EVALUATION OF DIFFERENT FORMULAS FOR WEIGHT ESTIMATION IN BEETAL, TEDDI AND CROSSBRED (BEETAL X TEDDI) GOATS

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ABSTRACT

The objectives of the present study were to evaluate the fitness of two different formulas for weight estimation of Beetal, Teddi and Crossbred goats and determination of the best fitted regression equation. Data on body weight and body measurements were collected from Livestock Production Research Institute (LPRI) Bahadar Nagar Okara (100 each Bettal, Teddi and Crossbred animals). The correlation coefficients between body weights body weight and body length + chest girth of Beetal goat were positively and significantly correlated (0.408 and 0.287) while non-significant with body height (0.091). The correlation coefficients for different body measurements ranged between 0.578 to 0.900 and 0.318 to 0.376 for Teddi and Crossbred goats, respectively which were significantly correlated with body weight ($P<0.01$). Simple and multiple regression models were fitted with body weight as dependant variable and height at withers, chest girth and body length as independent variables. Total variation in body weight accounted by three body measurements in case of Beetal goat was 21.0 percent while 12.4 percent in case of crossbred animals. The model constructed with given data was the best fitted multiple regression model with chest girth, body length and height at wither as independent variables (R^2 = 0.210, MS_E = 19(18.032). This suggests that weight could be estimated more accurately by combination of two or more measurements. It was concluded that the body weight of Teddi could be estimated with the formulae mentioned in literature but in Crossbreds and Beetal body weight can be estimated with some modifications formulae.

Key words: Body weight, Correlation, Goat breeds, Prediction and Regression

INTRODUCTION

Goat rearing is of great importance in Pakistanis households and plays major role for the sustenance of small and marginal farmers and landless agricultural laborers. There is an increase in goat population at the rate of 6% over the last many years, and present population is 54.70 million heads (Anonymous, 2005)**.** Beetal and Teddi are the breeds of goat with their home tract in central Punjab. Teddi goat is famous for its high prolificacy and higher twinning rate while Beetal is regarded as poor man's cow because of its considerably higher milk production than other goat breeds of the country apart from the very fact that its males are specifically preferred for sacrificial purposes. Because of having two distinct features of productive and reproductive traits, crossbreeding between these two breeds was done to get improvement in productive and reproductive parameters in crossbreds **(**Shah, 1994).

The body weight of a goat is important for a number of reasons, related to breeding (selection), feeding and health care. However this fundamental knowledge is often unavailable to those working with goats in the small scale-farming sector, due to unavailability of scales. Hence, farmers have to rely on questionable estimates of the body weight of their goats, leading to inaccuracies in decision-making and husbandry. The method of weighing animals without scales is to obtain a regression formula of body weight on a certain number of body characteristics, which can be measured readily. Body measurements have been used to predict body weight by several workers in many goat breeds (Das *et al.,* 1990; Prasad *et al.,* 1990*;* Tandon, 1965; Ulaganathan *et al.*,1992; Singh and Mishra, 2004). Such procedures are almost non-existent for the Pakistani goat breeds. Enevoldsen and Kristensen (1997) reported that different models might be needed to predict body weight in different environmental conditions and breeds. Hence, present study had been conducted to determine the suitability of available formulae for estimation of body weight of these breeds and in case of unavailability of any suitable formulae to determine the best fitted regression model for prediction of live weight of Teddi, Beetal and Crossbred goats under farm conditions.

MATERIALS AND METHODS

The study was carried out at Livestock Production Research Institute Bahadar Nagar, Okara district of central Punjab. Data were collected from a total of 300 (100 animals of each breed, (Beetal, Teddi and Cross-bred including adult males and females). Measurements recorded were live body weight, height at withers, body length and chest girth followed the

procedure described by Sasimowski (1987) as indicated in Figure 1. The body measurements were fitted in the following given formulae to determine the estimated weight and then was correlated with the actual body weights to determine the accuracy of these formulae.

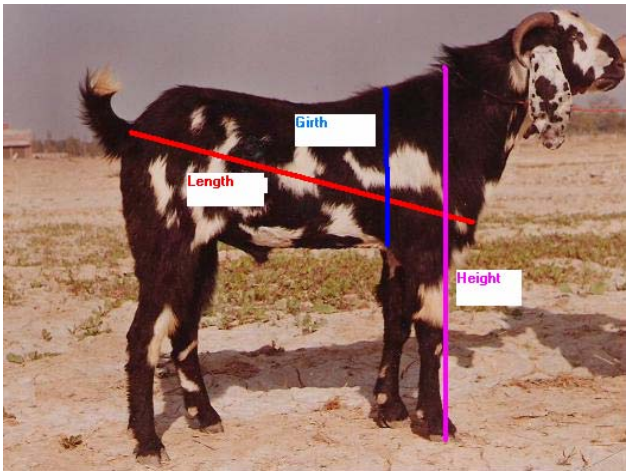

Figure 1. A Beetal goat showing the exact points at which the measurements were take

Formula 1. (Khan *et al.*,2004)

$$W = \frac{(G + L)^2}{X}$$

Where;

W= Live weight of goat in lbs L= Length in inches
X= 17.0 when girth ranges from 15-19 inches
X= 13.5 when girth ranges from 20-25 inches
X= 12.0 when girth ranges from 25 inches
Formula 2. (Khan *et al.*,2004)

Weight in lbs. = Heart Girth^2 X Body Length ÷ 300

For Beetal and Crossbred goats, weight was regressed on body measurements using least square by stepwise regression analysis by using SPSS version 10.0 for widows to determine the combination of body dimensions that explain variation in the dependent variable (Sharaby and Suleiman, 1987). The comparison amongst actual body weight and predicted body weight was made by Paired T Test (Slippers *et al.,* 2000). Pearson's correlation coefficients were estimated between body weight and all body measurements. To determine the best fitted regression equation the criteria viz., coefficient multiple determination (R^2), residual mean square (MS_E) and error standard deviation (SD_E) and range observed in predicted weight were also used for evaluating and comparing different regressions models (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Means and standard errors of live weight and body measurements are presented in Table 1.

Table 1: Average body measurements and weight of mature goats in Beetal, Teddi and Crossbred

Breed	Number of observations	Height at withers (inches)	Chest girth (inches)	Body length (inches)	Body weight (Kg)
Beetal	100	44.87±3.22	40.2640±4.05	36.13±2.86	58.21±4.78
Teddi	100	20.60±3.96	27.1540±6.0457	20.38±3.49	30.71±6.60
Crossbred	100	25.58±5.53	27.65±6.35	24.13±5.34	54.20±11.73

The correlation coefficients between body weight and body measurements for Beetal, Teddi and crossbred goat are presented in Table 2.

A positive and highly significant correlations ($P<0.01$) were observed in Teddi and crossbreds in the present study. The correlation coefficients observed were comparable to values reported by Mukherjee *et al.*,(1981), (1986); Das and Sharma, (1994); Singh *et al.*, (1987); Topal *et al.,* (2003) and Topal and Macit, (2004) for Kanni breed of India. The high correlation coefficients between body weight and body measurements for Teddi breed suggests that either of these variables or their combination could provide a good estimate for predicting live weight of Teddi goats. Among these three body measurements, chest girth had the highest correlation coefficient, followed by body length and height at withers. Since body measurements had high correlation with body weight, this may be used as selection criteria, (Bhattacharya *et al.*, 1984; Bose and Basu, 1984).

In Beetal goats the body measurement were also positively correlated to body weight, which was significant in case of body length and chest girth ($P<0.01$) while non-significant ($P> 0.01$) in case of height at withers but the correlation is not as high as in case of Teddi goat, which indicated that these measurements can be used to predict the body weight of these animals which was also indicated in the regression equations from the results of present study, although further study is needed in this regard.

Table 2: Correlation of body measurements and weight of Beetal, Teddi and Crossbred animals

Breed	No. of observations	Height at withers	*Chest girth*	Body length
Beetal	100	0.091^{NS}	0.287**	0.402**
Teddi	100	0.578**	0.900**	0.715**
Crossbred	100	0.318**	0.376**	0.350**

Correlation between estimated and actual body weight of Beetal, Teddi and Crossbred animals is given in Table 3 which was highest for formula 2 in case of Teddi goat (0.823) and minimum for crossbred in case of formula 2 (0.346).

Table 3: Correlation between formula estimated and actual body weight of Beetal, Teddi and Crossbred animals

Breed	Mean Weight (Lbs)			Correlation between F1 and Actual Weight.	Correlation between F2 and Actual Weight.
	Formula 1 (F1)	Formula 2 (F2)	Act. Wt		
Beetal	156.29±63.36	58.60±31.08	58.21±4.79	0.366^{NS}	0.465^{NS}
Teddi	84.94±34.76	24.98±11.54	30.71±6.60	0.786**	0.823**
Crossbred	101.64±49.10	31.76±20.24	54.20±11.73	0.355**	0.346**

3** Correlation is significant at the 0.01 level (2-tailed)

There was a positive and significant correlation ($P<0.01$) between actual body weight and estimated body weight for Teddi and crossbred animals (Table 3). The correlation for Teddi goat was maximum with formula 2 while maximum for formula one in case of crossbred animals. This indicates that these formulae can be used to estimate the body weight of these two breeds of goat. But positive and non-significant ($P> 0.01$) correlation in case of both formulae for Beetal goats indicated the less reliability of these formulae to estimate the body weight of Beetal goat and the reason for this may be that this breed is much massive as compared to others.

Table 4 shows two final models for the estimation of body weight for Beetal breed while one for crossbred animals.

Table 4: Regression equations for estimation of body weight in Beetal and crossbred animals

Breed	Equation	R^2
Beetal	Wt = 39.15 + 0.47HG	0.153
	Wt = 24.39 + 0.45HG+0.42L	0.210
Crossbred	Wt = 35.51 – 0.054 H + 0.424 HG	0.124

HG = Heart Girth in inches L= Length in inches H = Height in inches

In a multiple regression analysis the important thing to be considered was which independent variables were most considered in determining the dependent variable.

The coefficient of determination (R^2) indicates the body measurements success to describe variation in live weight. The variation of body weight due to body measurements differed between two breeds. Thus chest girth accounted 15.3 percent of the total variation in body weight, together with total variation of 21.0 percent of all three measurements in case of Beetal breed while in case of crossbred animals all three estimates of body measurements showed 12.4 percent variation. This indicated that involvement of some other factors in estimating the body weights and among those the major one may be feed and water intake status of animals. The association of body weights with body measurements was of course due to contribution in body weight by the body measurements. It is in line with findings of Mayaka *et al.,(*1995); Mohammed and Amin, (1996); Benyi,(1997); Myeni and Slippers,(1997); Nesamvuni *et al.,(*2000); Slippers *et al.,*(2000); Topal *et al.,(*2003) and Topal and Macit, (2004). But in case of Beetal breed there is need of further study to establish such relation because the relationships are not strong enough to be more reliable for estimating body weight of Beetal breed. It is clear that maximum value of R^2 was obtained by combination of more than one estimates of body measurements so this indicated that weight can be estimated more accurately by combination of two or more than two factors than only one. The studies reported by Bhattacharya *et al.,(*1984); Bose and Basu,(1984); Das and Sharma, (1994); Prasad *et al.*,(1990); Topal *et al.,(*2003) and Topal and Macit (2004) also supported these results.

As a criterion, the value of R^2 always increased as more independent variables were added to the regression. So, R^2 was not suitable for comparing two different equations in case of Beetal breed. Hence, the criterion that was free from this disadvantage viz., residual mean square (MS_E) as per Snedecor and Cochran (1989) was used. Inclusion of chest girth and body length produced higher R^2 with the smallest MS_E. Hence, the regression equation with the above combinations may be used for estimating the body weight of Beetal. This is similar to the reports of Topal *et al.,(*2003); Topal and Macit, (2004) and Ulaganathan *et al.*,(1992) who reported that larger R^2 and smaller MS_E produced better goodness of fit.

The coefficient of variation for males (residual standard deviation/ mean of the dependent variable) was 3.787 to 1.866 percent for Beetal while 10.9 percent in case of crossbred animals.

The predicted weight, difference between actual weight in proportions and the range for actual and predicted weight in different regression equations of both Beetal and crossbred animals is presented in Table 5.

In both breeds there was no significant difference between actual weight and predicted weight. But there was a difference in range values in each equation and the approximation to the actual was observed in equations with high R^2 and lower MS_E and SD_E in case of Beetal breed.

Table 5. The predicted weight, difference between actual weight in proportions and the range for actual and predicted weight in different equations of both Bettal and crossbred animals

Beetal Goat								
Actual weight			Predicted weight					
Mean	Min	Max	Equation 1			Equation 2		
			Mean	Min	Max	Mean	Min	Max
58.21±0.48	50.00	70.00	58.07±0.19	56.07	61.15	57.68±0.23	53.44	63.93
Crossbred goat								
Actual weight			Predicted weight					
Mean	Min	Max	Mean			Min	Max	
54.20±1.17	18.00	69.00	45.86± 0.24			41.75	49.95	

REFERENCES

Anonymous., (2005). Economic Survey of Pakistan. MinFAL, Islamabad.

Benyi K., (1997). Estimation of live weight from chest girth in pure and crossbred West African goats. Tropical Animal Health and Production. 29: 124-128.

Bhattacharya, B., T.K. Ghosh, R. Duttagupta and D.N. Maitra, (1984). Estimation of body weight in Black Bengal goats from body measurements. Indian Veterinary Journal. 61: 406-408.

Bose, S. and S.B. Basu, (1984). Relationship between body weight-measurement and meat production in Beetal goats. Indian Vet. J. 61: 670-673.

Das, N., H.B. Joshi and G.S. Bisht, (1990). Prediction of body weight from body measurements in Barbari and Jamnapari goats reared under intensive management system. Indian Vet. J. 67: 347-351.

Das, N. and A.K. Sharma, (1994). Growth performance of Black Bengal goats. Cheiron. 23:2 66-78.

Enevoldsen, C., T. Kristensen, (1997). Estimation of body weight from body size measurements and body condition scores in dairy cows. J. Dairy Sci. 80: 1988-1995.

Khan B.B., A. Iqbal, M. Riaz, M. Yaqoob, M. Younas, (2004). Livestock Management Manual I, Department of Livestock Management, Uni. Agri., Faisalabad, Pakistan.

Mason, I.L., (1996). A World Dictionary of Livestock Breeds, Types and Varieties, Fourth Edition, C.A.B International, 273 pp.

Mayaka, T.D., J. Tchoumboue, Y. Manjeli, and A. Teguia, (1995). Estimation of live weight in West African Dwarf goats from heart girth measurement. Tropical Anim. Hlth and Prod. 28:126-128.

Mohammed, I.D. and J.D. Amin, (1996). Estimating body weight from morphometric measurements of Sahel (Borono White) goats. Small Rumin. Res. 24: 1-5.

Mukherjee, D.K., C.S.P. Singh, and H. R. Mishra, (1981). Note on bodyweight measurement relationship in Grey Bengal goats. Indian J. Anim. Sci. 51 (9): 882-883.

Mukherjee, D.K., C.S.P. Singh, H.R. Mishra, and S. Nath, (1986). Body weight measurement relationships in Brown Bengal goats. Indian Vet. Medi. J. 10: 104-106.

Myeni, S.P. and S.C. Slippers, (1997). Estimation of body weight of Nguni goats from heart girth measurements. In: Proceedings of the Annual Symposium of the South African Society of Animal Scientists, Development of Animal Agriculture Branch. Mtunzini, RSA.

Nesamvuni, A.E., J. Mulaudzi, N.D. Ramanyimi, and G.J. Taylor, (2000). Estimation of body weight in Nguni type cattle under communal management conditions. South African J. of Anim. Sci. 30(1): 97-98.

Prasad, R.D.D., R.T. Madhava, E.K. Charyulu, and D. Munirathnam, (1990). Note on the prediction of body weights based on body measurements in Nellore sheep. Cheiron. 19 (6): 275-277.

Shah, S.I., (1994). Animal Husbandry. National Book Foundation, Islamabad.

Sasimowski, E., (1987). Animal Breeding and Production an Outline. Elsevier, Amsterdam. pp.31-113.

Sharaby, M.A., I.O. Sulleiman, (1987). Factors influencing meat production traits and their association with body weight dimensions. Word Review of Animal Production. 23 (4):86-88.

Singh, N. H., S.C. Mohanty, and M. Mishra, (1987). Prediction of body weight from body measurements in Black Bengal goats: a note. Indian J. Anim. Prod. and Management. 3 (1): 46-49.

Singh, P.N., and A.K. Mishra, (2004). Prediction of body weight using conformation traits in Barbari goats. Indian J. Small Ruminants. 10 (2): 173.

Slippers, S.C., B.A. Letty, and J.F. de Villiers, (2000). Prediction of the body weight of Nguni goats. South African J. Anim. Sci. 30 (1): 127-128.

Snedecor, S.W. and W.G. Cochran (1989). Statistical Methods. Eighth Edition. Iowa State University Press, USA.

Tandon, H.S., (1965). Relationship of body weight with body measurements in Betal goat. Indian J. of Dairy Sci. 18: 1987-1990.

Topal, M. and M. Macit, (2004). Prediction of body weight from body measurements in Morkaraman sheep. J. of Applied Anim. Res. 25: 97-100.

Topal, M., N. Yildiz, N. Esenbuga, V. Aksakal, M. Macit and M. Ozdemir, (2003). Determination of best fitted regression model for estimation of body weight in Awassi sheep. J. Applied Anim. Res. 23: 201-208.

Ulaganathan, V., K. Krishnappa and S. Shanmugasundaram, (1992). Prediction of body weight from linear body measurements in local goats. Indian J. Anim. Genetics and Breeding. 14: 2:31-32.