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Body Weight Prediction of Ongole Grade Cattle Using Body Volume and Body Measurements

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Abstract. Ongole Grade (OG) cattle is one of the local Indonesian cattle and is the result of a crossbreeding between Sumba Ongole cattle and Java cattle. This study aimed to find the fittest prediction of body weight of OG cattle using body volume and body measurements (chest girth and body length) which were analyzed using their correlation and regression equations. This research was conducted in February 2022 in the Livestock Groups in Tanjung Sari District, South Lampung Regency. The research method used was a survey method with a sampling technique using purposive sampling of 120 male and female OG cattle, with the criteria of cattle aged 2-5 years, not pregnant, and not aggressive. The data were analyzed using correlation and regression models with the help of the R program. The results showed that body volume had the highest correlation value (0.93) with body weight compared to chest girth (0.92), and body length (0.90). The regression equation between body volume (BV), chest girth (CG), and body length (BL) to body weight (BW) were BW = 17.0304444392 + 0.01085426*BV, BW = -484.6830 + 4.8495*CG, and BW = -652.4710 + 7.6876*BL, respectively, with the coefficient of determination of 0.87, 0.84, and 0.81, respectively. The conclusion of this study is that body volume can be used to estimate the body weight of OG cattle with the smallest deviation from actual body weight, compared to other body measurements. However, for practical application, chest girth is best predictor for body weight of OG cattle. Our finding suggested that body measurements (CG and BL) can be used as selection criterion to improve performance of OG cattle.

INTRODUCTION

Every year the need for national beef cattle continues to increase significantly along with the increase in the amount of meat consumption which is in line as well with several aspects such as population, high income, and welfare levels so that people generally realize the importance of animal protein sources for body health [1,2]. Currently, domestic beef needs are met by three main sources, such as domestic cattle, imports, and cattle from smallholder farms. The Central Statistics Agency [3] recorded as many as 515,627.74 tons of demand for Indonesian beef throughout 2020. The increasing demand for beef is not accompanied by domestic beef production, this causes domestic beef needs to rely heavily on imports. The development of beef cattle farming in Lampung is increasing along with the increasing demand for meat in the community. According to the Central Statistics Agency [3], there is a significant increase in the number of beef cattle every year in Lampung. The number of beef cattle in Lampung Province in 2020 reached 864,213 heads spread across 15 regency.

The total meat production in Lampung province, according to the Central Statistics Agency [3], is 164,689 tons from various beef animals, consisting of cattle, buffaloes, goats, and sheep. The percentage for beef cattle is the highest, namely 82.11% or the total beef production, which means that Lampung Province contributes to beef production as much as 135,226.14 tons. The development of the livestock sector, especially beef cattle, must be further improved in order to provide more benefits and income for people engaged in the fields.

One type of Indonesian local cattle that is widely cultivated by smallholder farms is Ongole Grade (OG) cattle. OG cattle are cattle from the *Bos indicus* breed, which is a crossbreeding between Sumba Ongole cattle and Java

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cattle. The advantages of OG cattle over other types of cattle are that they are more resistant to disease, resistant to heat, and good mothering ability.

One of the main indicators of cattle productivity is determined based on the body weight of the cattle by looking at several supporting aspects, namely the size of the chest girth, shoulder height, and body length. The body weight of beef cattle is used as the main target in meeting consumer demand. The body weight of the cattle is also used as a reference in determining the price of the local meat market.

Body weight of cattle is a high economic value trait and an important factor associated with several management practices including breeding, selection for slaughter, feeding levels to be given and an indicator of the cattle condition [4]. However, it is difficult to determine body weight of cattle in rural areas because of unavailability or limited scales.

Prediction or estimation of live weight is an alternative that can be used by smallholder farms in determining body weight. Previous research reported that body volume and body measurements can be used to predict cattle body weight accurately [5-11]. Paputungan et al. [12] reported that there was a positive correlation between chest girth and body length in OG cows on body weight with R^2 = 97%. Ozkaya and Bozkurt [4] added that body length, shoulder height, and chest girth had a close correlation with body weight of cattle which resulted in regression equations with R^2 of 79.2, 70.8, and 91.1% , respectively, in Swiss Brown cattle and with R^2 of 82.2, 71.8, and 88.8% , respectively, in crossbreed cattle. The combination of body length, shoulder height, and chest girth produced a regression equation that can be used to estimate body weight of cattle with R^2 = 91.3% in Swiss Brown cattle and R^2 = 93.9% in crossbred cattle.

To estimate the live weight of cattle using body volume, it can be done by measuring the volume of the cattle's body which is likened to the shape of a tube. The chest girth is likened to the area of the base and the length of the body as the height of the tube, so the live weight of cattle can be likened to the volume of the body [5,7,8,12]. Previous study indicated that body volume was more fit to predict body weight of cattle compared to body measurements [5,6,8]. However, research on body weight prediction using body volume in cattle is limited. The purpose of this research was to find the fittest prediction of body weight of OG cattle using body volume and body measurements.

MATERIALS AND METHOD

The research was conducted in February 2022 in the Livestock Group, Tanjung Sari District, South Lampung Regency. The tools used in this study were measuring tape, measuring stick, digital cattle scale, laptop, camera, and stationery. While the materials used in this study were OG cattle as many as 120 heads consisting of male and female cattle. The research method used was a survey. The sampling technique was done by purposive sampling with the criteria for the age of the cattle 2-5 years, the cows were not pregnant, and the cattle were not aggressive.

The variables observed in this study were body length (cm) which was measured from the sitting bone (*tubercullum ischiadium*) to the shoulder bone (*tuberculum humeralis*) using a measuring tape, chest girth (cm) which was measured by looping the tape measure just behind the scapula, and body weight (kg) using a digital scale.

The data obtained from measurements of chest girth (CG) and body length (BL) were used to calculate body volume (BV) as follows:

$$BV = \pi \left(\frac{CG}{2\pi}\right)^2 BL \quad (1)$$

where BV is body volume, Л = 22/7 = 3.14, CG is chest girth, and BL is body length. Body volume (independent variable) obtained from every OG cattle was used as an estimator for body weight (dependent variable) with the following regression model.

$$BW = a + b.BV \quad (2)$$

where BW is body weight (dependent variable), a is intercept, b is regression coefficient, and BV is body volume (independent variable).

Pearson's correlation and regression analysis between body volume (BV) and body weight (BW) was carried out using the R. Program. In addition to the body's volume variable, as a comparison, the variable of the chest girth (CG) and body length (BL) were also used to predict the body weight of the OG cattle with the following regression models.

$$BW = a + b.CG \quad (3)$$
$$BW = a + b.BL \quad (4)$$

where BW is body weight (dependent variable), a is intercept, b is regression coefficient, CG is chest girth (independent variable), and BL is body length (independent variable).

RESULT AND DISCUSSION

Statistics of Body Volume, Body Measurements and Body Weight of Ongole Grade Cattle

Statistics of body measurements of 120 OG cattle are presented in Table 1 and visually shown in Figure 1. Based on Table 1 and Figure 1, it can be seen that body measurements of OG cattle varied greatly and were normally distributed. The body weight and body measurements of this study was lower than the result reported by Paputungan et al [6,12] that the average body weight, chest girth, and body length of OG cattle at the age of 2.5-5.5 years were 416.14 kg, 171.46 cm, and 141.47 cm, respectively.

TABLE 1. Statistics of chest girth, body length, and body weight of OG cattle.

Statistics	Chest girth (cm)	Body length (cm)	Body weight (kg)
Mean and standard deviation	164.92 ± 9.8190	125.86 ± 6.0935	315.08 ± 52.0433
Minimum	132	108	171
Maximum	192	140	424
Total sample	120	120	120

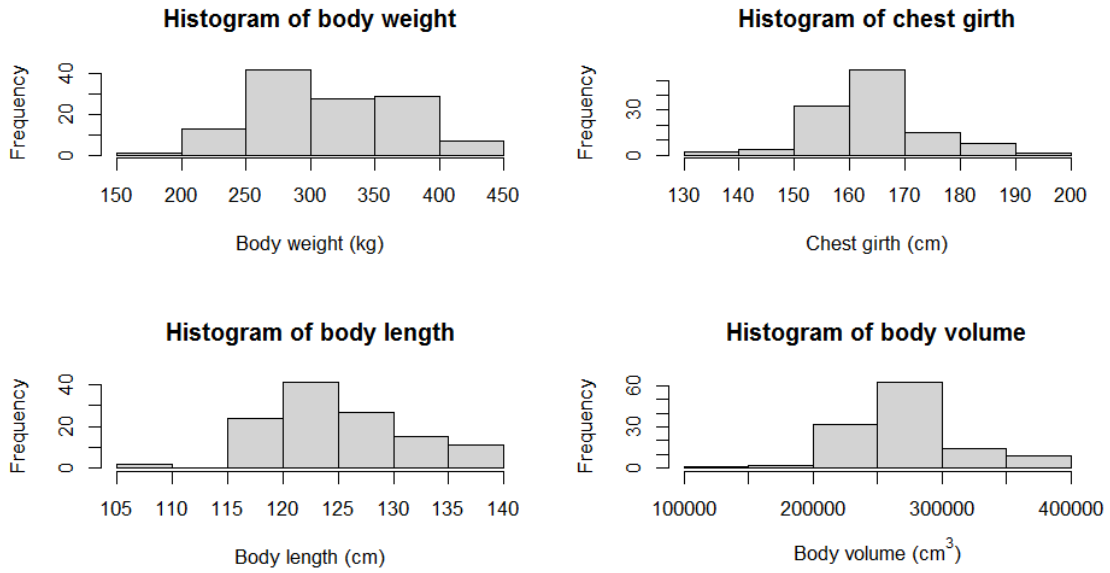

FIGURE 1. Histogram of all variables

The different in body weight and body measurements of this research and the previous research might be due to different feedstuff and feeding management. Sandi et al. [13] reported that feed deficiency is the main obstacle of the growth process, especially if the feed does not meet the substances needed such as protein, vitamins, and minerals so that this can make livestock growth not optimal. The same type of livestock but gets the frequency of feeding and different types of feed, can affect the growth of the livestock.

Correlation and Regression Equations of Body Volume and Body Measurements on Body Weight of OG Cattle

The results of the correlation and regression analysis of the body's volume and body measurements on body weight of OG cattle are presented in Table 2.

TABLE 2. Correlation and regression equations between chest girth (CG), body length (BL), and body volume (BV) on body weight (BW)

Regression equation	R^2	r	Probability
BW=-484.6830 + 4.8495*CG	0.84	0,92	P<0.01
BW=-652.4710 + 7.6876*BL	0.81	0,90	P<0.01
BW=17.030444392 + 0.001085426*BV	0.87	0,93	P<0.01

We can see in Table 2 that body volume had the highest correlation with body weight of OG cattle followed by chest girth and body length. Description of correlation and regression between chest girth and body weight can be visualized using scatter plot as shown in Figure 2.

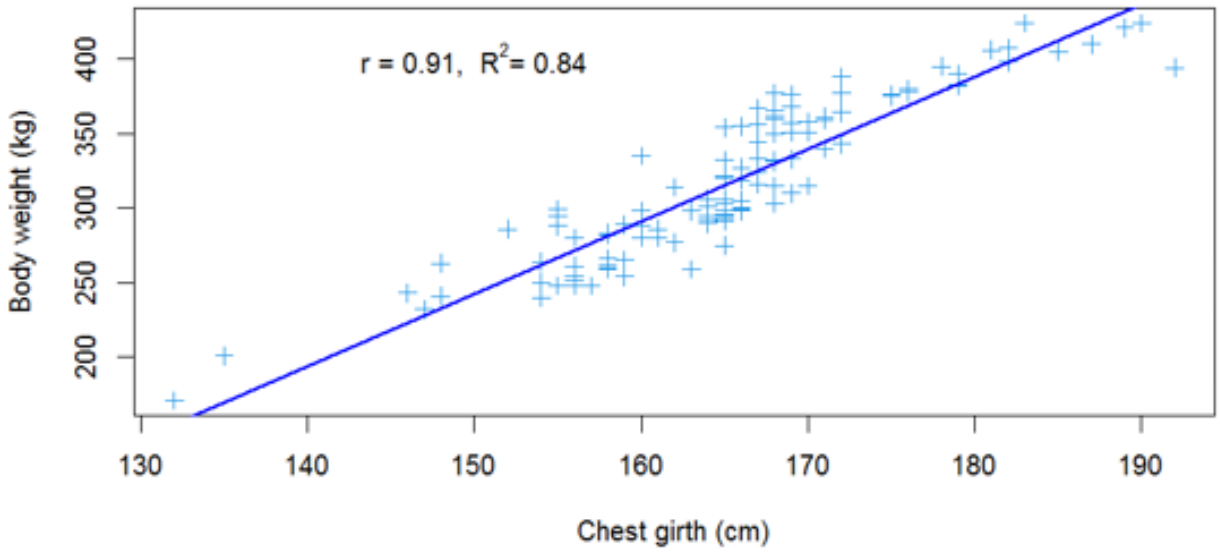

FIGURE 2. Scatter plot describing correlation and regression between chest girth and body weight of Ongole Grade cattle

Based on Figure 1 and Table 2, it can be seen that the correlation between chest girth and body weight of OG cattle is classified as very high. The correlation between chest girth and body weight of OG cattle, which was 0.92, means that the correlation was very strong, according to Sugiono [14] the correlation coefficient value is stated to be very strong if the correlation value is between 0.80-1,00. The results showed that if there is an increase in the size of the chest girth in OG cattle, it will be followed by an increase in body weight. The coefficient of determination of the regression equation obtained between chest girth and body weight is 0.84, which means that the ability of chest girth to estimate body weight is 84%, meaning that 16% is influenced by other factors. In line with the research of Paputungan et al. [6] who reported that coefficient of determination between chest girth and body weight was 0.71-0.86. However, the results of research by Gunawan et al. [15] reported that correlation between chest girth and body weight of OG cattle was 0.91.

In line with the research of Pratama et al. [16] where chest girth is the closest to body weight when compared with other body measurements in each different age group, Raja et al. [17] also reported the highest correlation of chest girth to body weight compared to other body measurements. This result is reinforced by Rashid et al. [18] reported that chest girth is highly correlated with live weight of cattle.

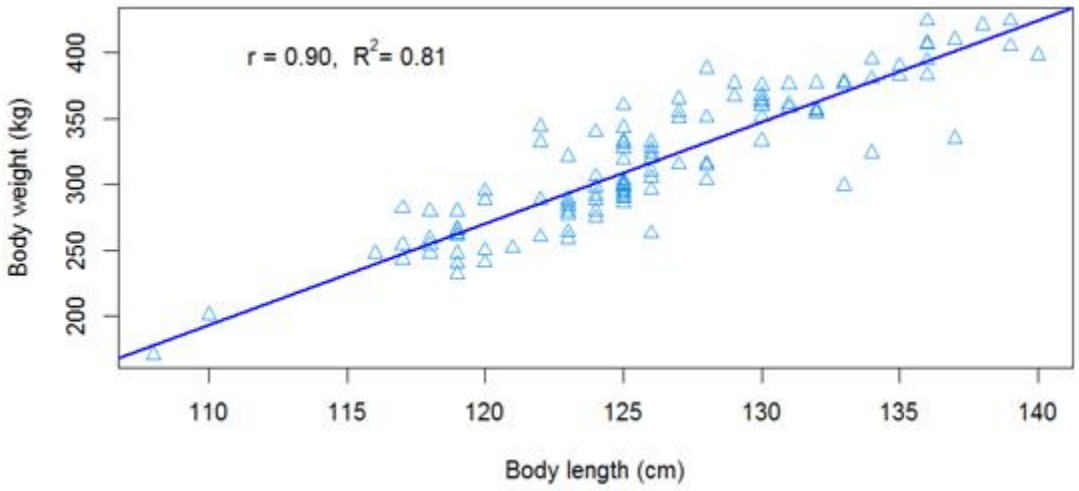

FIGURE 3. Scatter plot describing correlation and regression between body length and body weight of Ongole Grade cattle

Figure 3 shows the scatter plot describing correlation and regression between body length and body weight of OG cattle. Based on Figure 3 and Table 2, it can be seen that the correlation between body length and body weight of OG cattle in this study, which was 0.90, is classified as very strong. According to Sugiono [14] the correlation value is very strong if the correlation coefficient is between 0.800-1,000. Paputungan et al. [6] reported that the relationship between body length and body weight in OG cattle showed a moderate correlation value of 0.50. The results of this study indicated that if there is an increase in body length in OG cattle, it will be followed by an increase in body weight. Based on Figure 3, it can be seen that the regression equation between body length and body weight was BW = -652.4710 + 7.6876*BL, meaning that when there is an addition of 1 cm in body length measurement, there will be an increase in body weight of 7.6876 kg on the scales. The coefficient of determination of the regression equation generated between body length and body weight was 0.81, which means that the ability of body length to estimate body weight is 81% and 19% is influenced by other factors. This correlation coefficient is higher when compared to the research results of Ni'am et al. [19], the correlation coefficient value between body length and body weight in Bali cattle is 79.6%, the remaining 21.4% is influenced by other factors.

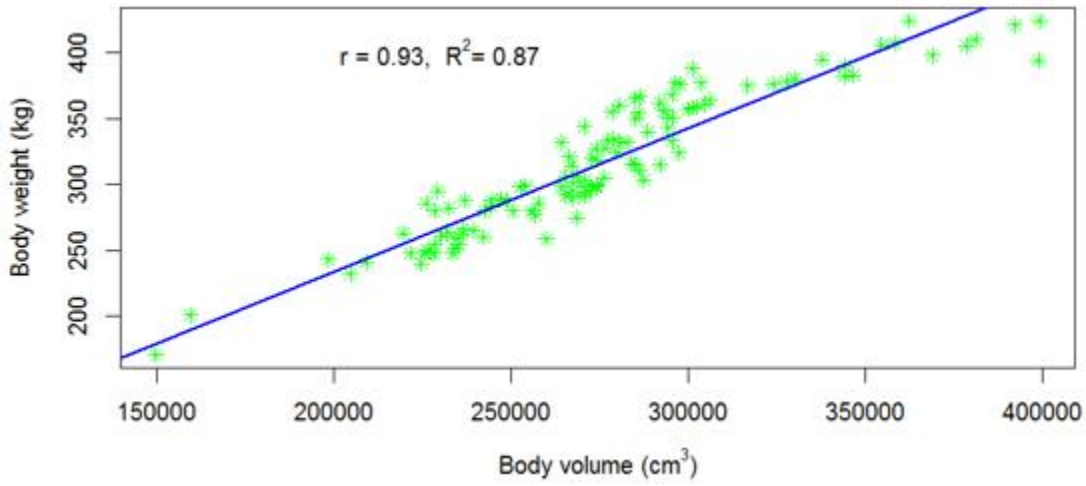

FIGURE 4. Scatter plot describing correlation and regression between body volume and body weight of Ongole Grade cattle

Figure 4 describes the correlation and regression between body volume and body weight of OG cattle. Based on Figure 4 and Table 2, it can be seen that the correlation between body volume and body weight was 0.93 and was classified as very strong according to Sugiono [14], that correlation value will be very strong criterion if the correlation coefficient is 0.800-1,000. This result indicated that if body volume increase, it will be followed by an increase in body weight. Based on Figure 4, it can be seen that the regression equation between body volume and body weight was BW = 17.0304444392 + 0.01085426*BV. The coefficient of determination of this regression equation is 0.87, which means that the ability of body volume to estimate body weight is 87% and 13% is influenced by other factors. The result of this study was smaller when compared to the results of Paputungan et al. [6] that coefficient of determination between body volume and body weight is 0.92--0.98 or 92%--98%. Based on the results of the study, estimation of body weight using body volume resulted in higher prediction accuracy when compared to body measurements (chest girth and body length).

CONCLUSION

In conclusion, body volume and body measurements (chest girth and body length) correlated greatly to body weight of Ongole Grade cattle with correlation coefficient of 0.93, 0.92 and 0.90, respectively. Body volume could be used as an alternative predictor for body weight of OG cattle because of the lowest deviation to the actual body weight. However, for practical purpose, chest girth is more parsimonious in predicting body weight of OG cattle. The result of this study suggested that body measurements (CG and BL) can be as selection criterion to improve performance of OG cattle.

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REFERENCES

1. A. Agus and T.S.M. Widi. Current situation and prospect of beef cattle production in Indonesia —A review. Asian-Australas J Anim Sci. **00(00)**,1-8 (2018). https://doi.org/10.5713/ajas.18.0233.
2. R. H. Puradireja, L. Herlina, dan H. Arief, H. Analisis faktor-faktor yang mempengaruhi permintaan daging sapi di Provinsi Lampung. Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis **7(2)**, 1439-1448 (2021).
3. Central Statistics Agency. 2020. Population of Beef Cattle Based on Province (head) 2018-2020. https://www.bps.go.id. Accessed on 29 November 2021.
4. S. Ozkaya and Y Bozkurt. The accuracy of prediction of body weight from body measurements in beef cattle. Archiv Tierzucht **52(4)**, 371-377 (2009).
5. B. J. Takaendengan**,** U. Paputungan, R. R. Noor, and S. Adiani. Live Weight Estimation by Chest Girth, Body Length and Body Volume Formula in Minahasa Local Horse. Media Peternakan **35(2)**, 80-84 (2012). https://doi.org/10.5398/medpet.2012.35.2.80
6. U. Paputungan, L. Hakim, G. Ciptadi, and H. F. N. Lapitan. Application of body volume formula for predicting live weight Ongole crossbred cows. International J. Livestock Prod. **6(3)**, 35-40 (2015). https://doi.org/10.5897/IJLP2014.0243
7. A. Dakhlan, M.D.I. Hamdani, and Sulastri. Regression models and correlation analysis for predicting body weight of female Ettawa Grade goat using its body measurements. Advances in Animal and Veterinary Sciences **8(11)**, 1142—1146 (2020).
8. R.S. Cuytun, R.A.G. Hirrera, A.L.M. Benitez, E.C. Perez, G.A.M. Osorio, M. Ptacek, R.P. Salgado, E.V.B. Perez, and A.J.C. Canul. Relationship between body volume and body weight in pelibuey ewes. Tropical and Subtropical Agroecosystems **24,** 1-7 (2021).
9. A. Dakhlan, M.D.I Hamdani, D.R. Putri, Sulastri, and A. Qisthon. Short communication: Prediction of body weight based on body measurements in female saburai goat. Biodiversitas **22(3)**, 1391-1396 (2021).
10. A. Dakhlan, A. Qisthon, and M.D.I Hamdani. Predicting Body Weight Based on Body Measurements at Different Ages and Sex in Saburai Goat. Advances in Animal and Veterinary Sciences **9(11)**, 1791-1799 (2021).

11. U.S. Shoimah, A. Dakhlan, Sulastri, and M.D.I Hamdani. Use of body measurements to predict live body weight of Simmental bull in Lembang Artificial Insemination Center, West Java. IOP Conference Series: Earth and Environmental Science, **888(1)**, 012030 (2021).
12. U. Paputungan, L. Hakim, G. Ciptadi, and H. F. N. Lapitan. The estimation accuracy of live weight from metric body measurements in Ongole grade cow. Jurnal Indonesian Trop. Anim. Agric. **38(3)**, 149-155 (2013). https://doi.org/10.14710/jitaa.38.3.149-155
13. S. Sandi, M. Desiarni, dan Asmak. Manajemen pakan ternak sapi potong di peternakan rakyat di Desa Sejaro Sakti Kecamatan Indralaya Kabupaten Ogan Ilir. Jurnal Peternakan Sriwijaya **7(1)**, 21-29 (2018). https://doi.org/10.33230/JPS.7.1.2018.7080
14. Sugiyono. 2017. Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Alfabeta: Bandung.
15. A. Gunawan dan B.W. Putera. Aplikasi linier ukuran tubuh untuk seleksi fenotipik bibit induk sapi PO di Kabupaten Bojonegoro. Jurnal Ilmu Produksi dan Teknologi Hasil Peternakan **4(3)**, 375-378 (2016).
16. *A.A. Pratama, E. Purbowati dan C.M.S. Lestari*. Hubungan antara ukuran–ukuran tubuh terhadap bobot badan domba wonosobo jantan di Kabupaten Wonosobo Jawa Tengah. Jurnal Agromedia **34(2)**, 11-15 (2016). https://doi.org/10.47728/ag.v34i2.169
17. T.V. Raja, R. T. Venkatachalapathy, A. Kannan, and K. A. Bindu. Determination of best-fitted regression model for prediction of body weight in Attapady black goats. Global Journal of Animal Breeding and Genetics **1(1)**, 020-025 (2013).
18. M.M. Rashid, M. A. Hoque, K.S. Huque., M.A.I. Talukder, and A..F.H. Bhuiyan. Morphometric characterization of Brahman Crossbred cattle and prediction of live weight using linear body measurements. Asian Journal of Medical and Biological Research **1(3)**, 569-577 (2015). https://doi.org/10.3329/ajmbr.v1i3.26480
19. H.U.M. Ni'am, A. Purnomoadi, dan S. Dartosukarno. Hubungan antara ukuran-ukuran tubuh dengan bobot badan sapi Bali betina pada berbagai kelompok umur. Animal Agriculture Journal **1(1)**, 54-556 (2012).