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ESTIMATION OF LIVEWEIGHT OF BUFFALOES FROM BODY MEASUREMENTS

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Body measurements such as height, girth and length and body weight of 350 buffaloes in three age groups (2–5, 6–8, and above 8 years) were recorded to develop suitable formulae for the estimation of liveweight of buffaloes. Highly significant correlations between various body measurements and body weight were observed. From the joint effect of body measurements, the following prediction equations were derived for estimating the liveweight (Y) of buffaloes:

$Y = -1697.226 + (16.761) X_1 + (23.947) X_2 + (0.514) X_3$
(for 2–5 years old buffaloes)

$Y = -1604.790 + (1.268) X_1 + (30.902) X_2 + (3.960) X_3$
(for 6–8 years old buffaloes)

$Y = -1263.663 + (8.060) X_1 + (18.924) X_2 + (8.565) X_3$
(for more than 8 years old buffaloes)

The goodness of fit of these equations was tested by comparing the expected body weights with those of the observed by using Chi-square methods. The result showed that these equations fitted well with the data.

Of the milch animals of Pakistan, buffalo is considered a major source for the production of milk. Several millions of buffaloes presently available here, contribute in a large way to the agricultural economy and dietry standards of the nation. However, maximum benefit of the potential of this species is not being derived so far. This species, therefore, needs close attention and careful study of its various traits. Economical and simple procedures ought to be devised for proper management of these animals under field conditions.

The determination of liveweight of buffaloes is essentially required for various purposes such as for calculating maintenance requirements, for estimating gain or loss in liveweight of the animals and for finding out rate of growth in younger animals. For determining the liveweight of buffaloes, no alternative means other than the use of weighbridge are currently available.

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The use of a weighbridge is not only cumbersome and costly but also the weighbridge may not be easily available at all places. It was, therefore, planned to devise such a method that could enable the farm operators, stock owners, etc., to estimate the liveweight of their buffaloes without using the laborious weighbridge method.

REVIEW OF LITERATURE

The estimation of liveweight of buffaloes from their body measurements does not appear to have been undertaken elsewhere so far in an ogranised manner. However, references pertinent to the estimation of liveweight from body measurements in other species are available and are cited below :

Johnson (1939) estimated the liveweight of beef breeds of cattle (finished as well as feeder cattle) from their body measurements. The errors in calculations as determined by him ranged from 3.6 to 5.0 per cent. He suggested the following formula for the purpose :

$$W = \frac{G^2 X L}{300}$$

Where,

W = Liveweight of cattle
G = Heartgirth in inches
L = Length of cattle from the point of shoulder to the point of pin bone.

Brody (1945) reported that among all linear measurements, heartgirth was found to be highly correlated with liveweight in growing cattle. It was observed that weight varied most nearly with the cube of heartgirth. Anderson (1958) suggested the following formula for estimating liveweight (W) of dairy cattle and heifers :

$$W = 0.342\ (G+g)^{1 \cdot 85}$$

Keeping in view the age and breed differences in cattle, a girth modifier (g) in inches as given in the table was also used along with the heartgirth (G).

Inches to be added to actual heartgirth for age and breed differences.

Age	*Breed*			
	Jersey	*Guernsey*	*Ayrshire*	*Holstein*
Less than 3 years	0"	2"	2"	6"
Three to four years	2"	4"	4"	8"
Five years and over	2"	5"	5"	9"

Bozo (1967) reported that the correlations of body weight with heartgirth and height at withers of Hungarian Brown dairy cows were 0.705 and 0.363, respectively. Subhan (1975) determined the liveweight of sheep from their body measurements and reported that highly significant correlations existed between various body measurements and body weight of Damani and Thalli sheep.

MATERIALS AND METHODS

The data for this study were collected from 350 buffaloes partly maintained at the University of Agriculture, Faisalabad, dairy farm and partly from those of private animals brought for insemination to the Department of Animal Reproduction of the University. Only normal and healthy animals, not less than two years old, excluding pregnant buffaloes were used for this study.

The following data were recorded :

1. Age and weight of animals
2. Height at withers
3. Heartgirth
4. Length—from the point of shoulder to the point of pin bone

The liveweight of a buffalo was considered as a dependent variable (Y), while height (X_1), girth (X_2) and length (X_3) were considered independent variables. The method of linear multiple regression was employed to estimate the liveweight of a buffalo using the information on independent variables. Where a dependent variable is influenced by two or more independent variables, the relationship can be symbolically represented by the equation,

$$Y = a+b_1X_1+b_2X_2+b_3X_3 \quad \ldots\ldots(1)$$

Where,

Y is the estimate of the dependent variable,

X_1, X_2 and X_3 represent the independent variables,

b_1, b_2 and b_3 are partial regression coefficients.

The equation is actually an equation of multiple regression as it represents a method of predicting values of Y from individual values of the variables. By changing to deviations from the mean, equation (1) becomes

$$Y = b_1x_1 + b_2x_2 + b_3x_3 \quad \ldots\ldots(2)$$

These and other subsequent equations were solved by a tabular method known as abbreviated Doolittle solution as referred to by Goulden (1952). Separate regression equation for each of the three groups of buffaloes was derived. To test the significance of multiple regression effect of independent variable on body weight, the data were subjected to analysis of variance and F values thus calculated were tested for significance.

RESULTS AND DISCUSSION

The mean values and standard errors in respect of height (X_1), girth (X_2) and length (X_3) and body weight of buffaloes are given in Table 1.

Table 1. *Mean values for body measurements and body weight of buffaloes*

Age groups	Height (inches)		Girth (inches)		Length (inches)		Weight (lb)	
	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
2-5 years (136 animals)	49.58	0.186	73.00	0.400	49.58	0.186	929.00	11.720
6-8 years (182 animals)	51.35	0.137	79.40	0.276	56.65	0.229	1137.70	8.905
Above 8 years (32 animals)	52.09	0.110	82.38	0.589	58.25	0.176	1214.00	20.800

It is obvious from the data given in Table 1 that body measurements and body weight gradually increased with age in buffaloes in three age groups (this may be read within the meaning of this study). Simple correlations between various body measurements and body weight of buffaloes in various age groups were determined (Table 2).

Table 2. *Simple correlation coefficients between various body measurements and body weight of buffaloes.*

Age groups	Measurements	Body weight (Y)	Length (X_3)	Girth (X_2)
2-5 years	Height (X_1)	0.659**	0.523**	0.473**
	Girth (X_2)	0.947**	0.370**	
	Length (X_3)	0.495**		
6-8 years	Height (X_1)	0.298**	0.392**	0.248**
	Girth (X_2)	0.910**	0.208**	
	Length (X_3)	0.281**		
Above 8 years	Height (X_1)	0.520**	0.521**	0.543**
	Girth (X_2)	0.730**	0.489**	
	Length (X_3)	0.590**		

**Highly significant.

The correlation values showed that as compared to body height and length, heartgirth was remarkably correlated with body weight of buffaloes falling in all the three age groups. The correlations between body weight and

length and body weight, respectively, did not show a consistent trend. However, all the correlations presented in Table 2 were found to be significant ($P<0.01$). Brody (1945) reported that among all linear measurements, heartgirth was found to be highly correlated with liveweight in growing cattle.

Simple regression coefficients of body weight on height, girth and length in 2–5 years old buffaloes were 41.509, 27.768 and 24.356, respectively. It was thus indicated that body weight increased on an average by 41.509 pounds for every one inch increase in height; 27.768 pounds for an increase of one inch in girth and 24.356 pounds for an increase of one inch in length. In case of 6–8 years old buffaloes, simple regression coefficients of body weight on height, girth and length indicated an increase of 19.294 pounds of body weight for every one inch increase in height; 29.306 pounds of body weight for each increase of one inch in girth and 10.906 pounds weight for every one inch increase in length. Similarly, in buffaloes with more than 8 years age, the corresponding regression coefficients indicated an increase of 22.153 pounds in body weight for every one inch increase in height; 24.903 pounds of body weight for each increase of one inch in girth and 19.691 pounds weight for every one inch increase in length. These regression coefficients were significant and showed the relationship between dependent and independent variables when considered individually, ignoring the effects of other variable.

Since all the independent variables were affecting the body weight simultaneously, the effect of each independent variable on body weight could not be indicated by the simple correlation or regression coefficients. Therefore, to study the joint effect of independent variables on the dependent variable, partial regression coefficients were calculated.

By using the partial regression coefficients in the equation,

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

the following prediction equations were derived :

$$Y = -1697.226 + (16.761) X_1 + (23.947) X_2 + (0.514) X_3$$

(for 2–5 years old buffaloes)

$$Y = -1604.790 + (1.268) X_1 + (30.902) X_2 + (3.960) X_3$$

(for 6–8 years old buffaloes)

$$Y = -1263.663 + (8.060) X_1 + (18.924) X_2 + (3.960) X_3$$

(for buffaloes with more than 8 years age)

Where,

Y denotes predicted body weight in pounds. The regression in three

age groups of buffaloes was tested by the analysis of variance. The values of F in three age groups were highly significant.

The goodness of fit for the equations derived from this study was tested by Chi-square method on fifteen per cent observations randomly picked from total data for each group of buffaloes by comparing the estimated body weights with those of the observed. It was found that no significant difference existed between observed and the predicted values. Of the twenty randomly picked observations for 2–5 years old buffaloes, it was noticed that in 50 per cent of the cases, the variation in observed and estimated body weights was not more than 2.0 per cent of the observed body weight. It was only in one case that the variation reached the level of 7.13 per cent. For 6–8 years old buffaloes, the percentage variation in observed and the estimated body weights was not more than 2.0 in 37 per cent of the cases and in no case variation exceeded 5.6 per cent of the observed body weight. Similarly, in buffaloes that were more than 8 years old, the percentage difference in observed and the estimated body weights was not more than 2.0 in 60 per cent of the cases and in any case the variation did not exceed 3.5 per cent of the observed body weight.

Johnson (1939) and subhan (1975) suggested simulating formulae for determining the body weights of various species of farm animals. These formulae do not appear to take into account the variation in body weight due to age. The age factor has been taken care of in the formulae derived from the present study. These formulae, thus may be considered more accurate. Anderson (1958), while suggesting a formula for the purpose did keep in view the age and breed differences in cattle by using a girth modifier.

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