The relationship between heart-chest girth, body length and shoulder height, and live weight in Indonesian goats[1]

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ABSTRACT: Knowledge of the live weight and rate of growth of animals is critical to the success of any animal enterprise. Decisions about the onset of breeding, weaning, supplementary feeding and health management should be made with an understanding of the live weight of the animals involved. In developed countries there are number of mechanical (e.g. clock face) and electronic weighing systems available for goat producers to purchase. The cost of weighing systems is a major expense and only purchased where large numbers of animals are farmed. These weighing systems are rarely used in (small holder) goat production systems where the farmer may own less than 20 animals and these animals may not be managed as a large flock but as small units. In many parts of Asia goats are housed in *kandangs* – raised wooden huts that hold 1to10 goats that are fed using cut and carry systems. In the Enrekang Regency of South Sulawesi, Indonesia we involved local goat farmers in the measurement of body length, shoulder height and heart-chest girth of local goats, from across a wide range of ages and live weight, to develop predictive equations for estimating the live weight of their goats. A total of 302 measurements from 135 goats from 9 to 61 kg live weight were used and heart-chest girth measurement gave the best estimate of live weight ($y = 0.0127x^2 - 0.69x + 14.7$; $R^2 = 0.92$). There was some difficulties in ensuring the repeatability of measurements of shoulder height and body length, and these difficulties may have contributed to the lower correlations ($y = -0.0007x^2 + 1.0027x - 24.6$, $R^2 = 0.64$; $y = 0.0128x^2 - 0.478x + 5.98$; $R^2 = 0.75$; respectively) with live weight. The process of estimating live weight from heart-girth measurement was embraced by goat farmers as a cheap and effective management tool, partly as they were directly involved in the generation of the relationship, and as a cheap husbandry (and marketing) tool for measuring and thus managing their goats.

Key words: heart-chest girth, live weight, Indonesian goat

INTRODUCTION

Knowledge of the live weight and rate of growth of animals is critical to the success of any animal enterprise. Decisions about the onset of breeding, supplementary feeding and weaning should be made with an understanding of the live weight of the animals involved. Changes in an animal's live weight can indicate developing gestation, changes in the quality or quantity of the feed consumed by animals, problems with nutritional deficiencies, and the onset of diseases. Many diseases are treated where knowledge of the animal's live weight is necessary for the correct treatment to occur (e.g. drenching for control of intestinal helminths) and where animals are sold based on their live weight and income derived on a per kilogram basis this can only be accurate where the weight of the animal is known.

In developed countries there are number of mechanical (e.g. clock face) and electronic weighing systems available for goat producers to purchase. The cost of weighing systems is typically a relatively major expense (hundreds to several thousand dollars) and only purchased where large numbers (typically thousands) of animals are farmed. Thus these weighing systems are rarely used in (small

holder) goat production systems where the farmer may own less than 20 animals and these animals may not be managed as a large flock but as small units, as found in parts of Asia.

The Enrekang Regency has the third largest population of goats in South Sulawesi and has been identified as an area of eastern Indonesia where goats have the potential to increase intake of animal protein in the diets of village people as well as significantly increasing their incomes and thus their standard of living (ACIAR-SMAR/2007/201). The majority of Enrekang goats are housed in kandangs – widely spaced raised wooden huts that typically hold 1 to 4 goats - where they are primarily fed gliricidia, using a cut and carry system from the surrounding forest where vanilla, cocoa and other estate crops are grown.

In an ACIAR project (ACIAR-SMAR/2007/201) it was necessary to weigh goats to monitor the effectiveness of strategies to improve feeding and watering systems for goats housed in kandangs in estate forests in the Enrekang Regency.Traditional animal weighing systems are difficult to use in hilly terrain where each small group of housed animals, that need to be weighed regularly, may be hundreds of meters apart.

The scientific literature contains studies from various groups around the world that have used morphometrics to derive a relationship between some body measurement, typically the girth around the chest, above the heart (hence forth known as the heart-chest girth measurement), and the live weight of the animal (Ayoade, 1981, Hassan and Ciroma, 1991, Mohammed and Amin 1996, De Brito Ferreira et al. 2000, Kafidi et al. 2000, Khan et al. 2006, Alade et al. 2008, Thanh et al. 2008). Estimates of live weight based on the relationship can be reliable if the measurement of heart-chest girth is done accurately and consistently. However it is not clear if an equation developed on one breed or type of goat in one location is suitable for use elsewhere with other goats.

Incorporating a combination of morphometric measurements has in some instances improved the accuracy of the prediction of live weight. However the development of an equation to predict live weight is only useful for goat farmers in rural communities where (1) the predictive equation is applicable to their goats across a wide range of live weights; (2) farmers have a clear understanding of what they are doing when they use, for example, the measurement of heart-chest girth to estimate live weight (and why the measurement must be taken with due care); and (3) the predictive equation is in a form useable by goat farmers - ideally as a cloth tape measure that has units of measurement on one side and the estimated live weight of the animal on the other side of the tape measure.

The primary purpose of this research was to develop the best predictive equation for estimating live weight for goats, across a wide range of live weights, in the Enrekang Regency of South Sulawesi. As an outcome of involvement by farmers in collecting data for development of the equation we were also interested in determining the level of farmer usage of a cloth measuring tape as a husbandry (and marketing) tool for measuring and thus managing their goats.

MATERIALS AND METHODS

Goats used in this study belonged to two farmer groups, Penanian and Sipakana groupsin the Enrekang District of South Sulawesi. These two groups participated in this study following a selection process conducted by team members from ACIAR Australia, University of Hasanuddin, BPTP Sulsel and the Livestock Service of Enrekang District. Responsibility for taking care of the experimental animals, such as provision of feed and water remained the responsibility of the farmers.

The number of goats used was 135 goats with body weights ranging from 9 to 61kg, of different sexes (male and female) and of different ages (does and kids). During the study, measurement for each goat was carried out three times (with one month intervals between the measurements) in three different positions, namely heart-chest girth, body length, and shoulder height using a measuring tape (Figure 1). Following those measurements, each goat was weighed using a clock-face balance with 100 kg capacity to determine its actual live weight.

As the goats belonged to the farmers, and due to some technical problems during the measurements, not all of the135 goats were measured each time. Of the 135 goats, the actual number of measurements obtained was only 302 measurements. Problems typically were that the animal was sold by the farmers as they needed cash.
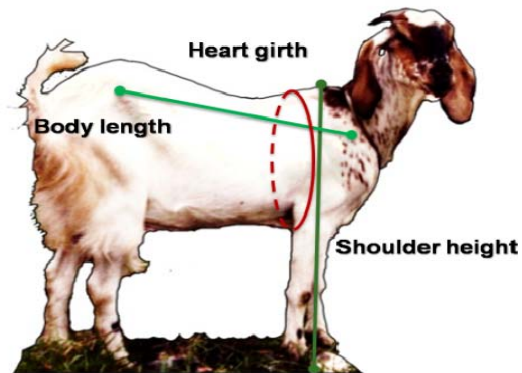
Figure 1. Sites of body measurement for the goats

Data were analysed using regression analysis using the program of SPSS

RESULTS AND DISCUSSION

The heart-chest girth, body length, and shoulder height were analysed to determine the relationship between these measurements with live weight taking into consideration the age (kid, doe, and bucks) and sex (male and female) of the goats. The results of these analyses are presented The results of these analyses are presented in Figures 2, 3, and 4
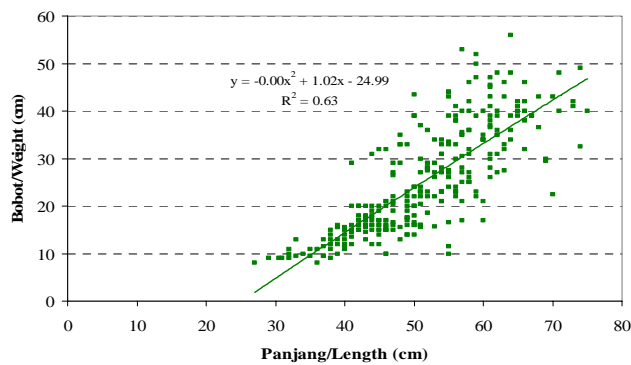

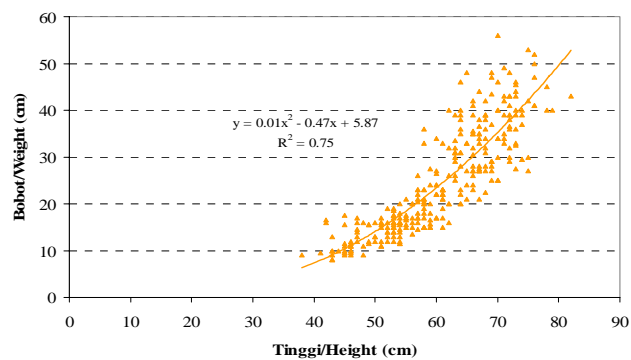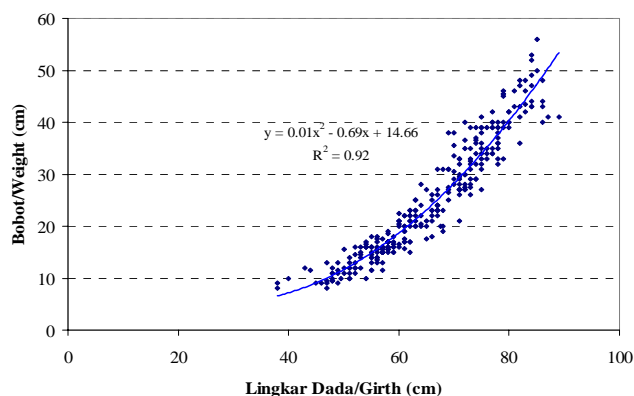**Figure 2.** Relationship between body length and live weight.

Figure 3. Relationship between shoulder height and live weight.

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The equation shown on the chart is $y = 0.01x^2 - 0.69x + 14.66$, $R^2 = 0.92$, with axes labeled **Bobot/Weight (cm)** and **Lingkar Dada/Girth (cm)**.

Figure 4. Relationship beween heart-chest girth and live weight.

Development of predictive equations for estimating the live weight from body measurements was carried out accross ages and sexes of Enrekang goat. From the total of 302 measurements taken from 135 goats, the heart-chest girth measurement gave the best estimate of live weight ($y = 0.0127x^2 - 0.69x + 14.7$; $R^2 = 0.92$) compared to others. Several studies have reported similar findings regarding significant correlation between body weight and heart girth. However, the equation developed was for particular ages or sex. For instance Thanh et al. (2008) reported that coeffisient determination between bodyweight and heart girth varied between 0.67 and 0.98 depending on age, sexes, and breeds of goat.

There was some difficulties in ensuring the repeatability of measurements of shoulder height and body length, and these difficulties may have contributed to the lower correlations ($y = -0.0007x^2 + 1.0027x - 24.6$, $R^2 = 0.64$; $y = 0.0128x^2 - 0.478x + 5.98$; $R^2 = 0.75$; respectively) with live weight. This finding is in agreement with that reported by Alade et al. (2008) who claimed that coefficient of determination (R^2) between body weight and heart girth was higher compared to that for shoulder height and body length.

The process of using a simple heart-chest girth to estimate live weight was embraced by farmers as a cheap and effective management tool partly as they were directly involved in the generation of the relationship to estimate live weight from the measurement of heart-chest girth. At the end of the ACIAR project, farmers were given a 120 cm cloth tape measure with the live weight estimates of thier goats printed on it with a live weight range from 1to 114kg.

CONCLUSIONS

Heart-chest girth measurement was determined to be the best predictor of live weight in Enrekang goats compared to the other predictors studied, i.e. shoulder height and body length.
The process of estimating live weight from heart-chest girth measurement was embraced by goat farmers as a cheap and effective management tool, partly as they are directly involved in the generation of the relationship, and as a cheap husbandry (and marketing) tool for measuring and thus managing their goats.

LITERATURE CITED

Alade, N. K., Raji, A. O. and Atiku, M. A. 2008. Determination of appropriate model for the estimation of body weight in goats. Journal of Agricultural and Biological Science Vol. 3 (4): 52-57.

Ayoade, J. A. 1981. Body measurements and weights of Malawian local goats. Trop. Anim. Prod., 6:4, 355.

De Brito Ferreira, M.P., Ramos De Carvalho, F.F., Nogueira Barros, N., and De Assis Mello, A. 2000. Relationship between body measurements and live weight in Saanen and Nubian goat breeds. In: 7th International Conference on Goats, p.223. Tours, France 2000

Hamayun Khan, Fida Muhammad, Riaz Ahmad, Gul Nawaz, Rahimullah and Muhammad Zubair. 2006. Relationship of body weight with linear body measurements in goats. Journal of Agricultural and Biological science, Vol. 1 No. 3: 51-54.

Hassan, A. and Ciroma, A. 1991. Bodyweight measurements relationship in Nigerian Red Sokoto goats. www.fao.org/wairdocs/ILRI/X55208/ 520bid.htm.

Kafidi, N., Baillargeon, J., Pelletier, R., Mellor, S., Brochu, E., Lapointe, J., Sneek, L., Baldassarre, H. 2000. Use of body measurement to predict body weight in goats. In: 7th International Conference on Goats, p222. Tours, France 2000.

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

Trinh Xuan Thanh, Dinh Van Binh, Nguyen Thi Mui, and Barry W. Norton. 2008. Prediction of live-weight from girth measurements of Bachthao goats in south central Vietnam. CARD AAAP Poster.