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Relationship of Chest Girth, Body Length, and Sex with Body Weight and Average Daily Gain in Batur Lambs

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ABSTRACT. This study aimed to investigate the relationships between chest girth, body length, and sex with body weight and average daily gain (ADG) in Batur lambs. The study sample consisted of 12 male and 8 female Batur lambs, aged 5 to 12 months, with an average body weight of 23.97 kg. Data were collected through a survey study using a random sampling method. The variables measured included chest girth, body length, sex, body weight, and ADG. The results demonstrated that: (1) the regression equation for chest girth on body weight was Y= -50.47 + 1.02CG (r = 0.91, R^2 = 0.82); (2) the regression equation for body length on body weight was Y= -64.19 + 1.58BL (r = 0.88, R^2 = 0.78); (3) the multiple regression equation for chest girth and body length on body weight was Y = -62.08 + 0.65CG + 0.69BL (r = 0.93, R^2 = 0.85). These results indicate a very strong positive correlation between chest girth, body length, and body weight, suggesting that body weight in Batur lambs can be accurately predicted using these variables. However, ADG was not significantly correlated with chest girth or body length due to a low coefficient of determination.

Keywords: Batur lambs, body length, body weight, chest girth

INTRODUCTION

Lambs, alongside cattle and goats, are key red meat-producing livestock. Lamb meat is characterized by fine fibers, a pink color, a distinctive aroma, and white fat, with a nutritional composition of 17.1% protein and 14.8% fat (Suantika *et al*., 2017). Lambs are well-regarded for their adaptability to various climatic conditions, which enhances their environmental resilience and contributes to their popularity as livestock. They are typically classified into three types: meat-type lambs, wool-type lambs, and dual-purpose lambs (meat and wool producers).

Batur lambs are a local breed originating from Batur District, Banjarnegara Regency, Central Java Province, and are the result of crossbreeding Merino lambs from Spain with local Thin-tailed lambs. Physically, Batur lambs are characterized by white fleece, long and large bodies, absence of horns in both sexes, small sideways-pointing ears, small tapered tails, prominent facial lines, and wool covering almost the entire body. Their thick fleece makes them suitable as dual-purpose livestock, producing both meat and wool. Batur lambs are known for their high productivity and adaptability, with rapid growth rates. According to Ariffien and Waluyo (2017), Batur lambs can reach body weights of up to 100 kg, with well-bred rams weighing as much as 140 kg.

Body weight is closely related to carcass yield and plays a significant role in determining market value, feed requirements, medication dosages, and optimal marketing times. The most precise method for determining body weight is through the use of a scale. However, this method has limitations in terms of equipment, labor, and its impact on animal welfare. Weighing can stress animals, leading to aggressive behavior (Aditia *et al*., 2018). For large-bodied livestock such as Batur lambs, weighing them accurately can be challenging due to their size.

Weighing Batur lambs can be challenging due to their large size, which complicates the accurate measurement of body weight. The limitations associated with weighing include not only the need for specialized equipment and labor but also the potential stress imposed on the animals. This stress may cause behavioral issues, making the process inefficient. As a result, alternative methods for determining the body weight of Batur lambs are necessary. One widely accepted approach is body weight estimation through body measurements. Several techniques can be employed for this, including correlation analysis and linear regression analysis. The use of body measurements, particularly chest girth and body length, as proxies for body weight is common in livestock management. These measurements are strongly correlated with livestock production performance, making them reliable indicators of body weight. Correlating body measurements with body weight provides a non-invasive, accurate means of estimation, which is particularly useful for large-bodied livestock (Satrio *et al*., 2019).

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This study aims to investigate the strength of the relationship between body length, chest girth, and body weight, as well as their correlation with Average Daily Gain (ADG) in Batur lambs. By calculating regression equations based on these body measurements, the study seeks to develop practical formulas for estimating the body weight of Batur lambs. Additionally, the study will explore the degree to which body length and chest girth correlate with ADG, offering insights into how these variables can be utilized to predict livestock growth and performance more efficiently.

MATERIALS AND METHODS

This study was conducted from September 13, 2021, to January 13, 2022, at Griya Ternak Farm, Kemiri Hamlet, Wringinanaom Village, Kertek District, Wonosobo Regency, Central Java. The sample comprised 12 male and 8 female Batur lambs, aged between 5 to 12 months, with an average body weight of 23.97 kg. Equipment used included a DLE brand digital hanging scale, measuring tape (in cm), and writing tools.

A survey method was employed to collect data, involving measurements of chest girth, body length, and body weight. The samples were selected using a random sampling technique, consisting of both male and female Batur lambs. All lambs were intensively raised in pens, receiving the same feed and careful health monitoring.

The Average Daily Gain (ADG) of the Batur lambs was calculated using the formula:

$$\text{ADG} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Number of days}}$$

For data analysis, correlation and linear regression analyses were used. The correlation coefficient (r) was calculated using the following formula:

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{n})(\sum Y^2 - \frac{(\sum Y)^2}{n})}}$$

Explanation:
r : Correlation coefficient
X : Body measurements (chest girth and body length)
Y : Body weight
N : Number of samples

The strength of the relationship between chest girth, body length, and body weight, as well as their effect on ADG, was determined by the coefficient of determination, calculated using the formula from Sudjana (1996):

Coefficient of determination = r^2 x 100%

To estimate the body weight of Batur lambs based on chest girth and body length, a multiple regression analysis was performed. The regression equation was formulated as follows (Sugiyono, 2017):

$$Y = a + b_1X_1 + b_2X_2$$

Explanation:
Y : Dependent variable
a : Constant
b_1, b_2 : Regression coefficients
X_1, X_2 : Independent variables

RESULTS AND DISCUSSION

Body Measurements, Body Weight, and Average Daily Gain (ADG) of Batur Lambs

The average chest girth, body length, body weight, and Average Daily Gain (ADG) of Batur lambs are presented in Table 1.

Table 1. The average chest girth, body length, body weight, and Average Daily Gain (ADG)

Chest Girth	Body Length	Body Weight	ADG
----------cm----------		----------kg----------	
72.7 ± 7.51	55.75 ± 4.71	23.97 ± 8.46	0.19 ± 0.10

The data show that the average chest girth of Batur lambs is 72.7 cm with a standard deviation of 7.51 cm, the average body length is 55.75 cm with a standard deviation of 7.51 cm, the average body weight is 23.97 kg with a standard deviation of 8.46 kg, and the average ADG is 0.19 kg with a standard deviation of 0.10 kg. The average body weight in this study is lower than that reported by Haren *et al*. (2020), who found an average body weight of 27.28 kg with a standard deviation of 1.76 kg in six-month-old Batur lambs. The higher standard deviation observed in this study reflects the greater variability in the body weights of the sampled lambs. According to Hilmansyah *et al*. (2019), a higher standard deviation indicates more dispersed data points around the mean. In this study, body weight had the highest standard deviation (8.46), indicating significant variability in body weight among the sampled Batur lambs.

The Relationship Between Chest Girth, Body Length, and Sex with Body Weight in Batur Lambs

The correlation values between chest girth, body length, sex, and body weight in Batur lambs are presented in Table 2.

Table 2. The Relationship Between Chest Girth, Body Length, and Sex with Body Weight in Batur Lambs

Variable	n	r	R^2	*p-value*
Chest Girth	20	0.91	0.82	$3.03x10^{-8}$
Body Length	20	0.88	0.78	$2.95x10^{-7}$
Chest Girth + Body Length	20	0.93	0.85	0.003
Chest Girth + Body Length + Sex	20	0.94	0.86	0.124

Explanation: n= number of samples; r= correlation coefficient; R^2= R-*square*.

The effect of chest girth on body weight was found to be highly significant (P<0.01), with a correlation coefficient close to 1, indicating a strong positive relationship between chest girth and body weight. This finding is consistent with Laya *et al*. (2018), who noted that a correlation value close to 1 represents a very strong association between two variables. Chest girth showed a stronger correlation with body weight than body length, suggesting that chest girth is a more accurate predictor of body weight in Batur lambs. Hailitik *et al*. (2021) also noted that chest girth has a high correlation with body weight, making it a valuable metric for estimating live weight in livestock.

The coefficient of determination for chest girth was 0.82, meaning that 82% of the variation in body weight could be explained by chest girth. This value was higher than that for body length, suggesting that chest girth has a greater influence on body weight. Chest girth correlates with the size of the chest and abdominal cavity, where a significant portion of body weight is concentrated. The development of the chest cavity, which houses vital organs such as the lungs and heart, significantly contributes to increases in body weight (Yanto *et al*., 2021). As body weight increases, the chest girth expands due to muscle development in the chest area, further increasing the correlation between chest girth and body weight.

The effect of body length on body weight was also highly significant (P<0.01), with a correlation coefficient of 0.88, indicating a very strong positive relationship. This suggests that body length, like chest girth, can be used to estimate body weight. According to Satrio *et al*. (2019), chest girth and body length are the body measurements most strongly correlated with body weight. The coefficient of determination for body length was 0.78, indicating that body length accounted for 78% of the variation in body weight. Body length's influence on body weight is largely due to the growth of the spine, as noted by Yanto *et al*. (2021), who suggested that body length is a critical parameter in estimating body weight.

The combined effect of chest girth and body length on body weight was highly significant (P<0.01), with a correlation coefficient close to 1, indicating a very strong positive relationship between these variables and body weight. The coefficient of determination for the combined effect of chest girth and body length on body weight was 0.85, meaning that 85% of the variation in body weight could be explained by these two variables, with the remaining 15% influenced by other factors. The strong combined effect of chest girth and body length on body weight makes them reliable parameters for estimating body weight in livestock. Ersi *et al*. (2018) noted that body weight estimation should include measurements such as chest girth and body length to ensure accuracy.

However, the combined effect of chest girth, body length, and sex on body weight was not significant (P>0.05). The analysis revealed no significant interaction between sex, chest girth, and body length in influencing body weight. The regression lines for male and female Batur lambs were the same, suggesting that factors other than sex have a greater impact on body weight. Sari *et al*. (2020) suggested that physiological conditions are often influenced by environmental factors, which may explain why sex does not significantly affect body weight in this study.

The Relationship Between Chest Girth, Body Length, and Sex with Average Daily Gain (ADG) in Batur Lambs

The calculation of the correlation values between chest girth, body length, and sex with Average Daily Gain (ADG) in Batur lambs is shown in Table 3

Table 3. The Relationship Between Chest Girth, Body Length, and Sex with Average Daily Gain (ADG) in Batur Lambs

Variable	n	r	R^2	*p-value*
Chest Girth	20	0,29	0,035	0,209
Body Length	20	0,16	0,028	0,492
Chest Girth + Body Length	20	0,33	0,011	0,468
Chest Girth + Body Length + Sex	20	0,40	0,005	0,352

Explanation: n= number of samples; r =correlation coefficient; R^2= R-square.

The research results reveal that the correlation coefficients and coefficients of determination for chest girth, body length, and sex in relation to Average Daily Gain (ADG) in Batur lambs are very low. The correlation coefficients for chest girth, body length, sex, and their combination with ADG are 0.29, 0.16, 0.33, and 0.40, respectively. These values indicate that there is a low correlation between chest girth, body length, and sex with ADG, as none of the correlation coefficients exceed 0.5. Gogtay and Thatte (2017) define correlation values ranging from 0 to 0.5 as indicative of a weak or low relationship. Furthermore, chest girth, body length, and sex together account for less than 20% of the variation in ADG, demonstrating that these variables are not effective predictors of ADG in Batur lambs. This suggests that factors other than body measurements and sex are more important in determining ADG in Batur lambs.

Estimating Body Weight

The results of the regression analysis for estimating body weight in Batur lambs based on chest girth and body length are presented in Table 4.

Table 4. Estimating Body Weight Using Regression Equations

Variables Estimation	Regression Equation
Chest Girth	Y= -50.47+1.02 CG
Body Length	Y= -64.19+1.58 BL
Chest Girth + Body Length	Y= -62.08 + 0.65 CG + 0.69 BL

Explanation: Y = Body Weight; CG = Chest Girth; BL = Body Length.

The results of the regression analysis for estimating body weight in Batur lambs based on chest girth and body length are presented in Table 4. The regression equation between chest girth and body weight is:

$$Y = -50.47 + 1.02CG$$

This equation shows that for every 1 cm increase in chest girth, body weight increases by 1.02 kg. Suliani *et al*. (2017) also reported that chest girth is a significant determinant of body weight, noting that as chest girth increases, body weight tends to increase as well. Similarly, the regression equation between body length and body weight is:

$$Y = -64.19 + 1.58BL$$

This equation demonstrates that for every 1 cm increase in body length, body weight increases by 1.58 kg. Body length is thus a critical factor in body weight estimation. As body length increases, body weight correspondingly rises, which is consistent with the findings of Nurfitriani *et al*. (2021), who stated that body weight increases proportionally with body size. The multiple regression equation combining chest girth and body length for estimating body weight is:

$$Y = -62.08 + 0.65CG + 0.69BL$$

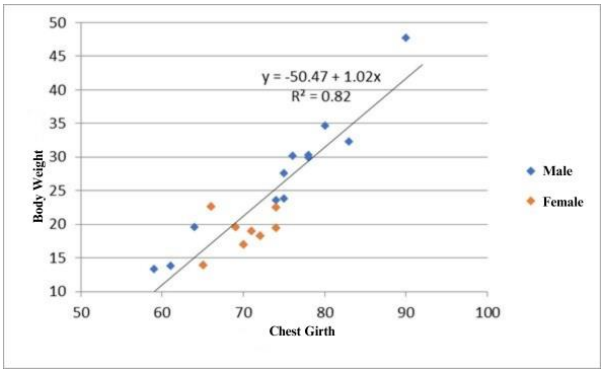

Figure 1. Graph of Body Weight Based on Chest Girth

This combined regression equation offers the highest level of accuracy, as it results in a higher correlation value compared to the individual use of chest girth or body length alone (Table 2). The use of both variables in the multiple regression equation significantly improves the precision of the body weight estimate. According to Ikhsanuddin *et al*. (2018), multiple regression models are generally more accurate than simple regression models when estimating the body weight of livestock. The synergistic effect of using both chest girth and body length in body weight estimation makes this approach the most reliable and precise

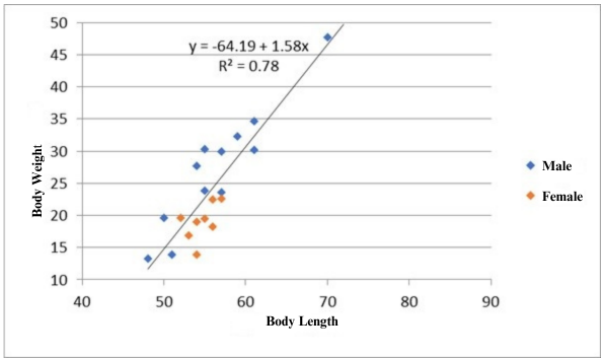

Figure 2. Graph of Body Weight Based on Body Length

CONCLUSIONS

Based on the findings of this research, it can be concluded that chest girth and body length have a very strong positive correlation with body weight

in Batur lambs. The most accurate estimation of body weight in Batur lambs is achieved by using a combination of chest girth and body length, as demonstrated by the high correlation coefficients and coefficients of determination. However, both chest girth and body length exhibit a low positive correlation with Average Daily Gain (ADG), indicating that these body measurements are not suitable for predicting ADG in Batur lambs.

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REFERENCES

Aditia, E, L., Priyanto, P., Muhammad, A., 2018. Behavior Assessment of Brahman Cross Cattle During the Loading and Unloading Process. Journal of Animal Production and Processing Technology. 6(1): 13-18.

Ansori, R, N., Titin, N., Iman, H., 2021. Effect OF Pennisetum purpureum Balance and Concentrate on Circumference, Width and In the Chest of Rams Garut Age 16–18 Months. Journal of Animal Husbandry Science. 5(2): 162-171. https://dx.doi.org/10.52434/janhus.v5i2.1348

Ariffien, A., Waluyo, S, T., 2017. Sheep Farming Agribusiness. Media Nusa Creative. Jakarta.

Ersi, F., Muhammad, D, I, H., Sulastri, Kusuma, A., 2018. Correlation Between Body Weight and Body Dimensions in Ongole Crossbreed Cattle on age 7-12 Months in Wawasan Village, Tanjungsari District, South Lampung Regency. Journal of Research and Innovation of Animals. 2(3): 16-22.

Gogtay, N, J., Thatte, U, M., 2017. Principles of Correlation Analysis. Journal Association of Physicians of Inda. 65(3): 78-81.

Hailitik, V, I., Handayani, H, T., Abdullah, MS., 2021. Growth of Local Goat Pre Weaning in The Rainy Season at Sumlili Village Sub-District of Kupang Barat District of Kupang. Jurnal Peternakan Lahan Kering. 3(3): 1649-1657.

Haren, H, I, H., Dattadewi, P., Mas, Y, S., Prayitno., 2020. Polymorphism at third exon of the Myostatin gene and its association with growth and carcass traits in Batur Sheep. Biodiversitas Journal of Biological Diversity. 21(5): 2074-2078. https://doi.org/10.13057/biodiv/d210534

Hilmansyah, M, A, F., Mochamad S., Agus, P., 2019. The Relationship Between Body Weight and Lambing Index of Batur Lambs in Batur District, Banjarnegara Regency. Journal of Animal Science and Technology. 1(2): 184-190.

Ikhsanuddin., Veronica., M, A, N., Kuswati., Zainuddin., 2018. Correlation between body size and body weight of Aceh Cattle at weaning and yearling age. Scientific Journal Encompassing All Areas of Animal Science. 18(2): 117-122. https://doi.org/10.17969/agripet.v18i2.12355

Laya, N, K., Fahrul, I., Suharyanto, S., 2018. The Relationship Between Body Weight and Milk Production in Peranakan Etawa (PE) Goats. Jambura Journal of Animal Science. 1(1): 13-17. https://doi.org/10.35900/jjas.v1i1.2600

Nurfitriani, R, A., Adirangga, F., Hafidz, I, A, T., 2021. Relationship Between Body Size and Bodyweight in First Lactating Friesian Holstein Dairy Cow. Jurnal Sains dan Teknologi Peternakan. 3(1): 19-26. https://doi.org/10.31605/jstp.v3i1.1404

Sari, R, M., Harissatria., Mila, A., 2022. Relationship of Birth Weight, Weaning Weight and Sex on Parity Simmental Cows at BPTU HPT Padang Mengatas. Jurnal Peternakan Mahaputra (JPM). 1(1): 24-33.

Satrio, A, J., Agus, P., Pambudi, Y., 2019. The Relationship of Chest Circumference and Plumpness Index with Body Weight of Young Kejobong Goats in District Purbalingga. Journal of Animal Science and Technology. 1(1): 101-108.

Suantika, R., Lilis, S., Jajang, G., 2017. The Effect of Soaking Time Use Ginger Juice to Sheep Meat Physical Quality (Water Holding Capacity, Tenderness and Ph). Journal of Animal Science Padjadjaran University.

17(2): 67-72. https://doi.org/10.24198/jit.v17i2.15129

Sudjana., 1996. Regression and Correlation Analysis Techniques. Tarsito. Bandung.

Sugiyono., 2017. Quantitative, Qualitative, and R&D Research Methods. Alfabeta. Yogyakarta.

Suliani, S., Ahmad, P., Joko, R., Sigit, P., 2017. The Relationship Between Body Size and Body Weight of Male Simmental Ongole Crossbred at Various Age in Jagalan Surakarta Abattoir. Livestock and Animal Research. 15(1): 16-21. http://dx.doi.org/10.20961/sainspet.v15i1.4998

Yanto, O., Dima, I, H, Dian, K., Sulastri., 2021. Analysis of Correlation and Regression between Body Measurements and Body Weight of Brahman Cross (Bx) Cow in KPT Maju Sejahtera Trimulyo Village, Tanjung Bintang District, South Lampung Regency. Journal of Research and Innovation of Animals. 5(2): 99-104. https://doi.org/10.23960/jrip.2021.5.2.99-104