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Morphometric predictors of market value in indigenous sheep breeds in Yobe State, Nigeria

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Abstract

The study was conducted to determine the relationship between some morphometric traits (live weight, girth circumference, body length, wither height, rump length, loin girth and horn length) and price in indigenous breeds of sheep. A total of 150 (135 males and 15 females) matured sheep were randomly sampled from Local markets in the study area, of which 117, 19 and 14 were Yankasa, Uda and Balami, respectively. Data obtained were subjected to analysis of variance, Pearson's correlation and linear regression analysis. Breed and sex had a significant ($P<0.05$) effect on some of the morphometric traits observed. Balami sheep recorded the highest values for all traits significantly ($P<0.05$) affected traits and price, while the lowest values were observed among the Yankasa breed. However, a non-significant ($P>0.05$) effect of sex on back length, wither height, rump length and loin girth was realized. The correlation coefficient (r) between morphometric traits and price was positive and strong. The coefficient of determination (R^2) of price from live weight was 0.783, subsequent inclusion of wither, height and girth circumstances into prediction equations yielded higher R^2 values of 0.785, 0.796 and 0.799, respectively. The higher relationship observed between morphometric measurements and price implies that it is easy to use the former individually to indicate the latter. The price of sheep can best be predicted more precisely when live weight, wither height, body length and chest girth are included in the prediction model. It is recommended that farmers should price sheep based on morphometric specifically those that are highly correlated with body weight and price.

Keywords: Breed, Morphometric Trait, Nigeria, Price, Sheep

Introduction

Sheep can adapt to a broad range of environments and are found in all agro-ecologies of Africa (Rege & Lipner, 1992). They have special features like efficient utilization of marginal and small plots of land, short generation length, high reproductive rate, low risk of investment and more production per unit of investment as compared with cattle (Rege & Lipner, 1992). In Nigeria, they represent about 63.70% of the total grazing domestic animals (FAOSTAT, 2011). The adaptive features of goats and sheep, such as feeding behavior, disease and heat tolerance and remarkable recovery capacity from drought, enable them to cope effectively with a variety of stressful tropical environmental conditions (Yakubu *et al.,* 2011).

Traditionally, animals are usually assessed visually, which is a subjective method of judgment (Abanikannda & Leigh, 2002). Body size and shape measured objectively could improve selection for growth by enabling the breeder to recognize early-maturing and late-maturing animals of different sizes. Morphological variation within a species can provide biologists with a wealth of information (Vargas *et al.,* 2007).

Morphological and morphometric animal selection can constitute an effective system to breed preservation and improvement (Nsoso *et al.,* 2004).

One of the most important aspects of animal husbandry is marketing because appropriate pricing of sheep can lead to economic profit (Cam *et al*., 2010). Despite this importance, it is seldom measured in rural areas (Edea *et al*., 2009). Therefore animals are sold based on shabby and tricky background of assessment using visual appraisal of sheep which do not reflect the weight (live weight is positively associated with price), leaving the farmer and the buyer at the mercy of bargaining skills with very little to fall back on in arriving at the appropriate price of sheep on offer.

The aim of the study was to assess some morphometric traits in indigenous breeds of sheep and their association with price.

Materials and Methods

Location and climate

The study was conducted in the Potiskum Local Government area of Yobe State, the northeastern part of Nigeria. It is located on latitude 11^{o} 43'N and longitude 11^{o} 04'E (Ibrahim *et al.,* 2020). There are two distinct seasons in Potiskum: the rainy season and dry season. The rainy season lasts for about three to four months (from June to September), while the dry season, on the other hand, lasts for about eight to nine months (from October to May).

Experimental animal

A total of 150 (135 males and 15 females) matured sheep of mixed sex were used, of which 117 (106 males and 11 females) were Yankasa, 19 (17 males and 2 females) Uda and 14 (12 males and 2 females) Balami were randomly sampled from Local market in the study area.

Data collection

Morphometric traits and price were measured and recorded using the procedure described by FAO (2012) and anatomical reference points for the measurements as described by Salako & Ngere (2021). The traits measured were; live weight (LW), girth circumference (GC), body length (BL), wither height (WH), rump length (RL), loin girth (LG), horn length (HL) and price (PR).

Data analysis

Data generated were analysed using the general linear model (GLM) procedure of SPSS, version 25 (2017). Significantly different means were compared using the Duncan multiple range test (DMRT) (Duncan, 1955). The model used was as follows:

$Y_{ijk} = \mu + B_i + S_j + e_{ijk}$

Y_{ijkl} = dependent variable

μ = Overall mean

B_i = ith breed fixed effect (i = Yankasa, Uda, Balami)

S_j = jth sex fixed effect (j= Male, Female)

$e_{ij}k$ = Random error

The regression model adopted was as follows:

$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + + b_4 X_4$

Where Y = dependent variable (price)

X_1 to X_4 = body measurements

a = Intercept

b (1-4) = regression coefficients of Y on X (i = 1, 2, 3, 4).

Results and Discussion

The average morphometric characteristics of indigenous sheep, based on breed and sex, are presented in Tables 1 and 2. A significant (P<0.05) effect of breed was observed on most of the recorded morphometric traits, as well as price. The fact that there was a significant breed effect on body measurements corroborates the findings of some authors (Yunusa *et al*., 2013; Salako& Samuel, 2008). The authors attributed this to differences in the genetic structure of the breeds. A similar assertion was also made by Iyiola-Tunji *et al.* (2015). Sexual dimorphisms of morphometric traits, as observed in this study, are in agreement with the findings of Sowande *et al*. (2010), who reported that the linear body measurements of the WAD sheep were significantly affected by sex. This observation also conforms to the reports of Aklilu *et al*. (2013) working on Ethiopian sheep.

Sex had a significant (P<0.05) effect on live weight and girth circumference. The authors recorded higher values for males than females in all the parameters taken and noticed that sexual dimorphism in sheep is manifested with respect to a large number of body attributes and in most breeds. A similar report by Taye *et al.* (2016) from the Horro and Bonga districts in Ethiopia also indicated a considerable effect of sex on body measurements. The authors attributed this to the differential effects of androgens and estrogens and suggested that the latter, produced in females, restrict the growth and development of long bones. Furthermore, Thiruvenkadan (2005) reported lower body measurement values for females than males sheep. According to the author, this may be due to sex hormones, which promote larger muscle development in the latter.

The correlation coefficients among the morphometric traits and price are presented in Table 3. The results revealed that the relationships among traits and price were positive and strong. Prediction equations of price from morphometric traits are presented in Table 4. The result of the study revealed that live weight is good predictor of price with a coefficient of determination (R^2) of 0.783. The coefficient of determination (R^2) of price values observed in the current study ranged of

Table 1: Average morphometric traits (live weight and linear body measurement) and price according to breed

Variable	Yankasa (n=117)	Uda (n=19)	Balami (n=14)	LOS
LW (kg)	44.72 ± 2.06[c]	50.89 ± 2.06[b]	65.01 ± 1.56[a]	*
GC (cm)	34.48 ± 0.90[b]	36.47 ± 0.90[b]	39.08 ± 0.68[a]	*
BL (cm)	18.85 ± 0.28[b]	19.43 ± 0.28[b]	19.66 ± 0.21[a]	*
WH (cm)	29.31 ± 0.63[b]	29.67 ± 0.63[b]	33.55 ± 0.47[a]	*
RL (cm)	17.76 ± 0.53[b]	17.95 ± 0.53[b]	19.66 ± 0.40[a]	*
LG (cm)	40.04 ± 0.93[c]	41.00 ± 0.96[b]	44.10 ± 0.72[a]	*
HL (cm)	9.49 ± 0.73[c]	11.37 ± 0.73[b]	14.64 ± 0.55[a]	*
PR (N)	55537.74 ± 5321.25	70684.21 ± 5321.25	105200.00 ± 4007.40	*

LOS Level of Significant
LW = Live weight, GC = Girth circumference, BL = Body length, WH = Wither height, RL = Rump length, LG = Lion girth, HL = Horn length and PR = Price, * = P<0.05.

Table 2: Average morphometric traits (live weight and linear body measurements) and price according to sex

Variable	Male (n=135)	Female (n=15)	LOS
LW (kg)	47.09 ± 2.30	38.19 ± 2.59	*
GC (cm)	35.10 ± 0.85	32.90 ± 1.07	*
BL (cm)	18.99 ± 0.25	18.75 ± 0.25	NS
WH (cm)	29.91 ± 0.58	29.18 ± 0.55	NS
RL (cm)	17.93 ± 0.46	18.08 ± 0.46	NS
LG (cm)	40.47 ± 0.88	39.02 ± 1.21	NS
PR (N)	61348.15 ± 5641.19	42333.33 ± 5184.14	*

NS = Non-Significant and LOS Level of Significant
LW = Live weight, GC = Girth circumference, BL = Body length, WH = Wither height, RL = Rump length, LG = Lion girth, and PR = Price, * = P<0.05.

Table 3: Phenotypic correlation among the morphometric traits and Price

Variable	1	2	3	4	5	6	7	8	9
LW (1)		0.756*	0.519*	0.612*	0.457*	0.674*	0.734*	0.304*	0.885*
GC (2)			0.455*	0.374*	0.333*	0.686*	0.604*	-2.09*	0.685*
BL (3)				0.541*	0.430*	0.393*	0.493*	-0.81	0.498*
WH (4)					0.457*	0.456*	0.581*	-0.102	0.631*
RL (5)						0.383*	0.483*	0.027	0.548*
LG (6)							0.595*	-0.134	0.655*
HL (7)								-0.267*	0.787*
S (8)									-0.267*
PR (9)									

LW = Live weight, GC = Girth circumference, BL = Body length, WH = Wither height, RL = Rump length, LG = Lion girth and PR = Price, * = P<0.05.

from 0.783 to 0.799. The highest value (0.799) was realized when body weight, wither, height and girth circumstances were used. The higher association of price and traits measured was possibly due to their large contribution to animal size.

In conclusion, breed and sex affected most of the morphometric traits. The strong and positive relationship between morphometric measurements and price implies that it is easy to use the former individually to predict the latter. It is therefore recommended that sheep pricing should be based on morphometrics, specifically, those that are highly correlated with body weight and price.

Table 4: Prediction equation of Price on Some morphometric traits (measurements)

Prediction Model	(R^2)
PR = - 39893.41 + 2150.19 LW	0.783
PR = - 60276.01+2084.60LW+1234.47BL	0.785
PR = - 75647.71+1930.20LW+214.19BL+1402.98WH	0.796
PR = - 86472.22+1778.62LW+(-64.63) BL + 1552.22WH + 534.91GC	0.799

PR = Price, LW = Live Weight, BL = Body length, WH = Wither height and GC = Girth circumference. R^2 = Coefficient of determination

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Conflict of Interest
The authors declare that there is no conflict of interest.

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