

Correlation of body size with body weight of Etawa crossbred (PE) goats of the Kaligesing type in Pamekasan Regency

Korelasi ukuran tubuh dengan bobot badan Kambing Peranakan Etawa (PE) tipe Kaligesing di Kabupaten Pamekasan

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ABSTRACT

The population of goats in East Java especially in Madura is the Etawa crossbred [PE] goat type Kaligesing, the goat is in great demand because has a larger body proportion than the Kacang goat which is native to Indonesia goat. The purpose of this study was to determine the performance of Kaligesing type PE goats using the correlation of body size with body weight in Pamekasan Regency, Madura. This research was conducted in smallholder farms in four villages (Panaguan, Larangan Dalam, Larangan Luar, and Montok) of Larangan sub-district, Pamekasan regency. The material used was 60 Kaligesing type PE goats aged 1-1.5 years (*Poel 1*) and 1.5-2.5 years (*Poel 2*). The research method used was a case study and sampling using the purposive sampling method. The results showed that gender had a very significant effect ($P < 0.01$) on body size and body weight in *Poel 1* and *Poel 2*. The correlation between body size (body height, body length, chest girth, body weight) and body weight of Kaligesing-type PE goats *Poel 1* and *Poel 2* was 0.88; 0.96; 0.97 for *Poel 1* and 0.80; 0.91; 0.97 for *Poel 2*, respectively. The conclusion of this study is that body size can be used to estimate body weight in Kaligesing type PE goats.

ABSTRAK

Kambing merupakan salah satu ternak penghasil daging. Populasi kambing yang ada di Jawa timur khususnya di Madura ialah kambing Peranakan Etawa [PE] tipe Kaligesing, kambing tersebut banyak diminati karena memiliki proporsi tubuh yang lebih besar dari pada kambing Kacang asli Indonesia. Tujuan penelitian ini untuk mengetahui performan kambing PE tipe Kaligesing menggunakan korelasi ukuran tubuh dengan bobot badan di Kabupaten Pamekasan Madura. Penelitian ini dilakukan di peternakan rakyat di empat Desa (Panaguan, Larangan Dalam, Larangan Luar, dan Montok) Kecamatan Larangan Kabupaten Pamekasan. Materi yang digunakan ialah Kambing PE tipe Kaligesing umur 1-1,5 tahun (*Poel 1*) dan 1,5-2,5 tahun (*poel 2*) sebanyak 60 ekor. Metode penelitian yang digunakan ialah studi kasus dan pengambilan sampel menggunakan metode purposive sampling. Hasil penelitian menunjukkan bahwa jenis kelamin memberikan pengaruh sangat nyata ($P < 0,01$) terhadap ukuran tubuh dan bobot badan pada *Poel 1* dan *Poel 2*. Hasil penelitian ini menunjukkan korelasi yang sangat kuat antara ukuran tubuh (tinggi badan, panjang badan dan lingkar dada) dengan bobot badan kambing PE tipe Kaligesing *Poel 1* dan *Poel 2* berturut-turut ialah 0,88; 0,96; 0,97 untuk *Poel 1* dan 0,80; 0,91; 0,97 untuk *Poel 2*. Kesimpulan penelitian ini ialah ukuran tubuh dapat digunakan untuk memperkirakan bobot badan pada Kambing PE tipe Kaligesing.

Kata kunci:
Ukuran tubuh
Bobot badan
Koefisien korelasi,
Kambing PE
Kaligesing

INTRODUCTION

Goats are one of the meat livestock commodities. The demand for meat in Indonesia

always increasing due to population growth and growing public awareness of nutritional needs. Goat meat is valuable for consumption because of



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its high nutritional content, including protein, fat, vitamins, and minerals. According to the Badan Pusat Statistik (2022) goat meat production in East Java was 19,674.35 tons in 2020, increasing to 20,166.21 tons in 2021, that data indicating a rising consumption trend. The goat population in East Java was 3,645,822 in 2020, growing to 3,763,061 in 2021, suggesting a stable and increasing number of farms in the region.

One of species goat in Indonesia is the Etawa Crossbreed Goat (*PE*), a local breed resulting from the crossbreeding of the Etawa Goat from India with the native Indonesian dwarf goat (Budiasaria, Panjono, Maharani, & Ibrahim, 2018). The *PE* Goat, widely distributed in Madura, is known as the Kaligesing goat, serving dual purposes of milk and meat production. However, in Madura, it is primarily raised for meat. The *PE* Goat exhibits good adaptability, making its care relatively straightforward. The Kaligesing type is characterized by a convex facial shape, long drooping ears, varied coat colors (white, black, brown, and combinations), a short tail, and a slightly curved back. The performance of *PE* goats is evaluated (Fitriyah, Subagja, Hasanadan, & Adhyatma, 2022) based on body weight and body sizes, including chest girth, body length, and body height, with various factors influencing their body weight including age and gender of livestock.

The correlation of body size serves as a distinctive feature for a livestock breed additionally, body sizes aid in quick and efficient body weight estimation (Hanafi, Adhianto, Wanniare, & Qisthon, 2022) The Kaligesing type of *PE* goat is widely popular and raised in small-scale farms, in spite of the hot climate in Madura Island, surrounded by the sea. Given this context, it is necessary to observe the correlation of body sizes, including body length, body height, and chest girth, with the body weight of Kaligesing *PE* goats to assess their performance. Performance, an externally measurable appearance, is influenced by both genetic and environmental factors (Kutsiyah, 2012). The relationship between body sizes and carcass weight is analyzed using the correlation coefficient (r). Meanwhile, to determine the extent of the influence of body sizes on carcass weight, it can be analyzed using the coefficient of determination (R^2). The objective of this study is to assess the performance of Kaligesing type *PE* goats based on the correlation between body sizes and body weight in Pamekasan Regency,

which has not been previously conducted in the Madura region. This aims to serve as a reference for understanding the production performance of *PE* goats in the Madura region, specifically in Pamekasan.

MATERIALS AND METHODS

Small scale farms in four villages Panguan, Larangan Dalam, Larangan Luar, and Montok in the Larangan sub district of the Pamekasan Regency would be the sites of this study. A total of 60 males out of 13 males and 13 females aged 1-1.5 years (*Poel 1*) and 17 male and 17 female aged 1.5-2.5 years (*Poel 2*) would be involved in August – September 2023. The method employed was a case study approach, with sample selection using the purposive sampling method, where samples were chosen based on criteria predetermined by the researchers (Shamad, Widyananda, & Nurgiartiningih 2023). The tools utilized in this research included measuring sticks, scales, and measuring tapes. Sizes were taken when the goats were standing upright in a perfect position, as illustrated in Figure 1.

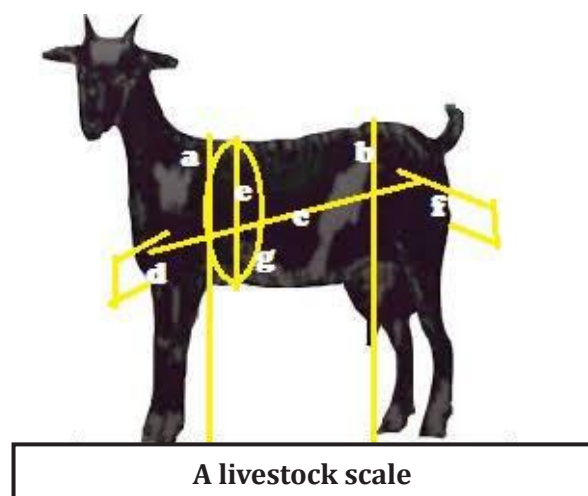


Figure 1. How to measure body sizes and weigh body weight

The method for measuring body sizes and weighing the body weight of Kaligesing *PE* goats was as follows, in accordance with SNI Kambing *PE* no 7352.1:2015:

- Body height: measured from the highest point to the ground.
- Body length: measured from the shoulder joint to the tailbone.
- Chest girth: measured with a measuring tape

- encircling the chest behind the elbow.
- d. Body weight: determined by lifting the goat and placing it on the scale.

Data Analysis

Body sizes and body weight data of male and female Kaligesing PE goats were analyzed using an unpaired t-test to compare the influence of gender on body weight (Sudarwati, Natsir, & Nurgartiningih 2019):

$$S^2 = \frac{JK_A + JK_B}{(n_A - 1) + (n_B - 1)}$$

$$T_{hit} = \frac{\bar{X}_A - \bar{X}_B}{\sqrt{S^2 \left(\frac{1}{n_A} + \frac{1}{n_B} \right)}}$$

Explanation:

- X_A : Mean of research results for male Kaligesing PE goats
- X_B : Mean of research results for female Kaligesing PE goats
- JK_A : Corrected sum of squares for male Kaligesing PE goats
- JK_B : Corrected sum of squares for female Kaligesing PE goats
- n_A : Sample size for male Kaligesing PE goats
- n_B : Sample size for female Kaligesing PE goats

The relationship between body sizes and body was analyzed using the correlation coefficient. The correlation coefficient was calculated using the formula as follows (Nurgartiningih, 2017):

$$r = \frac{cov_{xy}}{\sigma_x \sigma_y}$$

Explanation:

- r : Correlation coefficient
- cov_{xy} : Covariance of properties X and Y
- σ_x : Standard deviation of property X (body

size)

- σ_y : Standard deviation of property Y (body weight)

The magnitude of the correlation coefficient is:

- a. If $(r)^2$ 0 s/d 1 s between 0 and 1, it indicates a positive relationship between body weight and body size.
- b. If $(r)^2$ 0 s/d -1 is between 0 and -1, it indicates a negative relationship between body weight and body size.
- c. If $(r)^2$ 0 it is considered no relationship between body weight and body size.

The extent of the influence of body sizes on goat body weight was determined by the coefficient of determination. The coefficient of determination (R^2) expresses the magnitude of X influencing Y, with the formula as follows (Sudarwati, Natsir, & Nurgartiningih 2019):

$$R^2 = (r)^2 \times 100 \%$$

Explanation:

- R^2 : Coefficient of determination
- r : Correlation

The magnitude of the coefficient of determination (R^2) between 0 and 1; if the value approaches 1, it means the observed variable is independent.

RESULTS AND DISCUSSION

Body Size and Body Weight of Kaligesing PE Goats, Male and Female, at Poel 1 Age (1-1.5 years)

The results of the body sizes analysis of male and female Kaligesing PE goats at Poel 1 age are presented in Table 1.

The results of the analysis in this study show that gender has a very significant effect on body sizes and body weight of Kaligesing PE goats at Poel 1 age ($P < 0.01$). This was demonstrated

Table 1. Mean and standard deviation (SD) of body sizes and body weight of male and female Kaligesing PE goats at Poel 1 age

Parameter	n	Male Kaligesing PE Goats	n	Female Kaligesing PE Goats
Body height (cm)	13	76.38 ± 1.71 ^a	13	67.07 ± 2.46
Body length (cm)	13	78.38 ± 3.33 ^b	13	65.00 ± 2.70
Chest girth (cm)	13	83.69 ± 2.32 ^c	13	74.38 ± 3.45
Body weight (kg)	13	54.92 ± 5.13 ^d	13	36.00 ± 3.55

^{abc}Different superscript in the same column show significantly difference ($P \leq 0.05$).

by the difference in body height, body length, chest girth, and body weight of male PE goats with females in the sequence were 9.31 cm, 23.28 cm, 9.31 cm, and 18.92 kg. This can be caused by be due to the influence of differences in male and female sex hormones, as stated by Setiyono, Kusuma, & Rusman (2017) that the male hormone (testosterone) produced by the testes is beneficial for the growth of male livestock, resulting in faster growth compared to female livestock. This statement is also supported by Damanik, Wijayanto, & Depison (2020) that testosterone is a growth-regulating hormone produced by interstitial cells and adrenal glands, causing faster growth in male livestock compared to females of the same age. The gender of livestock plays a crucial role in the growth stimulation process, with males showing faster growth than females.

The results of chest girth and body length sizes for male Kaligesing PE goats at *Poel 1* age in this study are higher compared to the findings of Victori, Purbowati, & Lestari (2016) which were 81.57 cm for chest girth and 76.76 cm for body length. This suggests that the livestock quality in this study has good genetics and a well-maintained system. The differences in chest girth and body length may be attributed to variations in livestock genetics and management systems. This is supported by Gunawan, Jamal, & Sumantri (2008) statement that differences in livestock body sizes can result from environmental variations, including feeding practices and surrounding conditions. The body sizes in this study are also higher than the results of Purwanti, Setiatin, & Kurnianto (2019) which were 73.34 cm for body height, 74.93 cm for body length, and 82.61 cm for chest girth. These differences may stem from the accelerated bone growth in livestock influenced by genetics and environmental support. The growth differences in livestock can be influenced by the growth rate before the adult gender phase, and *Poel 1* age represents livestock in a newly

completed growth phase (adult sex), which can be optimized with an optimal management system (Hamdani, 2015). Feed is one of factors that can impact livestock growth, because a lack of nutrition can cause growth delays; livestock feed consumption is utilized by animals to meet production and reproductive needs.

Body Size and Body Weight of Kaligesing PE Goats, Male and Female, at *Poel 2* Age

The results of the body sizes analysis of male and female Kaligesing PE goats at *Poel 2* age are presented in Table 2.

The analysis results in this study indicate that gender significantly influences body sizes and body weight of *Poel 2* Kaligesing PE goats ($P < 0.01$). This is demonstrated by the difference in body height, body length, chest girth and body weight of male PE goats with females in sequence is 9.93 cm, 9.77 cm, 9 cm and 20.23 kg. This is due to their production and reproductive systems, male Kaligesing PE goats are often used for fattening as meat producers (production), while female Kaligesing PE goats are mainly used as breeding animals (reproduction). Therefore, the body sizes and body weight of male and female goats differ because the consumed feed serves growth purposes (male) and is utilized for milk nutrition provided to their offspring (female). Hamdani, Adhianto, & Husni (2017) state that in female animals, increased estrogen hormone secretion can lead to a decrease in calcium concentration. Thus, if there is an increase in estrogen hormones, it can result in a decrease in bone growth rate. Growth is a benchmark for assessing livestock productivity, consisting of body height, body length, and chest girth of the animals (Adiwinarti, Fariha, & Lestari 2011).

The analysis results indicate that the body sizes and body weight of Kaligesing PE goats in this study are higher compared to the findings of a study conducted by Hanafi et al (2022) with the

Table 2. Mean and standard deviation (SD) of body sizes and body weight of male and female Kaligesing PE goats at *Poel 2* age.

Parameter	n	Male Kaligesing PE Goats	n	Female Kaligesing PE Goats
Body height (cm)	17	85.11 ± 1.99 ^a	17	75.18 ± 3.14
Body length (cm)	17	86.06 ± 3.38 ^b	17	76.29 ± 6.03
Chest girth (cm)	17	93.35 ± 2.39 ^c	17	84.35 ± 5.96
Body weight (kg)	17	75.11 ± 5.80 ^d	17	54.88 ± 11.28

^{abc}Different superscript in the same column show significantly difference ($P \leq 0.05$).

same age, namely 41.57 kg for body weight, 83.09 cm for chest girth 77.51 cm for body length, and 78.32 cm for body height. This difference could be attributed to variations in the feed consumption of each animal, as the quality of feed significantly influences livestock growth. Better feed quality leads to optimal growth in both production and reproduction, as stated by Nugraha, Sampurna, & Suatha (2016) emphasizing that feed is a crucial factor influencing livestock growth. When animals are provided with good-quality feed in sufficient quantities, their growth becomes optimal.

Body Correlation with Body Weight of *Poel 2* Kaligesing *PE* Goats

The results of correlation coefficient and determination coefficient analyses in this study, focusing on body sizes (body length, body height, and chest girth) with body weight of *Poel 1* Kaligesing *PE* goats, are presented in Table 3.

Table 3. Correlation and determination coefficients of body sizes with body weight of *Poel 1* Kaligesing *PE* goats.

<i>Poel 1</i>	n	r	R ²
Body height – body weight	26	0.88	0.78
Body lenght – body weight	26	0.96	0.91
Chest girth – body weight	26	0.97	0.93

In this study, body weight has a very strong correlation with body sizes (body height, body length, and chest girth) of *Poel 1* Kaligesing *PE* goats ($P < 0.01$). The highest correlation coefficient is found between chest girth and body weight, which is 0.97, indicating a strong positive correlation. This means that an increase in chest girth results in an increase in body weight. The determination coefficient value is 0.93, meaning that 93% of the increase in body weight is influenced by the increase in chest girth. The correlation values for body length and body height with body weight are also strong, i.e., 0.88 for body height and 0.96 for body length. The determination coefficients are 0.78 for body height and 0.91 for body length, indicating that an increase in body weight is influenced by body height by 78% and body length by 91%. study by Victori, Purbowati, & Lestari (2016) on the correlation between body sizes and body weight of Kaligesing *PE* goats obtained similar results, with correlation values categorized as very strong, namely 0.930 for chest girth, 0.905 for

body length, and 0.884 for body height. Therefore, body weight estimation can be accurately done by measuring chest girth, followed by body length and body height. Chest girth provides an estimate of livestock body weight, as it has the closest relationship with the body weight of livestock. This is supported by Gunawan, Suwiti, & Sampurna (2016) who assert that the body size most related to body weight is chest girth. The length of the livestock ribs influences the attachment of muscle tissue, leading to an increase in chest girth. The size of the chest girth is influenced by several factors, including genetics, environment, feed, management, and gender. Genetic factors are inherited from ancestors, and each livestock breed has unique characteristics also states that chest girth has an accurate correlation with body weight and the highest value compared to other body sizes.

Body Correlation with Body Weight of *Poel 2* Kaligesing *PE* Goats

The results of correlation coefficient and determination coefficient analyses in this study, focusing on body sizes (body length, body height, and chest girth) with body weight of *Poel 2* Kaligesing *PE* goats, are presented in Table 4.

Table 4. Correlation and determination coefficients of body sizes with body weight of *Poel 2* Kaligesing *PE* goats.

<i>Poel 2</i>	n	r	R ²
Body height – body weight	34	0.80	0.64
Body lenght – body weight	34	0.91	0.82
Chest girth – body weight	34	0.97	0.93

The results of correlation coefficient analysis indicate a significant influence between body sizes and body weight of *Poel 2* Kaligesing *PE* goats ($P < 0.01$). The highest correlation value is found between chest girth and body weight, which is 0.97, followed by the correlation between body length and body weight at 0.91, and body height correlation with body weight at 0.80. These correlations are considered strong positive values, meaning that an increase in body height, body length, and chest girth will be followed by an increase in the body weight of *PE* goats. Positive correlation values suggest that an increase in body sizes (chest girth, body length, and body height) will impact the increase in livestock body weight (Ikhsanuddin, Nurgartiningih, Kuswati,

& Zainuddin, 2018). Beyleto, Sumadi, & Hartatik (2010) added that differences in population and research locations can lead to variations in the obtained values due to changes in livestock composition within that population.

The coefficient of determination analysis results for body sizes with body weight of Kaligesing *PE* goats are 0.60 for body height, 0.82 for body length, and 0.93 for chest girth. This indicates that body height, body length, and chest girth respectively influence weight growth by 64%, 82%, and 93%. This is because chest girth represents the size of the livestock's rib, body length represents the backbone of the livestock, and body height represents the body height of the livestock's leg (Murti, et al., 2014). The largest impact on the body weight gain of Kaligesing *PE* goats in this study is influenced by chest girth, in line with the statement by Putra, Sumadi, & Hartatik (2014) that changes in chest girth have the greatest impact on body weight compared to changes in other body sizes such as body length and body height. In this investigation, *Poel 2* Kaligesing *PE* goats had a lower coefficient of determination than *Poel 1* Kaligesing *PE* goats, which could be due to the difference in the age of the goats. Younger animals tend to have faster growth rates; *Poel 1* goats experience rapid growth as they enter the period of sexual and body maturity (Trisnawanto, Adiwiniarti, & Dilaga 2012).

CONCLUSIONS

The results of this study show that the body sizes and body weights of male Kaligesing *PE* goats are higher than those of female goats at the age of *Poel 1* and *2*. The correlation between body sizes (chest girth, body length, and body height) with body weight of Kaligesing *PE* goats included in the category of high and very strong positive values, that is 0.97, 0.96, and 0.88 for *Poel 1*, 0.97, 0.91, and 0.80 for *Poel 2*.

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