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PHENOTYPE VARIATION, CORRELATION, AND REGRESSION OF MORPHOLOGY CHARACTERISTICS IN RAMS AND EWES GARUT INDONESIAN LOCAL SHEEP

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ABSTRACT

This research was conducted to examine phenotypic variation, correlation, and regression of various morphometric characteristics in Garut sheep, as a basis for consideration in selecting prospective candidate rams and ewes. The method used in this research was a case study, with the sample criteria of ewes having at least one kid and rams having offspring. Malang Regency farmer conducted this research with a total sample of 27 Garut Sheep as a Javanese thin-tail. The five standard morphological traits observed were body length (BL), chest circumference (CC), body height (HG), height hip (HH), and width hip (WH). Data analysis used analysis of variance with a single factor to characterize the morphology of rams and ewes of Garut Indonesian Local sheep. The results showed that BL and BH of rams were significantly different ($P < 0.05$) higher than the ewes, with no significant difference ($P > 0.05$) in CC, HH, HW, and TL of ewes and rams, but CC and HH tended to be higher in ram than ewes; in contrast, HW and TL mean tended to be lower in ram than ewes. Variation or diversity, correlation, and determination coefficient in all morphological traits ranged from 4.86 to 47.10, 0.41 to 0.74, and positive regression in rams and ewes. The conclusion was that 67% of morphological traits (CC, BL, BH, and HH) were higher in Rams than in Ewes and lower than 33% of HW and TL. The closest correlation of morphology in both rams and ewes was the relationship between BL (X) and CC (Y), with a determination coefficient of 43-55% and the regression equation $Y = 35.64 + 0.51 X$ (rams) and $Y = 14.86 + 0.70 X$.

Keywords: Body Measurement, Diversity, Thin-tail Sheep

1. INTRODUCTION

In recent years, sheep have become one of the important animal protein-producing livestock in Indonesia. In Indonesia, sheep are the second largest ruminant population. The sheep population in Indonesia reaches 14.06 million, ranking as the third largest population (27.38%) after cows (34.27%) and goats (36.14%) of the total population of large and small ruminants in Indonesia (Central Statistics Agency, 2024). They are exclusively local livestock raised in intensive and semi-intensive production systems in various regions of Indonesia. Sheep are raised to produce meat, skin, and family savings (Najmudin and Nasich, 2019; Mohapatra and

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Shinde, 2018; Silveira et al., 2021). Local sheep productivity is a top priority which can be achieved by improving good maintenance and feed management as well as a sustainable breeding program (Sujarwanta et al., 2024, Ngcobo, 2022; Nasich et al., 2021).

One of the local Indonesian sheep that gets priority in breeding is the Garut sheep (Adiati and Rusdiana, 2022). The people of Garut have cultivated Garut sheep for a long time. Garut sheep are included in the Javanese Thin Tail, especially the males used for the art of fighting in the Bayongbong area of Garut, West Java, Indonesia. Garut sheep were the result of a triangular cross between native Indonesian sheep, Merino sheep from Asia Minor, and fat-tailed sheep from Africa. The public knows this sheep as the Garut sheep, which is also known as the Priangan sheep. The color of Garut sheep is usually black or striped; sometimes, there are grey or brown individuals. Male sheep have horns, while female sheep have horns or no horns, some even do not have external ears.

To support the fulfillment of meat needs, sustainable efforts to ensure good productivity of local Garut sheep can be obtained through good maintenance and feed management and following a breeding program. In the breeding program, selection needs to be carried out to see the superiority of the livestock, one of which is by looking at the morphology of the livestock, following the opinion that morphological measurements are a very important method used to estimate and assess the characteristics of various types of animals (Islam et al., 2022; Ardinata et al., 2023; Mudawamah et al., 2023 & 2021). The measurements provide basic information about the suitability of animals for their selection. In addition, morphological measurements can be used as a management tool to increase livestock productivity, predict genetic progress, growth rate, body condition score (BCS), carcass conformation and traits (Berry et al., 2021), to detect metabolic disease (Schmidtmann et al., 2023).

Based on the background above, research on the phenotyping study of Rams and Ewes Garut Local sheep in Indonesia based on morphology characteristics was necessary to provide an overview of phenotypic diversity, the correlation and regression of various body sizes of Garut sheep ancestors in breeding programs on small farms in Indonesia.

2. RESEARCH METHODS

The method used in this research was a case study. Sample measurements were determined using purposive sampling with the criteria of ewes had having at least one kid and rams having had offspring also. Malang Regency farmer carried out this research with a total sample of 27 Garut Sheep as a Javanese thin-tail (Figure 1). The farm location is located in a highland area at an altitude of 746 meters above sea level with a temperature of around 17-27°C. Providing sufficient amounts of concentrate and forage grass. Feeding in the morning is in the form of concentrate, and in the afternoon and evening, they are given forage in the form of grass. The cages were in the form of colony cages on stilts with wood for the floor and bamboo for insulation.

Data was analyzed using analysis variance single factor and correlation and regression with the Excel program. The variables observed were body length (BL), chest circumference (CC), body height (HG), height hip (HH), and width hip (WH). CC was obtained by wrapping a measuring tape around the chest cavity behind the shoulder joint (unit cm). BL was obtained by measuring from the edge of the humerus bone to the lump of the sieve bone or sit bone, which is measured with a measuring tape (unit cm). BH was obtained by measuring the distance from the highest shoulder to the ground, which was measured with a measuring pipe (in cm). HH was

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measured perpendicular to the ground surface from the highest distance in the lumbar vertebrae; measurements were made with a measuring stick in cm. HW was measured between the right and left sides of the hip joint (the top protrusion of the thigh bone). Measurements are made with capillaries in cm units. TL was measured from the base of the tail to the tip of the tail; measurements were made with a measuring tape (unit cm).

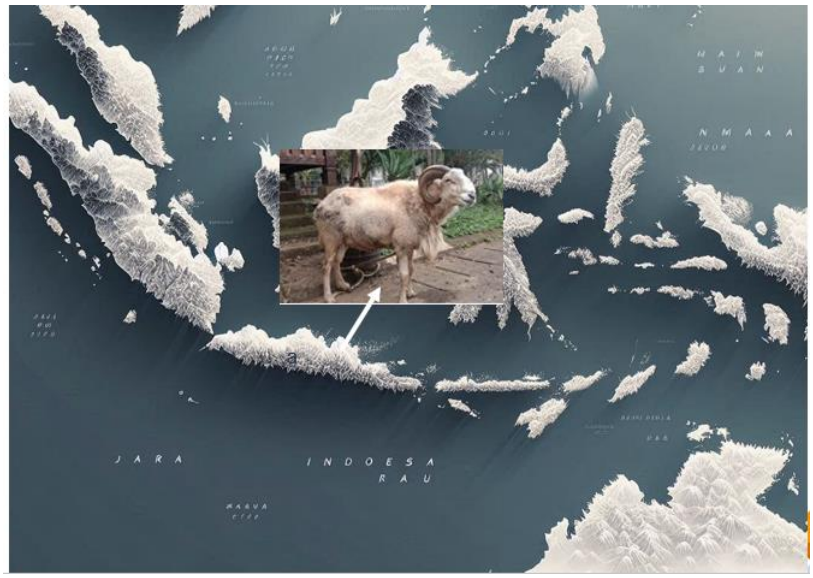

Figure 1. Garut Sheep as a Javanese Thin-Tail originally came from West Java Indonesia

Results and Discussion

This research explained the results and discussion into two parts: the average value and morphological variance of ewes and rams in Garut sheep and the second discussion about morphological correlation and regression.

Variance and Mean

Based on descriptive analysis of morphology data, it was found that the mean values for the BL, BH, and TL traits were statistically significantly different ($P < 0.05$) between males and females, followed by variance values that varied from low to very high, Table 1.

Table 1. Morphology Mean and Variance of Garut Sheeps

Parameters	Rams	Ewes	Rams	Ewes
	Mean (cm)		Variance	
CC	81.46 ± 6.86	79.14 ± 5.48	47.10	29.98
BL	77.08 ± 5.35[a]	70.21 ± 5.16[b]	28.58	26.64
BH	69.14 ± 3.09[a]	69.13 ± 4.34[b]	9.53	18.75
HH	71.46 ± 2.88[a]	68.29 ± 4.18[b]	8.27	17.45
HW	18.85 ± 2.34	19.64 ± 2.21	5.47	4.86
TL	22.08 ± 3.84[a]	26.64 ± 4.53[b]	14.74	20.55

Note: [a] significant difference with [b] in the same row, CC (chest circumference), BL (body length), BH (body height), HH (hip height), PW (hip width), TL (tail length)

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Table 1, Garut sheep (thin-tail sheep) were higher than Arsi Bale sheep (thin-tail sheep) from Africa (Worku, 2019) in both adult male and female livestock with the highest CC values of 81.46 cm and 79.14 cm vs 69.14 cm, BL 77.08 cm and 70.21 cm vs 64.66 cm, BH 69.14 cm and 69.13 cm vs 64.83 cm (Garut sheep vs Arsi Bale sheep) and also higher than sheep in southwestern region Ethiopia except in TL was lower than sheep in southwestern region Ethiopia. The mean of CC, BL, BH, and TL were 75.5 ± 0.18 cm, 62.8 ± 0.14, 64.0 ± 0.12 cm, and 28.2 ± 0.20 cm, respectively.

Variation or diversity in all morphological traits ranged from 4.86 to 47.10, with the variation being higher in rams compared to ewes in CC, BL, and HW. In contrast, BH, HH, and TL traits were lower in rams than in ewes. It shows that rams were heterozygosity numerically (Variance > 10) on the CC, BL, and TL traits but numerical homozygosity on the BH, HH, and HW traits. Meanwhile, ewes showed numerical heterozygosity in the CC, BL, BH, HH and TL traits but numerical homozygosity in the HW traits. Therefore, selection for Rams of Garut sheep based on morphology should be based on BH, HH, and HW while Ewes Garut sheep should be based on HW. The opinion of Mudawamah et al. (2021) supports that the selection of candidate doe for goats should also be based on HW, which has a value of > 19.60 cm.

Table 1 showed that the BL and BH mean of rams was significantly different ($P < 0.05$) and higher than the ewes. There was no significant difference ($P > 0.05$) in CC, HH, HW, and TL mean of ewes and rams. It was interesting to discuss that CC and HH mean tended to be higher in ram than ewes; in contrast, HW and TL mean tended to be lower in ram than ewes. The percentage of mean morphology comparison between rams and ewes can be seen in Figure 1.

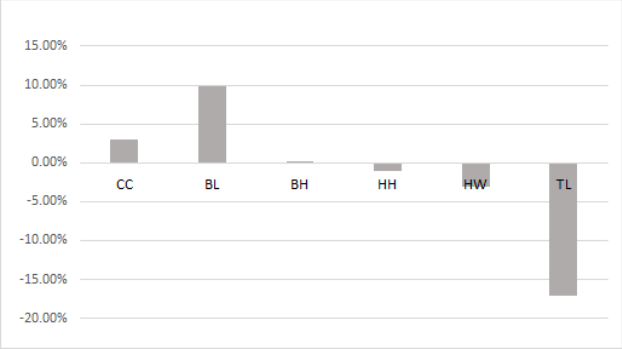

Figure 1. The ratio of mean morphology between rams and ewes (%)

The morphology ratio between rams and ewes (Figure 1) showed a higher positive percentage for rams than ewes, around 2.93% for CC properties and 9.78% for BL properties. BH properties were relatively the same (with a positive difference of 0.98%) between compared rams. Ewes. On the other hand, the HH, HW, and TL traits were higher in ewes compared to rams, with percentages of 0.98 %, 3.13 %, and 17.1 %, respectively.

Correlation and Regression

Table 1 shows relationships and regression equations between some morphological traits in Garut sheep, namely BL and CC, BL and BH, and BH and CC in both Rams and Ewes.

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Table 1. Correlation and Regression of Various Morphological Traits of Garut Sheep

Sex	relation	r	R2	regression	Significance F
Male	BL (X) with CC (Y)	0.65	0.43	Y = 35.64 + 0.51 X	0.02
	BL (X) with BH (Y)	0.59	0.35	Y = 2.66 + 1.03 X	0.03
	BH (X) with CC (Y)	0.47	0.22	Y = 6.51 + 1.04 X	0.1
Female	BL (X) with CC (Y)	0.74	0.55	Y = 14.86 + 0.70 X	0.02
	BL (X) with BH (Y)	0.45	0.20	Y = 42.67 + 0.38 X	0.11
	BH (X) with CC (Y)	0.41	0.17	Y = 43.48 + 0.52 X	0.15

Note: CC (chest circumference), BL (body length), BH (body height), HH (hip height), PW (hip width), TL (tail length)

The relationship between BL and CC in both rams and ewes of Garut sheep was significantly different ($P < 0.01$), with the r value and coefficient of determination being 0.65 and 0.43 (rams), 0.74 and 0.55 (ewes), respectively. The data meant that the relationship between BL and CC for male and female sheep (ewes and rams) was high, at more than 0.6. Specifically, the relationship between BL and BH in rams had a real correlation in the medium category. Therefore, the most crucial morphological measure obtained data for selection was BL because it was closely related to CC and BH in rams and closely related to CC in ewes from Garut sheep. The results aligned with research by Selala and Tyasi (2021), who found that the crucial morphological measure was BL because it correlated with body weight.

3. CONCLUSION

Morphological trait variation or diversity in ewes and rams of Garut Indonesian Local Sheep ranged from 4.86 to 47.10. Rams were numerically heterozygous on the CC, BL, and TL traits, with numerical homozygosity on the BH, HH, and HW traits. Meanwhile, ewes showed numerical heterozygosity in the CC, BL, BH, HH, and TL traits and numerical homozygosity in the HW traits. 67% of morphological characteristics (CC, BL, BH, and HH) were higher in Rams than in Ewes and lower than 33% of morphological traits (HW and TL). The closest correlation of morphology in both rams and ewes was the relationship between BL (X) and CC (Y), with a determination coefficient of 43-55% and the regression equation Y = 35.64 + 0.51 X (rams) and Y = 14.86 + 0.70 X. For implementation in the field, BL could predict CC in rams and ewes Garut sheep and BH in male Garut sheep. Selection for Rams of Garut sheep based on morphology should be based on BH, HH, and HW, while Ewes Garut sheep should be based on HW.

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