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Estimation of Live Weight From Linear Body Measurements of Three African Breeds of Cattle Under Extensive Management System in Nigeria

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Target Audience: Animal Scientists, Cattle Breeders, Livestock policy Makers, Livestock Extensionists.

Abstract

Live weight (LWT) and linear body measurements (LBM) of N'dama, Muturu and White Fulani breeds of African cattle during rainy and dry seasons were examined. Fifty and fifty-five cattle under extensive management system were used during rainy and dry season, respectively. Traits measured were live weight, head length, head width, body length, height at wither, heart girth, width of hind quarter, loin girth and length of hindquarter. The data obtained were classified ±SE subjected to linear analyses using Minitab Statistical Software Programme. Breed of cattle significantly (P<0.05) affected all linear body measurement except for length of hind quarter and live weight at rainy season. Effect of sex was not significant (P>0.05) on the traits in both seasons. Age of cattle significantly (P<0.05) accounted for all LBM except LHQ at the dry season. There were high positive significant (P<0.01) correlation between each of the linear body measurement and live weight and also within the linear body measurement observed. The head length had the highest correlation coefficient with body weight R^2=0.936 which can be used to predict the live weight of the cattle while the least correlation coefficient was obtained in head width, R^2=0.825. In conclusion, White Fulani was the heaviest among the African breeds of cattle. Live weight of cattle can be calculated using Linear Body Measurement. However, Head length can be used to estimate the Live Weight.

Keywords: Live weight, linear body measurement, N'Dama, Muturu, White Fulani cattle, Humid tropic.

Description of problems

The livestock industry in Nigeria represents a very important national resource. It contributes substantially to the nation's wealth hence, the need for raising animals of which cattle is one of them.

Traditionally, animals are visually assessed, which is a subjective method of judgment (1). Therefore, the development of objective means (linear body measurements) for describing and evaluating body size and conformation

characteristics would overcome many of the problems associated with visual evaluation (2). The body weight of live animal is the most comprehensive measurement of growth generally available, but it is particularly subjected to short term changes.

Linear measurements can be used as indicator of weight changes and maturing rate in cattle and sheep (3, 4). Linear body measurements have been used severally to characterize breeds, evaluate breed performance and predict live weight gain. It has also being used to study the effect of crossbreeding and as a criterion for selecting replacement animals and evaluating breed in a controlled environment (2, 5). However, there are scanty information in literature on the effect of breed, sex and age on live weight and linear body measurement in South Western Nigeria. This study was designed to compare the effect of breed, sex and age on weight and linear body measurements of Ndama, Muturu and White Fulani cattle.

Materials and Methods

This study was carried out at the Cattle Production Unit of the Teaching and Research Farm, Federal University of Agriculture, Abeokuta, Nigeria. Fifty and fifty-five breeds of N'dama, Muturu and White Fulani cattle breeds were used. 20 N'dama, 12 Muturu and 18 White Fulani were used during the rainy season while 20 N'dama 12 Muturu and 23 White Fulani were used during the dry season. The ages of cattle ranged between <12 months to 36 months.

Data on Live weight (LWT), Head length (HDL), Head width (HDW), Body Length (BLT), Height at withers (HTW), Heart girth (HGT),Width of hindquarter (WHQ), Loin girth (LGT), Length of hindquarter (LHQ) of each animal following standard procedure and anatomical points of reference, were collected in the morning before the animals were released for grazing. Linear body measurements (LBM) were recorded in centimeter (cm) using a measuring tape. Animals were restrained with the help of three farm assistants who held the animal in an up- faced position.

The reference points for the linear body measurements were observed according to the method of (5). Heart girth (HGT): Measured as body circumference just behind the foreleg. Body length (BLT): Distance from the head of the humer2 to the distal end of the pubic bone. Head width (HDW): Measured as the distance between the outer end of both eyes. Head length (HLT): Distance from between the horn site to the lower lip. Loin girth (LGT): Distance round the animal just before the hind leg. Height at Whither (HTW) measured as the distance from the highest point on the dorsum of the animal to the ground surface at the level of the front feet. Length of hindquarter (LHQ): Distance between the point located in the 10th rib and the ventral tuberosity of the tuber isch2. Width of the hind quarter (WHQ): Distance round the animal around the 10th rib. Live weight (LWT): The weight of the animal was measured in kilogram (kg) using weighing bridge.

Statistical analyses

The interrelationship of live weight and linear measurements were estimated by simple correlation. The live weights were regressed on the linear body measurements separately for breeds, males and females and ages using the following linear and Pearson correlation.

Linear regression equation: $W = a + bG$

Where

a = intercept,

W = live weight,

G = linear body measurement and b is gradient.

The linear measurements were subjected to the three regression equations. The goodness of fit (R^2) was tested to determine the contribution of each of the eight independent variables measured to the prediction of the dependent variable, the body weight of the individual cattle.

Results and Discussion

The mean live weight (kg) and linear body measurements of the cattle at rainy and dry seasons as well as pooled means are presented in Table 1. The mean live weight for rainy and dry seasons of Ndama, Muturu and White Fulani breeds of cattle were 97.35±8.75, 92.92±11.09 and 118.78±9.05; 95.75±9.97, 89.50±12.63, 110.78±9.05, respectively. Pooled mean values for live weight (kg) were 96.55±6.25, 91.21±8.41 and 114.78±6.44. However, the variations in live weight were not significant (P>0.05). White Fulani cattle had the highest live weight value, followed by Ndama and the least value was obtained in Muturu. The animals gained more weight during the rainy season unlike during the dry season. The pooled value also revealed that White Fulani was the heaviest among the three breed.

The results regarding linear body measurements (cm) from Table 1 shows that apparent variations in the values of HLT, BLT, HTW, WHQ and LGT were significant (P<0.05). Mean values obtained were 35.10±1.43, 36.08±1.84, 40.50±1.51; 78.15±3.37, 82.33±4.13, 90.78±3.38; 91.65±3.37,87.00±4.36, 105.56±3.50;124.10±4.91, 127.17±6.34, 142.33±5.17; and 112.25±4.38, 11.75±5.65, 126.83±4.61 for N'dama, Muturu and White Fulani cattle respectively. These mean values ranged from 16.60±0.58 to 17.50±0.61; 107.25±5.17 to 121.78±4.22 and 43.58±2.38 to 46.61±1.94, respectively. For linear body measurements taken during the dry season, the differences in mean values among the three African breeds of cattle were not significant (P>0.05). White Fulani cattle had the highest mean for HLT, BLT, HTW and LGT which ranged from 36.95±1.65 to 111.96±5.00. Muturu had the highest value in HDW (17.17±0.86) while N'dama had the highest means in HGT, WHQ and LHQ. For pooled, the measurements were not significant (P>0.05) except HTW where White Fulani had the highest mean of 101.46±2.50, followed by N'dama 91.70±2.50 and Muturu 86.29±3.35. Table 2 presents the average measurements obtained for live weight and linear body measurement as affected by sex. The values obtained for linear body measurement and live weight were

higher in bull than in cow. The mean live weight for male and female for rainy season were 104.94±9.35, and 103.47±7.01, respectively. The linear body measurement ranged from 17.61±0.61 to 134.28±5.54; and 16.69±0.45 to 130.53±4.09 for the bull (male) and cow (female) respectively, but the difference was not significant ($P>0.05$). The female in turn had higher values in HDL, HGT, WHQ, LGT, LHQ and LWT than male in the dry season ($P>0.05$).When the data were pooled, the values were not significant ($P>0.05$). The effect of age on live weight and linear body measurement of cattle is presented in Table 3. Live weight (kg) of the cattle generally differed significantly ($P<0.05$) and increased with age ranging from 61.88±4.78 to 144.24±4.17 during the rainy season. In this study, the result of the experiment revealed significant differences between seasons in live weight and linear body measurements. The live weight and linear body measurements of the cattle breeds decreased with transit from rainy to dry season. This may be attributed to scarcity of forage on which these animals graze during the dry season as a result of drought, although the apparent difference in live weight was not significant ($P>0.05$).

Linear body measurements (LBM) also followed the same pattern, as ages increased the linear body parameters also increased which ranged from 14.25±0.40 to 106.13±3.08; 17.46±0.45 to 132.00±3.42; 18.86±0.35 to 151.43±2.70 or <12, 13-24 months and 25-36 months, respectively.

Results observed during the dry season showed decrease in weight 59.43±4.12; 94.92±5.24 and 139.62±4.12 and varied significantly ($P<0.05$). It was obvious that the parameters dropped during the dry season which was probably as a result of the unavailability of pasture. It was observed that the LW increased with age. This observation can be expected since increase in body size and weight of animals arising from laying down of body tissue and growth of skeletal structure are directly related to age (6). Although, value of the LW was lower, this could be attributed to the younger animals sampled in this study and the scarcity of forage and the stress in moving round to scavenge for water and pasture.

The LBM of the cattle increased with age as expected in both seasons and the pooled value. The mean value were positive and significant ($P<0.05$) ranging from 14.25±0.40 to 151.43±2.70; 13.71±0.39 to 146.95±3.22; 13.95±0.28 to 149.19±2.18, respectively. The increment is more between <12 to 13 -24 months. The observation correlates with those of (7, 8) who observed that LBM of N'dama cattle increased with age in a similar manner from birth to 30 month of age. Length of hindquarter was not affected by age and values ranged from 35.62±1.32 to 50.14±1.32.

Table 1: Effect of Breeds on Live Weight (kg) and Linear Body Measurements (cm) of Cattle

Rainy season	N	HLT	HDW	BLT	HTW	HGT	WHQ	LGT	LHQ	LWT(kg)
N'dama	20	35.10±1.43[b]	16.60±0.58	78.15±3.37[b]	91.65±3.37[ab]	109.95±4.00	127.10±4.91[b]	112.25±4.38[b]	43.80±1.84	97.35±8.75
Muturu	12	36.08±1.84[b]	17.00±0.74	82.33±4.13[a]	87.00±4.36[b]	107.25±5.17	124.17±6.34[b]	111.75±5.65[b]	43.58±2.38	92.92±11.09
White Fulani	18	40.50±1.51[a]	17.50±0.61	90.78±3.38[a]	105.56±3.50[a]	121.78±4.22	142.33±5.17[a]	126.83±4.61[a]	46.61±1.94	118.78±9.05
Dry Season										
N'dama	20	35.35±1.76	16.75±0.67	78.35±3.94	91.75±3.95	108.80±4.99	123.25±6.27	111.00±5.37	44.15±2.02	95.75±9.97
Muturu	12	36.08±2.28	17.17±0.86	81.50±5.09	85.58±5.10	104.25±6.45	118.80±8.10	105.67±6.93	43.83±2.61	89.50±12.63
W. Fulani	23	36.95±1.65	16.26±0.62	89.96±3.67	104.02±3.68	106.57±4.66	122.13±5.84	111.96±5.00	42.04±1.89	110.78±9.05
Pooled										
N'dama	40	35.23±1.14	16.68±0.44	78.25±2.55	91.70±2.50[ab]	109.38±3.26	125.18±4.08	111.63±3.50	43.98±1.37	96.55±6.52
Muturu	24	36.08±1.47	17.08±0.57	81.92±3.29	86.29±3.35b	105.75±4.21	121.08±5.27	108.71±4.50	43.71±1.77	91.21±8.41
W. Fulani	41	38.51±1.12	16.81+0.43	90.37±2.52	101.46±2.50[a]	113.24±3.22	131.00±4.03	118.48±3.47	44.05±1.35	114.78±6.44

[a,b,c:] Means on the same column with different superscripts are significantly different (P<0.05)

N= Number of animals, HLT=Head length, HDW=Head width, BLT=Body length, HTW=Height at wither, HGT=Heart girth, WHQ=Width of hindquarter, LGT =Loin girth,LHQ=Length of Hindquarter, LWT=Weight, Ages=<12, 13-24,25-36months.

Table 2: Effect of sex on live weight (kg) and linear body measurements (cm) of cattle

Rainy Season	N	HDL	HDW	BLT	HTW	HGT	WHQ	LGT	LHQ	LWT(kg)
Male	18	37.94±1.60	17.61±0.60	85.11±3.59	98.72±3.94	114.94±4.4	134.28±5.54	120.44±4.84	45.61±1.94	104.94±9.35
Female	32	36.98±1.20	16.69±0.45	82.90±2.70	93.75±2.95	112.78±3.30	130.53±4.09	115.67±3.63	44.28±1.46	103.47±7.01
DRY SEASON										
Male	23	34.74±1.62	16.44±0.62	83.61±3.62	98.01±3.79	101.22±4.51	114.96±5.68	104.78±4.88	41.70±1.86	99.87+8.96
Female	32	37.22±1.37	16.78±0.53	82.66±3.07	94.13±3.21	110.94±3.83	126.94±4.81	114.19±4.14	44.28±1.58	100.78+7.60
POOLED										
Male	41	36.15±1.14	16.95±0.43	84.36±2.56	94.81±2.73	107.24±3.22	123.44±4.04	111.63±3.5	43.42±`1.35	102.41±6.47
Female	64	37.06±0.91	16.73±0.34	82.78±2.05	93.94±2.18	111.86±2.58	128.48±3.24	114.92±2.81	44.28±1.08	102.13±5.18

HLT=Head length, HDW=Head width, BLT=Body length, HTW=Height at wither, HGT=Heart girth, WHQ=Width of hindquarter, LGT=Loin girth, LHQ=Length of Hindquarter, LWT=Weight, Ages = < 12, 13-24, 25-36 months. N= Number of animals

Table 3: Effect of age on live weight and linear body measurements of the cattle

Rainy Season	N	HLT	HDW	BLT	HTW	HGT	WHQ	LGT	LHQ	LWT (kg)
<12	16	29.50±0.80^{b}	14.25±0.40^{b}	67.06±2.04^{c}	79.44±2.83^{c}	92.56±2.46^{b}	106.13±3.08^{c}	94.56±2.91^{c}	37.75±1.46^{b}	61.88±4.78^{c}
13-24	13	37.08±0.88^{ab}	17.46±0.45^{a}	83.00±2.26^{b}	94.46±3.14^{b}	113.46±2.73^{ab}	132.00±3.42^{b}	118.62±3.23^{b}	43.08±1.62^{ab}	95.69±5.30^{b}
25-36	21	43.33±0.70^{a}	18.86±0.35^{a}	96.81±1.80^{a}	108.48±2.40^{a}	129.62±2.15^{a}	151.43±2.70^{a}	134.00±2.54^{a}	51.14±1.28^{a}	141.24±4.17^{a}
Dry Season										
<12	21	28.05±0.78^{b}	13.71±0.39^{b}	63.33±2.11^{c}	76.95±2.57^{c}	84.95±2.60^{b}	93.95±3.22^{c}	87.05±2.91^{a}	35.62±1.32	59.43±4.12^{c}
13-24	13	37.15±0.97^{ab}	17.07±0.50^{a}	83.08±2.68^{b}	94.77±3.26^{b}	109.77±3.31^{ab}	125.46±4.09^{b}	113.15±3.23^{ab}	43.15±1/67	94.92±5.24^{b}
25-36	21	43.71±0.78^{a}	18.86±0.40^{a}	96.19±2.11^{a}	108.27±2.50^{a}	127.00±2.60^{a}	146.95±3.22^{a}	131.62±2.90^{a}	50.14±1.32	139.62±4.12^{a}
Pooled										
<12	37	28.68±0.56^{b}	13.95±0.28^{b}	64.95±1.47^{c}	78.03±1.88^{c}	88.24±1.83^{b}	99.22±2.32^{c}	90.30±2.09^{c}	55.95±3.12^{c}	59.97±3.12^{c}
13-24	26	37.12±0.66^{ab}	17.62±0.33^{a}	83.04±1.75^{b}	94.62±2.18^{b}	111.62±2.18^{ab}	128.73±2.77^{b}	115.89±2.49^{b}	95.31±3.72^{b}	95.31±3.72^{b}
25-36	42	43.52±0.52^{a}	18.86±0.26^{a}	96.50±1.38^{a}	108.38±1.7	128.31±1.72^{a}	149.19±2.18^{a}	132.81±1.96^{a}	140.43±2.93^{a}	140.43±2.93^{a}

^{a,b,c}: Means on the same column with different superscript are significantly different (P<0.05)

HLT=Head length, HDW=Head width, BL=Body length, HTW=Height at wither, HGT=Heart girth, WHQ=Width of hindquarter, LGT=Loin girth, LHQ=Length of Hindquarter, LWT=Weight, Ages = < 12, 13-24, 25-36 months. N= Number of animals

The HLT, HDW, BLT, HTW, HGT, WHQ, LGT and LHQ also increased with age and varied significantly ($P<0.05$). Only length of hind quarter was not affected by age. The values ranged from 35.62±1.32 to 50.14±1.32. When the data were pooled, the parameters equally revealed that the values were significant ($P<0.05$).

Results of the correlation coefficients of the linear measurements to one another and to the live weight are presented in Table 4. The linear measurements, head length (HLT), head width (HDW), body length (BLT), height at wither (HWT), hearth girth (HGT), loins girth (LGT), length of hind quarter (LHQ),weight of hind quarter (WHQ), were highly correlated with live weight (LWT) (9,10). Head length had the highest correlation coefficient with live weight (R^2=0.936) while the correlation coefficient between live weight and head width was the least (R^2=0.825).

Table 4: Correlation matrix of live weight and Linear Body Measurements of Cattle

Parameters	HL	HDW	BL	HTW	HG	WHQ	LG	LHQ	LW
HL	1.000								
HDW	0.879	1.000							
BL	0.968	0.861	1.000						
HW	0.879	0.744	0.870	1.000					
HG	0.946	0.848	0.940	0.870	1.000				
WHQ	0.932	0.823	0.931	0.868	0.978	1.000			
LG	0.924	0.835	0.926	0.865	0.960	0.968	1.000		
LHQ	0.833	0.781	0.844	0.691	0.876	0.865	0.847	1.000	
WEIGHT	0.936	0.825	0.923	0.848	0.932	0.935	0.918	0.855	1.000

HLT=Head length, HDW=Head width, BLT=Body length, HTW=Height at wither, HGT=Heart girth, WHQ=Width of hindquarter, LGT=Loin girth, LHQ=Length of Hindquarter, LWT= Live Weight ($P<0.01$)

Conclusion and Application

1. White Fulani was the heaviest breed of the three African breeds of cattle.
2. Live weight and linear body measurements of N'dama, Muturu and White Fulani breeds were predominantly influenced by breed and age.
3. Live weight can be predicted more accurately from any of the linear body measurements in cattle.

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