Predicting body weight of Tanzania shorthorn zebu cattle using heart girth measurements

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Abstract

Impact of research findings on Tanzania shorthorn zebu (TSHZ) cattle under agro- pastoral system in Tanzania have been lessened due to difficulties in relating visual appearance of animals with their live body weights. Managerial decisions have therefore been based on rough and inaccurate estimates. A simple, workable and accurate means was therefore thought to predict live weight of zebu cattle using heart girth measurement. A total of 300 TSHZ cattle were subjected to weighbridge as well as heart girth measurements and the findings subjected to regression analysis. Their live weights ranged from 170 to 390 Kg. The study revealed that heart girth had high correlation coefficient with live weight ($r = 0.94$, $p<0.01$). Grouping of data according to sex indicated that heart girth and live weight had closest correlation coefficient in both male and female, $r = 0.9385$ and $r = 0.9318$, respectively. The regression analysis of live weight on heart girth was highly significant ($R^2 = 0.88$, $P<0.01$), and the regression lines indicated that a linear relationship existed. The general equation for prediction of live weight of the TSHZ cattle was as follows: $Y = 4.55 X – 409 (\pm 17.9)$, Where, Y = live weight (Kg), X = heart girth (cm). This implies that the use of the heart girth measurements in prediction of live weight of TSHZ cattle is credible.

Key words: Agro-pastoral system, marketing, regression analysis, visual assessment

Introduction

Tanzania has the third highest cattle population among the countries in sub-Saharan Africa. The country has 19 million head of cattle, in which over 95% are known as the Tanzania Shorthorn Zebu (MLDF 2009). The Tanzania Shorthorn Zebu (TZHZ) cattle accounts for 40% of the 6.1 percent contribution of livestock industry to total GDP (Njombe and Msanga 2008). The contribution of TSHZ cattle is not limited to its share in the total GDP but also play other important roles such as contribution to national food supply (meat and milk), and food security; acts as a source of cash income, employment and an inflation free store of value; and provides manure and draught animal power thus contributing to sustainable agriculture (MLDF 2009).

Despite its importance, more than 80% of the TSHZ cattle are kept in the agro-pastoral system which is characterized by poor resource investment. Management decision is therefore based on a trial and errors approach. Marketing weights and estimation of animal's cash value, drug administrations as well as conducting breeding studies, field experiments and estimation of dressed carcass weight are customary based on visual assessment (Msangi et al 1999). This is mainly because the use of live weight criteria as recommended worldwide requires sophisticated facilities, weighing instruments which are costly to obtain, need technical maintenance and heavy to transport to agro-pastoral herds especially in remote and rural areas. At present, animal owners, veterinarians and cattle traders depend on visual assessment (eye ball judgment) to live weight. The accuracy of such subjective method depends on individual use and experience.

Several authors have demonstrated that, there is a relationship between body measurements especially body condition score and heart girth with live-weight of animals (Nicholson and Sayers 1987, Msangi et al 1999, Nesamvuni et al 2000, Abdelhadi and Babiker 2009). Body condition scoring is a technique employed to determine through visual assessment of body fat deposition and manual palpation of subcutaneous fat cover on various parts of the body (Nelson et al 1985). Although the technique is simple to perform, it is subjective and requires practiced observers (Msangi et al 1999). Heart girth measurements have been reported to have high correlation coefficience with live weight in many breeds of cattle. Nicholson and Sayer (1987) reported good relationship between heart girth and body weight in Boran cattle. Also Msangi et al (1999) reported that heart girth can be used with great accuracy in estimating the live weight for all classes of cross bred dairy cattle. This work was therefore aimed at establishing relationship between heart girth measurements and live-weight of Tanzania Shorthorn Zebu cattle for managerial decisions in agro-pastoral system.

Materials and Methods

Three hundred live TSHZ cattle were used in to obtain data for this study. Sixty percent of animals were brought for sale at Morogoro cattle auctions and the remaining 40% were from pastoral herds around Morogoro region.

Photo 1. Tanzania shorthorn zebu cattle from Morogoro Region, Eastern Tanzania

Live body weights were taken using a mobile weighbridge and recorded to the nearest kilogram Kg). Heart girth (HG) was measured while animals were standing in a crush on four legs with head maintained in an upright position as described by Goe et al (2001). A plastic tape marked in centimeter (cm) was drawn around each animal directly behind the front legs and the base of the hump. In order to standardize readings, a constant tension of 300g was applied to each measurement. The measurement was repeated three times and average recorded to the nearest half centimeter. Estimation of age in all animals was done by visual assessment of eruption and wear of dentition using a standard method described by Goetz (1979). Heart girth measurements weighbridge readings and estimation of age were taken by the same individuals throughout the study period.

Statistical analysis

Collected data were handled in Microsoft excel whereas statistical analysis were done by using Statistical Analysis System (SAS 1999). The general linear model (GLM) procedure of SAS was used to get descriptive statistics (means, standard deviation and correlation coefficient) and the regression technique was also used to obtain the relationship between live body weight and heart girth for each sex and age groups.

Results

Live animal measurements

Table 1 shows overall body weights and heart girth measurements of Tanzania shorthorn zebu cattle.

Table 1. Live animal measurements of Tanzania shorthorn zebu cattle.

Age (years)	sex	No of animals	Heart girth cm (Average +SD)	Range	Weight (Average + SD)	Range
Less than 2	M	34	125 ± 4.7	112 -137	164 ± 18.6	106 - 185
	F	25	133 ± 3.6	131 - 139	199 ± 14.3	190 - 215
	M+F	59	126 ± 5.3	112 - 139	169 ± 21.4	106 - 215
2 to less than 3	M	46	132 ± 5.4	130 - 151	204 ± 18.3	146 - 247
	F	28	143 ± 3.9	139 - 147	237 ± 7.8	227 - 248
	M+F	74	140 ± 5.4	130 - 151	218 ± 19.1	146 - 248
3 to less than 4	M	56	147 ± 6.5	137 -155	249 ± 23.6	207 - 294
	F	26	149 ±2.3	146 - 152	255 ± 4.3	250 - 260
	M+F	82	147 ± 6.1	137 - 155	250 ± 21.9	207 - 294
4 and above	M	59	161 ± 6.6	147 - 175	332 ± 32.9	265 - 409
	F	26	156 ± 5.3	155 - 166	332 ± 33.3	290 - 387
	M+F	85	160 ± 6.6	147 - 175	332 ± 32.7	265 - 409
All Male animals		195	146 ± 14.4	112 - 175	253 ± 69.3	106 - 409
All Female animals		105	146 ± 8.6	130 - 166	257 ± 49.3	180 - 387
All animals		300	146 ± 13.8	112 - 175	253 ± 66.9	106 - 409

In this table: M = male, F= female

Correlation coefficients

The correlation coefficients between live weight and the heart girth measurement of all animals studied are shown in Table 2.

Table 2. Correlation coefficients between heart girth and live weight of Tanzania shorthorn zebu cattle

Heart girth	Correlation coefficient	Level of significance
All animals	0.94	<0.0001
Male animals	0.94	<0.0001
Female animals	0.93	<0.0001
Less than 2 years old	0.91	<0.0001
2 to less than 3 years old	0.50	<0.0003
3 to less than 4 years old	0.75	<0.0001
4 and above years old	0.65	<0.0001

All the correlation coefficients between live weight and the hear girth measurement were significant. A higher positive correlation coefficient was found between live weight and heart girth in male cattle/bulls ($r = 0.94$, $P < 0.01$) than in other classes of cattle studied.

Regression analysis

Regression of live body weight on heart girth around the chest for all animals gave a straight line relationship (Figure 1). The regression equation of live weight (y) on heart girth (x) for live weight indicated that an increase or a decrease of one cm of heart girth around the chest gave an increase or a decrease of 4.79 kg of live weight:

$Y = 4.55\ X – 409\ (\pm\ 17.9),\ R^2 = 0.88$

The regression equations for the live weight in female and male cattle were:

Female cattle: $Y = 6.24\ X - 525\ (\pm\ 62.2),\ R^2 = 0.87$

Male cattle: $Y = 4.81\ X – 410\ (\pm\ 18.9),\ R^2 = 0.88$

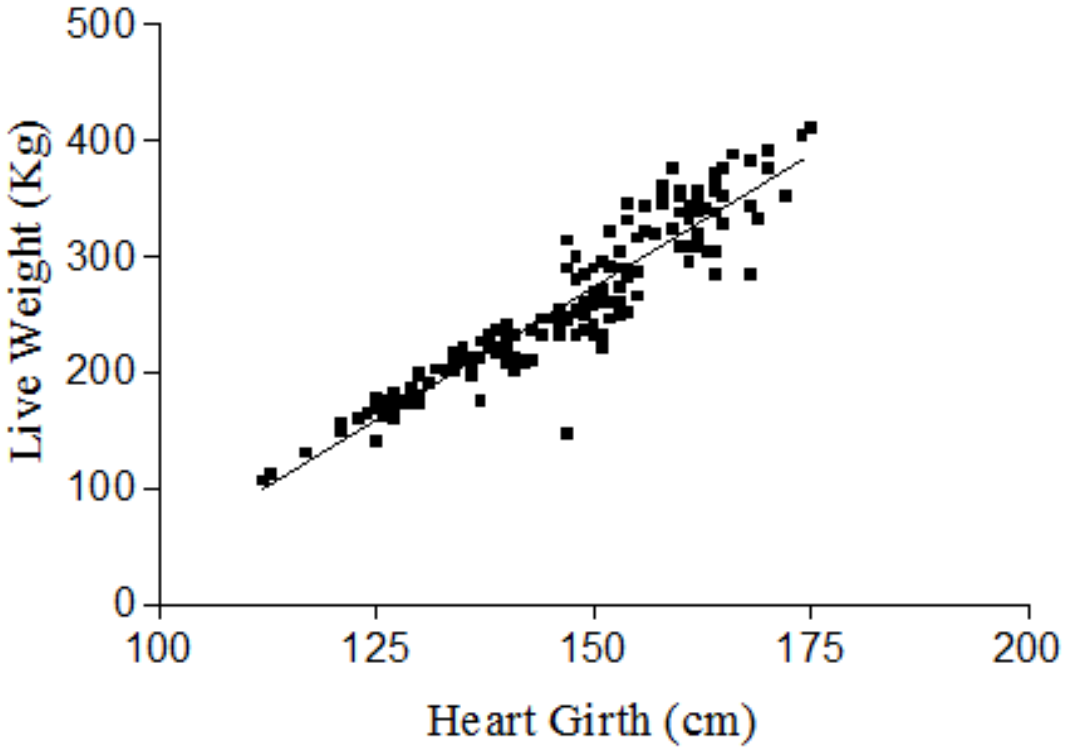

Figure 1: The regression line of live weight on heart girth around the chest of TSHZ cattle

The regression equation provides an accurate estimate of live weight of male Tanzania shorthorn zebu cattle, when heart girth measurements and live weights ranged from 112 to 175 cm and 106 to 409 Kg, respectively.

Discussion

The mean values of heart girth and live body weight in the present work were lower from those reported by (Abdelhadi and Babiker 2009) of 151 kg and 266 cm, respectively for Baggara zebu cattle from Western Sudan. The live weight is also lower than that reported for zebu cattle of South America (Sosa et al 2002), zebu cattle of Australia (MacGowan et al 2002) and Boran cattle of Ethiopia (Nicholson and Sayer 1987). These differences might be due to the variation genetic effects, environment and management practices. However, the mean weight in the present study is similar to that reported earlier by Mpiri et al (1988) and Shirima et al (2005) for TSHZ cattle.

The calculation of the correlation coefficients showed that live weight and heart girth were highly correlated, which clearly indicated that heart girth is the most reliable measurement for prediction of live weight of zebu cattle. This is in agreement with the findings of other studies

which reported high correlation coefficient between live weight and heart girth measurement (Msangi et al 1999, Abdelhadi and Babiker 2009).

The regression analysis of the results from all animals under study indicated that a linear relationship existed between live weight and heart girth. This was similar to the results for cross bred dairy cattle (Msangi et al 1999) and Baggara zebu (Abdelhadi and Babiker 2009) respectively.

The regression equation $Y = 4.79 X – 409 (\pm 17.8)$ gave an accurate estimate of live weight of male Tanzania shorthorn zebu cattle, when heart girth measurements and live weights ranged from 112 to 175 cm and 106 to 409 Kg, respectively. However, the equation is slightly different from that reported by other authors for zebu bulls. Abdelhadi and Babiker (2009) formulated an equation of $Y = 3.19x – 260 (\pm 0.13)$ for Baggara bulls in Sudan while Goe et al (2001) got an equation of $Y= 4.21X – 365$ for working Abyssinian Short-horned zebu oxen in the Ethiopian highlands. This variation might be due to the different genetic effects and management practices of animals involved in the studies.

Conclusion

- Body measurement such as heart girth can be used to predict live body weight of Tanzania shorthorn zebu cattle.

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