.00
Sombo Kejo	0 (0.00)	0 (0.00)	1 (14.30)	0 (0.00)	0 (0.00)	6 (85.70)	7 100.00
Total	6 15.00	8 20.00	7 17.50	6 15.00	6 15.00	7 17.50	40 100.00

Table 7. Squared Mahalanobis' distance between sites for female sample populations

From Site	Tulu Sangota	Dambi Dima	Gajo Kui	Ongobo Bakanisa	Ago Lafte	Sombo Kejo
Tulu Sangota	***					
Dambi Dima	2.56375	***				
Gajo Kui	6.33803	3.85845	***			
Ongobo Bakanisa	10.10004	8.81960	9.49726	***		
Ago Lafte	10.42881	7.40664	3.57195	5.59897	***	
Sombo Kejo	5.96005	3.90123	2.58855	5.32690	3.11006	***

Table 8. Squared Mahalanobis' distance between sites for male sample populations

From Site	Tulu Sangota	Dambi Dima	Gajo Kui	Ongobo Bakanisa	Ago Lafte	Sombo Kejo
Tulu Sangota	***					
Dambi Dima	20.08500	***				
Gajo Kui	38.77115	47.53672	***			
Ongobo Bakanisa	90.42525	85.20006	38.56328	***		
Ago Lafte	46.82492	69.56565	17.47181	31.67294	****	
Sombo Kejo	22.38670	28.46513	17.16468	49.67505	19.36472	***

Fig.1 Typical male right and female left Horro cattle

4. Summary and conclusion

The study was conducted in Bako Tibe and Gobu Sayo districts of western Oromia Regional State, Ethiopia, from October 2014 to January 2015, with the objective to undertake on-farm phenotypic characterization of indigenous cattle breed (Horro) in the study area. Field studies and collection of data were carried out through observations and linear body measurements of sampled cattle. The study indicated that on an average, heart girth was 140.53 cm and flank girth was 158.45cm for the sampled male population. They have a body length of 105.85 cm, height at withers of 111.55 cm, height at rump of 115.07cm and a horn length of 20.18 cm. Similarly for females mean measured values were 131.53cm for heart girth, 156.99 cm for flank girth, 99.42cm for body length, 107.18 cm for height at withers, 107.25 cm for height at rump and 23.63 cm for horn length. Coat color is

mainly red or reddish brown; their hump erect and cervico-thoracic in position, small to medium in size; dewlap is moderate and horns are moderate. Few dropping horned animals were also encountered, but no polled cattle observed from sample populations. Their ears were laterally oriented and they have long tails. They have straight back with sloppy rump. Hump size ranges from medium (15%), to large (75 %) in males. The females hump size ranged from small (28%) to medium (71%). Naval flap was small in (60%) of the observed female population and it ranged from medium (36%) to large (4%) in the rest of them. Majority of the female sampled population had small udder (58%) and teat (46%). The naval flaps of the female were small (60%) and medium (36%).
The estimated mature body weights as calculated from linear regression of body weight on heart girth measurement ($Y_f = 2.2 - 0.895x + 0.01743x^2$) for female and ($Y_m = 85.2 - 2.519x + 0.02448x^2$) for male were 215.92 kg for male and 185.36 kg for female. Selling and castration were an important mechanism for culling in the area.

Based on the result of this study, it is possible to suggest the following conclusions and recommendations.

- It can be concluded that Horro cattle possess its own unique breed characteristics features that enable it to distinguish it from other breeds.
- Morphological characteristics of the breed need to be complemented by genetic characterization for fully exploiting the potential of the breed.
- Horro cattle are multipurpose animals since they have been used for draught (Oxen), Milk production and meat. Therefore; any improvement attempt on this breed should consider this.
- To improve the breed, functional community based breeding strategies at farmers' level can be suggested.

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