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# Characterization of Indigenous Goats Type using Morphological Characters and Body Measurements in Sinana District, Bale Zone, South East Ethiopia

Gelana Jeda [α] & Belete Asefa [σ]

*Abstract-* The study was conducted on Characterization of Indigenous Goats Type Using Morphological Characters and Body Measurements in Sinana district, Bale zone, South East Ethiopia, with objectives of on-farm characterization of Indigenous Goats type using linear body measurement and qualitative physical characteristics and investigating the prediction of live weight using body measurement for Indigenous Goats type. For this study, purposive sampling and simple random sampling methods were used for selection of kebeles and experimental goats, respectively. About 120 animals were sampled for body measurements and qualitative characters. Statistical analysis system software was applied for analyzing of data. Goats type in the study area were characterized as red dominant coat color (35.83%), concave head profile (37.5%), no wattle (100%), have no toggles (86.67%), have no ruff (75%),horned (100%) of about (75%) were straight horn shape. The strong correlation between body weight and linear body measurement is observed between body weight and chest girth with correlation coefficient of (r=0.78). Overall mean of body weight, body length, chest girth, height at wither, rump height, rump length, head length, and ear length were 25 kg, 59.02 cm, 74.99 cm, 61.64 cm, 66.65 cm, 14.72 cm, 11.20 cm 12.72 cm and 25.08 cm, respectively. Body weight of goats were easily estimated from heart girth with equation of BW= -3.36+0.38HG as under field condition addition of more variable in the model is not economical.

*Keywords: body measurements; morphological characterization; indigenous goats type; sinana district.*

## I. Introduction

Ethiopia is endowed with abundant livestock resources of varied and diversified genetic pools with specific adaptations to a wide range of agro-ecologies. Farm animals as a whole are an integral part of the country's agricultural system and are raised both in the highland and lowland areas. Similarly, the habitats of the indigenous goat breeds extend from the arid lowlands (the pastoral and agro-pastoral production system) to the humid highlands (mixed farming systems) covering even the extreme tsetse-infested areas of the country (Workneh, 1992). Goats in Ethiopia are generally considered associated more with warm and dry areas of the lowlands. However, their broad feeding habits and multipurpose production functions appear to have well served the interests of highland farmers. Utilities of the goat and its products in Ethiopia vary with the traditional farming practices across the agro-ecological zones. But in all cases, goats are raised under low input management and they serve multiple output and input functions (Worknek, 1992; Alemayehu, 1994).The small body size, broad feeding habits, adaptation to unfavorable environmental conditions and their short reproductive cycle provide for goats comparative advantage over cattle and sheep to suit the circumstances of especially the poorer mixed crop-livestock production environments of the highlands. These attributes make it easier to adjust goat flock size to match the available resources, facilitate the integration of livestock production into small scale production systems (low capital, low risk) and enable flexible production (Peters, 1987; Devendra, 1992).

The number of goats in Ethiopia is estimated at 21.71 million. Out of these, about 69 percent are females and 31 percent are males (CSA, 2012). These goat populations are phenotypic ally classified into 11 distinct major breed types or populations and five additional sub-types (Workneh, 1992; Alemayehu, 1993; Nigatu, 1994; FARM-Africa, 1996; IBC, 2004). However, genetic/molecular characterization revealed only the presence of eight distinctively different breed types or populations in the country (Tesfaye, 2004). According to this author, the eight distinct genetic entities include Arsi Bale, Gumuz, Keffa, Woyto-Guji, Abergelle, Afar, highland goats (previously separated as Central and North-West highland) and the goats from the previously known as Hararghe highland, Short-eared Somali and Long-eared Somali).

The report of FARM Africa(1996) shows that the goat breed distributed in the Bale zone is Arsi Bale goat breed. Again the report of Belete (2013) shows that Somali goat breed is distributed in lowlands of bale zone including Madda Walabu, Sawena and Rayitu districts. The previous characterization done so far in bale zone does not cover all parts of bale zone,

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particularly in the study area. Againthere is a probability of mixing up of goats type with surrounding area,Thus, characterization of the breed is required for improving the productivity of the breed, to limit the existing constraints and for the conservation of indigenous animal genetic resources.

*Breed* characterization has been recognized as the first approach to the sustainable use of animal genetic resource (Lanari *et al*.,2003). Characterization of local genetic resources depends on the knowledge of the variation of morphological traits, which have playeda very fundamental role in classification of live stock based on size and shape(Ferra *et al*., 2010; Agga *et al*., 2010; Leng *et al.*, 2010). The most common measure of animal performance is live weight which provides reliable and informative measure for selection, feeding requirements, health management, and decision on selling price (Thiruvenkanden, 2005). Larger sized animals usually produce more meat than smaller animals (ESGPIP, 2009).

Measurements of various body conformations are of value in judging quantitative characteristics ofmeatandarehelpfulindevelopingsuitableselectioncriteri a.Moreover, the relative ease in measuring linear dimensions they can be used as an indirect way to estimate live weight (Tesfaye, 2008). Prediction of body measurements in sheep remains very important for avoiding the errors of visual determination of animal weights in areas where weighing balance cannot be assessed (Halima *et al*., 2012).In general, the information obtained in this study will be useful for designing appropriate breeding and selection schemes for indigenous Goats improvement and sustainable conservation. Therefore, the present study was conducted with the following objectives:

- To make on-farm Phenotypic characterization of Indigenous Goats type using linear body measurement and qualitative physical characteristics in Sinana District

## II. Material and Methods

*a) Selection of the Study Site*

A rapid field survey was conducted by the researcher in study district to locate appropriate sites for on farm phenotypic characterization of goats. Three Kebele from the district was selected purposively, based on the goat's population potential. For body linear measurements and qualitative characters a total of 120 animals, 40 animals per Kebeles was measured. Goats were classified based on sex and age. Each class of goats were sampled from one household once to incorporate diversity of goats in the sample. Sampling was continued until measurement of 120 mature goats have been obtained.

*b) Qualitative traits data collection*

Visual observation was made and morphological features will be recorded based on breed morphological characteristics descriptor list of FAO (2011) for phenotypic characterization of goat. Each animal was identified by its sex, dentition and sampling site. Dentition record was included, as this was the only reliable means to estimate the approximate age of an animal.

*c) Quantitative trait data collection*

Morph metric measurements were made on the quantitative traits of breed using measuring tape. The measurements were made on animals that will be classified based on sex and age group. Animal's age classification was made using dentition technique supplemented with owner's information. The linear body measurement was made using plastic tape, while body weight of animals was measured using suspended spring or Slater weighing scale having 50 kg capacity with 0.2 kg precision.

*d) Data Analysis*

Quantitative and qualitative data generated from field survey and on farm linear body measurement was recorded on Microsoft excel spread sheet and analyzed using statistical analysis system (SAS 2008). Simple descriptive statistics was compile the observed categorical variables and chi-square test was used to test independence of the categorical variables separately for both male and female.

For adult animals, sex and age group of the goats was fitted as independent variables while body weight and linear body measurement was fitted as dependent variables. A general linear model procedure (PROC GLM) of the Statistical Analysis System (SAS 9.2, 2008) wasused for quantitative variables to detect statistical differences among sample goat's populations. Least square means with their corresponding standard errors was calculated for each body trait over sex, dentition. When analysis of variance declared significant difference, least square means has been separated using Tukey-Kramer test. The model employed for analyses of body weight and other linear body measurements was:

$$Y_{ij} = \mu + Ai + Dj + + e_{ijk,}$$

Where:

$Y_{ijk}$= the observed $k$ (body weight or linear body measurements) in the $i^{th}$age group and $j^{th}$ Sex,

$\mu$ =Overall mean,

$A_i$= the effect of $i^{th}$ age group ($i$ = 1PPI, 2PPI, 3PPI and 4PPI),

$D_j$ = the effect of $j^{th}$ Sex ($j$=1(Female) and 2(male))

e$ijk$= random residual error.

Correlations of live body weight with different body measurement under consideration wascomputed for each sex using Pearson correlation coefficient.

Stepwise regression procedure of SAS (2008) was used to regress body weight for both male and female within each age group using PROC REG procedure of SAS in order to determine the best-fitted regression equation for the prediction of live body weight. Best fitting models was selected based on coefficient of determination ($R^2$), mean square error, the mallows C parameters C (p). The following models was be used for the estimation of body weight from LBMs.

$$Y= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + e_j$$

*Where:*

$y$ = the response variable (live body weight)

$\beta_0$ = the intercept

$X_1 \ldots Xn$ are the explanatory variables (chest girth, body length, height at wither and rump height)

$\beta_1 \ldots$, $\beta n$ are regression coefficients of the variables $X_1 .., Xn$

$ej$ = random error

## III. Result and Discussions

*a) Qualitative traits of goats*

Qualitative trait of study area are summarized in table 4,1.Out of the total sampled goat population in the study area (120 goats)48.3 plain 35 spotted and 16.67 were patchy coat color. In the study area the dominant coat color types were red (35.83%), black (19.19%), black plus red (19.16%), red plus white(17.5%),and black plus white (8.34%). The sample population has concave and convex head profile (37.5%), and flat (25%) and 100% of the population has no wattle. Majority of goats in the study area have no toggles (86.67%). About 75% goats in the study area have ruff which is common for both male and female goats. 100% of goats have horns and had straight (75%) and curved (25%) shape. Regarding horn orientation: backward (83.33%), (8.33%) up ward and lateral (8.34%). The most dominant ear form were lateral (64.17%) flowed by down ward (19.17%) and erect (16.99%) were observed in goat population. The hair type dominated in the study area were smooth (54.16%) flowed by curl (45.84%).

*Table 1 :* qualitative traits of goats in the study area

| Character | Attribute | female | | Male | | Over all |
|---|---|---|---|---|---|---|
| | | N | % | N | % | N(%) |
| Coat color pattern | plain | 43 | 35.83 | 15 | 12.5 | 58(48.33) |
| | spotted | 32 | 26.67 | 10 | 8.33 | 42(35) |
| | patched | 15 | 12.5 | 5 | 4.17 | 20(16.67) |
| | X square | | | | | 0.05 |
| Coat color type | black | 17 | 14.17 | 6 | 5.00 | 23(19.16) |
| | Red | 31 | 25.83 | 12 | 10.00 | 43(35.83) |
| | Black and white | 8 | 6.67 | 2 | 1.67 | 10(8.33) |
| | Black and red | 19 | 15.83 | 4 | 3.33 | 23(19.16) |
| | Red and white | 15 | 12.5 | 6 | 5.00 | 21(17.5) |
| | X square | | | | | 1.19 |
| Horn shape | Straight | 75 | 62.5 | 15 | 12.5 | 90(75) |
| | Curved | 25 | 20.83 | 5 | 4.17 | 30(25) |
| | Spiral | 0 | 0 | 0 | 0 | 0(0) |
| | X square | | | | | 0.00 |
| Horn orientation | Back ward | 75 | 62.5 | 25 | 20.83 | 100(83.33) |
| | Up ward | 7 | 5.83 | 3 | 2.50 | 10(8.33) |
| | Lateral | 8 | 6.67 | 2 | 1.67 | 10(8.33) |
| | X square | | | | | 0.27 |
| Ear form | Lateral | 57 | 47.50 | 20 | 16.67 | 77(64.16) |
| | Down ward | 17 | 14.17 | 6 | 5.00 | 23(19.16) |
| | Erect | 16 | 13.33 | 4 | 3.33 | 20(16.66) |
| | X square | | | | | 0.32 |
| Ruff | Present | 73 | 60.83 | 17 | 14.67 | 90(75) |
| | Absent | 26 | 21.67 | 4 | 3.33 | 30(25) |
| | X square | | | | | 1.35 |
| Toggle | Present | 12 | 10 | 4 | 3.33 | 16(13.33) |
| | Absent | 78 | 65 | 26 | 21.67 | 104(86.67) |
| | X square | | | | | 0.00 |
| hair type | Smooth | 46 | 38.33 | 19 | 15.83 | 65(54.16) |
| | Curl | 44 | 36.67 | 11 | 9.17 | 55(45.83) |
| | X square | | | | | 1.35 |

| | | | | | | |
|---|---|---|---|---|---|---|
| head profile | Flat | 22 | 18.33 | 8 | 6.67 | 30(25) |
| | Concave | 34 | 28.33 | 11 | 9.17 | 45(37.5) |
| | Convex | 34 | 28.33 | 11 | 9.17 | 45(37.5) |
| | X square | | | | | |

*Figure 1 :* Typical goats type in the study area

*b) Correlation between Body Weight and Linear Body Measurements*

The Pearson coefficient of correlation among various body measurements of goats in the study area are presented in the following table. The correlation of body weight with that of LBM ranges from weak to moderate correlation for both male and female (Table 2). The strong correlation between body weight and linear body measurement is observed between body weight and chest girth with correlation coefficient of (r=0.78). The finding was in line with the finding of Halima *et al*. (2012) where there were high correlation between body weight and chest girth (r=0.89) and body weight and body length (r=0.73) for west Amhara region goat population and Belete et al.(2013) for bale zone goat population of got types the correlation between body weight and chest girth (r=0.75). The strong correlation between body weight and chest girth indicates that body weight was easily estimated from chest girth. This was in agreement with the finding of (Adeyinka and Mohammed, 2006). However, the accuracy of prediction was improved when other significant and positive correlation was added in multiple regression analysis.

The correlation coefficient between body measurement and body weight were positive and significant for all traits under consideration in the study area. In this finding chest girth and wither height have high correlation with body weight. This was in agreement with the report of Mahilet (2012) for Hararghae high land goats, Grum (2010) for short-eared Somali goat. Similarly, the report of Halima *et al*. (2012) indicates that there were higher association between body weight and chest girth (r=0.89) and between body weight and body length (r=0.73).

The positive correlation between body weight and linear body measurements indicates that an increase in any one of the body measurement would result in a corresponding increase in live body weight. Further, the accuracy of prediction was ameliorated when traits are combined in multiple regressions. The strong relationship existing between body weight and body measurement suggests that either or the combination of these morphological traits could be used to estimate live weight in goats fairly well in the situation where weighbridge or scales are not available. The association may also be useful as selection criteria since positive correlation of traits suggest that the traits may be under the same genetic influences.

*Table 2 :* Correlation coefficient between body weight and other linear body measurement of goat in study area

| | HG | WH | BL | BW | HL | HRL | EL | RL | RH |
|---|---|---|---|---|---|---|---|---|---|
| HG | | 0.35* | 0.64* | 0.78* | 0.65* | 0.15* | 0.11* | 0.26* | 0.20* |
| WH | 0.35* | | 0.59* | 0.72* | 0.72* | 0.01* | 0.11* | 0.28* | 0.04* |
| BL | 0.64* | 0.59* | | 0.56* | 0.67* | 0.31* | 0.02* | 0.50* | 0.09* |
| BW | 0.78* | 0.72* | 0.56* | | 0.42* | 0.11* | 0.21* | 0.24* | 0.34* |
| HL | 0.65* | 0.72* | 0.67* | 0.42* | | -0.03ns | -0.06ns | 0.36* | 0.03* |
| HRL | 0.15* | 0.01 ns | 0.31* | 0.11* | -0.03ns | | 0.15* | 0.17* | 0.08* |
| EL | 0.11* | 0.11* | 0.02ns | 0.21* | -0.06ns | 0.07ns | | 0.60* | 0.10* |
| RL | 0.26* | 0.28* | 0.50* | 0.24* | 0.360* | 0.18* | 0.60* | | 0.09* |
| RH | 0.20* | 0.04ns | 0.09* | 0.34* | 0.03ns | 0.01ns | 0.10* | 0.09* | |

*c) Live Body Weight and Linear Measurements*

Least square mean and standard error for sex and age effect on body weight and linear body measurements are presented in (Table 3). In this study area females have higher body weight and other linear body measurements ($p<0.05$) than males counterpart.The present finding was in contrast with the report of Aladee*t al*.( 2008); Sowande *et al*. (2009); Samakula*et al*. ( 2010); and Okbeku *et al*. (2011) were female have higher body weight and other body measurements than male counterpart. On the other hand the finding is in agreement with the report of Alemayehu*et al*. (2012) for Abergelle goat and Adeyinke (2006) where males have higher body weight than female counterpart. The difference in live body weight between male and female across different age classes indicates that these parameters are sex and age dependent. Increase in live body weight and other linear body measurements with advance age were in line with the report of (Otoikhian *et al.*, 2008). In the study area location, sex and age differences were apparent forvarious body measurements. The finding was in agreement with the repot of (Belete et al, 2013; Grum, 2010; Halima *et al*., 2012; Mahilet, 2012).

The average value for body weight and other linear body measurement obtained from this study was comparable with other literatures. In the study area overall mean of body weight, body length, chest girth, height at wither, rump height, rump length, head length, and ear length were 25 kg, 59.02 cm, 74.99 cm, 61.64 cm, 66.65 cm, 14.72 cm, 11.20 cm 12.72 cm and 25.08 cm, respectively. The present finding for body weight of goat is lower than that of Belete et al.(2013) for goat types in bale zone (29.52kg).

*Age effect:* Age differences were obvious for most of linear body measurements ($p<0.05$). The linear body measurements increased as animal advances with age (1PPI to 4PPI). This was in consonance with the report of (Otoikhian *et al*., 2008). All body measurements were increased as age group increase from 1PPI to 4PPI.

*Sex effect:* The result revealed that sex is an important source of variation for live body weight and linear body measurements at all age groups. In the study area female have higher body weight than male ($p<0.05$). Most of linear body measurements were not significant ($p> 0.05$) between sexes except body weight, body length and height at withers.

*Table 3 :* Least square mean of quantitative traits of goats in study area (Mean± SE)

| | BW(Mean± SE) | BL(Mean± SE) | WH(Mean± SE) | HG(Mean± SE) | HL(Mean± SE) |
|---|---|---|---|---|---|
| Over all mean | 25±3.6 | 59.0±7.2 | 61.1±3.8 | 74.9±7.3 | 11.2±1.6 |
| CV | 13.41 | 12.35 | 7.56 | 9.35 | 16.77 |
| R square | 0.13 | 0.04 | 0.04 | 0.13 | 0.002 |
| SEX | * | ns | * | * | Ns |
| FEMAL | 24.4±0.35b | 58.1±0.7a | 61.7±0.4b | 73.4±0.7a | 11.16±0.2a |
| MALE | 27.5±0.78a | 61.73±0.4a | 59.36±0.8a | 79.56±1.29b | 11.33±0.3a |
| AGE | Ns | * | * | * | * |
| 1PPI | 24.13±0.78$^{a}$ | 58.68±0.68$^{ab}$ | 62.86±0.98$^{a}$ | 72.36±1.5$^{b}$ | 10.63±0.34$^{b}$ |
| 2PPI | 25.51±.46$^{a}$ | 59.73±0.9$^{a}$ | 62.95±0.45$^{a}$ | 76.85±0.9$^{a}$ | 12.13±0.2$^{a}$ |
| 3PPI | 25.11±0.8$^{a}$ | 54.56±1.7$^{b}$ | 55.72±0.9$^{c}$ | 72.72±1.7$^{b}$ | 10.05±0.38$^{b}$ |
| 4PPI | 25.57±0.8$^{a}$ | 61.36±1.6$^{a}$ | 58.47±0.8$^{b}$ | 74.21±1.5$^{ab}$ | 10.00±0.37$^{b}$ |

| | HRL | EL | RL | RH |
|---|---|---|---|---|
| OVER ALL MEAN | 1.3±0.4 | 12.7±0.8 | 14.3±1.1 | 66.6±5.3 |
| CV | 28.03 | 6.98 | 8.2 | 8.1 |
| R SQUARE | 0.0004 | 0.07 | 0.03 | 0.004 |
| SEX | ns | ns | Ns | Ns |
| MALE | 1.34±0.04a | 12.59±0.09a | 14.19±0.12a | 66.44±0.57a |
| FEMALE | 1.33±0.6a | 13.13±0.16a | 14.67±0.21a | 67.23±0.98a |
| AGE | ns | * | * | * |
| 1PPI | 1.3±007$^{a}$ | 12.9±0.18$^{ab}$ | 14.2±0.2$^{a}$ | 68.1±1.14$^{a}$ |
| 2PPI | 1.3±0.04$^{a}$ | 12.93±0.1$^{a}$ | 14.6±0.14$^{a}$ | 66.68±0.68$^{ab}$ |
| 3PPI | 1.2±0.08$^{a}$ | 12.11±0.2$^{c}$ | 13.2±0.25$^{b}$ | 64.55±1.3$^{b}$ |
| 4PPI | 1.36±0.08$^{a}$ | 12.42±0.2$^{bc}$ | 14.62±0.14$^{a}$ | 66.8±1.2$^{ab}$ |

*d) Regression Analysis*

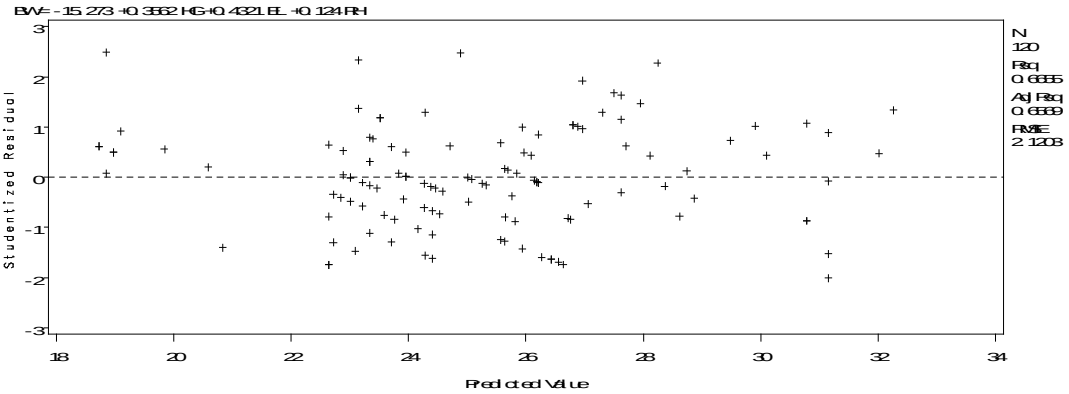
Multiple linear regression models for predicting the body weight of goats from linear body measurements were presented in (Tables 4). It indicates that the trend of increment in $R^2$ value as the number of variable increase. $R^2$ is widely used to determine how well regression fits as the coefficient of determination. All body measurements were fitted into the model and through elimination procedures, the optimum model was identified. Chest girth, rump height and ear length were the best fitted model for goats in the study area.

Chest girth was more reliable in predicting body weight than other linear body measurements. The better association of body weight with chest girth was possibly

due to relatively larger contribution to body weight of chest girth, which consists of bones, muscles and viscera(Thiruvenkadan,2005). Using many body measurements to predict the live weight is not handy in goat breeding, the less body parameters used, the easiest result obtained (Pesman and Yardmic, 2008). The result of stepwise regression analysis indicates that other measurement to the chest girth would result in significance improvement in accuracy of prediction in overall assessment even though the extra gain was small, which was in agreement with the report of (Afolayan *et al*., 2006). Under field condition addition of more variable in the model is not economical. Therefore, under this study body weight of goat is easily estimated from heart girth with equation of BW= -3.36+0.38HG.

*Table 4 :* Multiple linear regression analysis of live body weight on different LBMs of goats in the study area

| Model | I | B1 | B2 | B3 | R square | CP |
|---|---|---|---|---|---|---|
| CG | -3.36 | 0.38 | - | - | 0.618 | 33.84 |
| CG+RH | -10.608 | 0.36 | 0.13 | - | 0.65 | 21.66 |
| CG+RH+EL | -15.27 | 0.36 | 0.43 | 0.14 | 0.66 | 19.08 |




## V. Conclusion

Goats in the study area have some distinct physical character and other linear body measurements. Most of the measured body measurements of the goats were lowered as compared by different author with respect to comparable sex and age groups. This may be due to poor management aspect of goats in the study area. Phenotypic characterization of indigenous goats types in their existing production system is the prerequisite before making some breed improvement programs. The present study will put some base line information regarding goat type and their characteristics.

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