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External Characterization of Female Bali Cattle Populations in Gorontalo, Indonesia

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ABSTRACT

The study aims to characterize female Bali cattle morphometric and phenotype in the Bone Raya sub-district, Bone Bolango district, Gorontalo, Indonesia. The research was conducted at four locations (Alo, Mootayu, Mootawa, and Mootinelo villages) from January to April 2023. A total of 64 Bali cattle aged 4-8 years were used in this study. The method used was direct sampling, which examined the qualitative and quantitative characteristics. The analytical methods used were descriptive analysis and qualitative analysis. The results show that the body length of female Bali cattle has an average of 104.75 cm, chest circumference has an average of 150.67 cm and a standard deviation of 8.72, the body height of female Bali cattle in this study had a minimum average of 80.75 cm, a maximum average of 144.25. The body colors consisted of brick red, brown, and yellowish brown. The horn shapes were U-shaped, curved backward, and curved downward. Vulva's color was black. Eel lines consist of thick, medium back lines and thin back lines. Further development of Bali cattle was required to improve production and reproductive performance so that performance could be the same as that of Bali cattle in their native region.

Keywords: Bali cattle, Morphometric, Qualitative, Quantitative

INTRODUCTION

Bali cattle are a breed of Indonesian native cattle domesticated from Banteng (Bos javanicus), purified and conserved (Diwyanto and Inounu, 2009; Martojo, 2012). Their existence has been legalized through the Indonesian Ministry of Agriculture as an Indonesian native cattle breed (Jakaria et al., 2020). The characteristics of Bali cattle are brick red for females and black for the bulls; on the top of the back, there is a black line; the back of the thigh is white; the fur on the ears is white, and the fur on the tip of the tail is black (Hikmawaty et al., 2014). The high reproductivity and adaptive features of Bali cattle have made the cattle much in demand (Mohammad et al., 2009; Amiano et al., 2020). Bali cattle development in ex-situ areas allows the formation of new qualitative traits (Hayanti et al., 2022).

Bali cattle dominated Gorontalo in 2000 when Gorontalo officially became a separate province from North Sulawesi (Dako et al., 2023). Bone Raya is one of the sub-districts located on the coast in Bone Bolango Regency, Gorontalo, which consists of 10 villages with a total of 460 cattle in 2016 and 2021, the number of cattle increased by 1226, which is the type of livestock that is mainly kept in Bali cattle. A semi-intensive rearing system is used to raise Bali cattle in the Bone Raya District. The condition of female Bali cattle in Bone Raya District has different body sizes and varied coat colors, which is thought to be the result of genetic decline, which results in differences in livestock productivity and qualitative traits in Bali cattle. Qualitative characteristics are the main visual characteristics of livestock (Noor, 2008; Dako, 2019). Qualitative characteristics can be seen through fur, hair, horn shape, and leg color. Quantitative characteristics are needed to increase livestock production (Laya et al., 2020). Meanwhile, quantitative characteristics can be measured from body measurements such as body length, chest circumference, shoulder height, hip height, chest depth, chest width, hip width, head length, head width, and body weight.

Phenotypic characterization of livestock genetic resources provides the basis for development intervention. One of the first essential steps toward sustainable utilization of resources is to describe their typical quantitative and qualitative phenotypic traits (Ayalew et al., 2004). Proper evaluation of these traits is necessary for future use without compromising their current utilization (Tekle et al., 2011). This study aims to characterize female Bali cattle morphometric and phenotype in the Bone Raya sub-district, Bone Bolango district, Gorontalo, Indonesia.

MATERIALS AND METHODS

This research was conducted in Bone Raya District, Bone Bolango Regency, Gorontalo, in January-April 2023. The research materials used were 64 female Bali cattle aged 4-5 years from Mootayu, Alo, Mootawa, and Mootinelo Villages. This research method uses Proportional Sampling to determine the number of samples while obtaining the observed livestock through Accidental Sampling. Observations of quantitative traits in Bali cattle are focused on Body Length (A), Height (B), and Chest Circumference (C). Observations of qualitative traits include Body Color (D), Horn Shape (E), Sock Pattern (F), and Vulva Color (G)

The procedure used in this research was direct sampling, which examined the qualitative characteristics of female Bali cattle. The body parts observed from the quantitative attributes of female Bali cattle measured body dimensions. The procedure in this study was to observe the qualitative and quantitative characteristics of female Bali cattle. Observations of the exterior characteristics of the body were described descriptively using the formula:

Value of Relative Frequency of Body Color Traits

$$a = \frac{a_1 + a_2 + \cdots + a_n}{n} \text{ x } 100$$

Notes:
$\bar{a}$ = *Value of traits;* a_1, a_2, a_n*;* ***a****= observation frequency of trait;* n= *total of cattle*

Data Analysis

The analytical method used in quantitative and qualitative measurement results is descriptive and qualitative analysis. In qualitative and quantitative data obtained from the results of observation, documentation and analyzed descriptively, a description of the facts at the research location, using the formula for the maximum value and minimum value of the average/mean(x) standard deviation, correlation analysis is as follows:

Azis et al., (2023); Dako et al., (2024); Laya et al., (2024) Measurement of the body size of Bali cattle using the formula:

Mean Value

$$\bar{a} = \frac{a_1 + a_2 + \cdots + a_n}{n}$$

Notes:

$\bar{a}$ = Mean value of traits; a_1, a_2, a_n= several traits; n= total of cattle

Standard deviation:

$$S = \frac{\sqrt{\sum_{i-1}^{n} (a_1 - \bar{a})^2}}{n-1}$$

S = Standart deviation; Xi = The i-th x value; X = Average

Coefficient of variance:

$$Cov = \frac{S}{a} \text{ x } 100$$

Cov= Coefficient of variance; *S = Standart deviation*

The collected qualitative trait data is tabulated and then analyzed based on relative frequency (percentage) using the formula:

$$\boldsymbol{fR} = fin \text{X} 100\%$$

Notes:

fR = Relative frequency
fi = Observed trait
n = Number of data

RESULT AND DISCUSSION

Animal body size reflects an animal's ability and sound production. According to Dako et al. (2023), the body size of Bali cattle describes the quantitative profile of the livestock's performance, influenced by both genetics and the environment. The body measurements examined are length, chest circumference, and height. The body length of female Bali cattle in Bone Raya District has an average body length of 104.75 cm. The village with the highest body length of 113.00 cm was Mootinelo Village, and the town with the lowest body length of 90.00 cm was Mootawa Village.

Table 1. Quantitative Traits in female Bali cattle

Quantitative trait	Location				Average
	1	2	3	4	
Body length (A)					
Maximum	104.00	90.00	112.00	113.00	104.75
Minimum	98.00	13.00	98.00	91.00	75.00
Mean	100.50	96.43	102.14	100.13	99.80
Standard deviation	2.52	4.35	4.56	6.41	4.46
Variance	2.50	4.51	4.47	6.40	4.47
Chest circumference (B)					
Maximum	159.00	136.00	164.00	167.00	156.50
Minimum	142.00	26.00	142.00	124.00	108.50
Mean	149.50	149.57	154.43	149.17	150.67
Standard deviation	7.59	8.72	8.60	9.96	8.72
Variance	5.08	5.83	5.57	6.68	5.79
Body height (C)					
Maximum	114.00	105.00	120.00	118.00	114.25
Minimum	106.00	11.00	105.00	101.00	80.75
Mean	109.50	108.86	111.00	109.83	109.80
Standard deviation	3.70	3.93	5.48	4.51	4.40
Variance	3.38	3.61	4.93	4.11	4.01

Mootayu Village (1), Mootawa (2), Alo (3), Mootinelo (4)

Body length is one of the genetic traits that has economic value in Bali cattle. Body length in the results of this study can be compared with research by Fatmona et al. (2021) in Wasile District, East Halmahera Regency, i.e., with the highest average of 114.7 ± 3.7 cm and the lowest average of 108.6 ± 8.8 cm. Medina et al. (2021) in Pelaihari District, Tanah Laut Regency, with an average value of 156.0 ± 7.36 cm, and Gobel (2021) in Atinggola District, North Gorontalo Regency, i.e., 144.22 ± 14.62 cm. The body length in this study was considered very low compared to previous studies. This difference in size is usually caused by genetics, environment (conditions, location, feed), and different rearing systems.

Chest circumference measurements with a minimum mean of 108.50 cm and a maximum mean of 156.50, an average of 150.67 cm, and a standard deviation of 8.72. The chest circumference with the highest average value of 154.43 cm was in Alo Village, while the chest circumference with the lowest average was 149.17 in Mootinelo Village. The results of chest circumference measurements in this study can be compared with the results of research by Fatmona et al. (2021) in Wasil District, East Halmahera Regency; the chest circumference size of female Bali cattle was highest in Bumirestu Village with an average of 159.5 ± 7.3 cm, and the coefficient of diversity (KK) was 4.5%, while the lowest average body length was in Subaim Village i.e. 146.6 ± 8.8 cm. The coefficient of variation (Cov) was 6.0%, and Medina et al. (2021) in Pelaihari District, Tanah Laut Regency, with an average value of 156.0 ± 7.36. The chest circumference measurement in the study was considered low. Still, the results of this circumference measurement are better when compared with Gobel's (2021) research in the Atinggola subdistrict in the North Gorontalo district, which had chest circumference measurements with an average of 144.22±14.62. Environmental factors, feed, and different rearing systems cause this difference.

Based on Table 1, the body height of female Bali cattle in this study had a minimum average of 80.75 cm, a maximum average of 144.25, and the highest average value was in Alo village, i.e., 111.00 cm, and the lowest average value was in Mootayu village, i.e., 109.50 cm. The study's height measurement results were low compared to previous studies. Fatmona et al. (2021) found that the highest shoulder height for female Bali cattle was found in Cemara Jaya Village with an average of 113.2 ± 2.6 cm, and the coefficient of diversity (KK) was 2.3%. The lowest mean shoulder height was in Waisuba Village, i.e., 108.6 ± 7.8 cm, and the coefficient of diversity (KK) was 7.2%. Gobel et al. (2021) stated that body height in Atinggola District has a value of 144.22 ± 14.62 cm.

However, the results of this research are still better when compared to Bali cattle in the West Seram and South Seram island groups, with an average of 108.84 up to 109.16 cm. Environmental factors and feed usually cause this difference.

Table 2. Qualitative Traits in female Bali cattle

Qualitative trait	Location				Total	Percentage (%)
	1	2	3	4		
Body color (D)						
Brick red	13.79	24.13	20.68	41.37	29	45.31
Brown	0	11.11	33.33	55.55	18	28.13
Yellowish-brown	0	17.64	52.94	29.41	17	26.56
Horn shape (E)						
U-shape	6.25	6.25	62.5	25	16	25.00
Curved back	4.44	24.44	24.44	46.66	45	70.31
Curved down	33.33	0	0	66.66	3	4.69
Sock pattern (F)						
Limited	6.25	18.75	32.81	42.18	64	100
Unlimited	0	0	0	0	0	0
Vulva color (G)						
Black	6.25	18.75	37.5	37.5	64	100
Reddish	0	0	0	0	0	0
Eel line (H)						
Thick	4.76190	19.04762	33.3333	42.8571	21	32.81
Medium	10.00	13.33333	40.00	36.6667	30	46.88
Thin	0	30.76923	15.3846	53.8461	13	20.31

Note: Mootayu Village (1), Mootawa Village (2), Alo Village (3), Mootinelo Village (4)

Based on the results of research on body colors found at the research site, there are three colors i.e., 1). Red brick was 13.79% in Mootayu village, 24.13% in Mootawa, 20.68% in Alo, and 41.37% in Mootinelo village, with an average of 45.31%. 2). The brown color was only found in 3 villages, i.e., Mootawa, Alo, and Mootinelo village, with a percentage of 11.11%, 33.33%, and 55.55%, respectively, with an average of 28.13%. 3). The yellowish brown color was found in three villages, i.e., Mootawa, Alo, and Mootinelo Village, with percentages of 17.64%, 52.94%, and 29.41%, respectively, with an average of 26.56%. The results of this research are the same as those of Simanjuntak et al. (2021), who studied the body color of female Bali cattle kept in Wadio Village, West Nabire District. The dominant body color was brick red, but different from the cattle in the Atinggola sub-district. Gobel et al. (2021) stated that the body color of female Bali cattle in the Atinggola sub-district consists of brick red, light brown, and fawn, with percentages of 57.45%, 14.89, and 27.66, respectively. However, there are similarities between these two studies, which have a dominant body color of brick red. Meanwhile, according to Bansi et al. (2019), the body color of female Bali cattle in the western and southern Seram island groups mainly was yellowish brown, while the rest was distributed in pink and light brown, and a small number of black and dark brown.

Horns are a part of the body that grows on the heads of male and female cattle, which function as a means of self-defense from predators and attracting females during the mating season. Based on Table 2, the research results on the shape of the horns of female Bali cattle found in the Bone Raya sub-district show three horn shapes, i.e., 1). U -shaped 25%. 2) Curves backward 70.31% and 3) Curves downwards 4.69%. This research's results differed from those of Bansi et al. (2019). The horns have various shapes, i.e. curved upwards and forward, but very few female cattle are found without horns (dugul). Gobel et al. (2021) stated that Bali cattle in the Atinggola subdistrict, North Gorontalo Regency, were found only to have horns curved downwards.

The sock pattern is a white pattern on the feet of Bali cattle, characteristic of the cattle. This pattern is a genetic trait inherited in female and male Bali cattle, which is not found in other types of cattle. Based on Table 2, it was shown that all female Bali cattle in the Bone Raya subdistrict were found to have a sock pattern, and all had a phenotypic frequency bordering on a percentage of 100%.

The results of this research on sock patterns were different from those of Gobel et al. (2021), who stated that the white color pattern on the feet (socks) in the Atinggola sub-district was demarcated with a body hair color of 68.09% and 31.91% was invisible.

Based on the results of vulva color in Bali cattle in the Bone Raya sub-district, the average has a black vulva. This color was the standard color for the vulva of female Bali cattle because the vulva of female Bali cattle is black. According to Agustina et al. (2021), the color of the vulva of a group of Bali cattle in silent heat is pink; the peripheral vessels are not visible. Vulvar mucus in Bali cattle in silent heat often shows no mucus until there is little. Meanwhile, the color of the vulva of the group of cows in estrus tends to be bright red to dark red, and the branching of peripheral vessels is clearly visible. Vulvar mucus is found to be more plentiful, and the consistency tends to be thick, transparent, and hanging.

The eel/back line is a black line on the back of Balinese cattle and is one of the characteristics of Bali cattle that differentiate these cattle from local cattle, PO, limousine, and other cattle. Based on Table 2, female Bali cattle in the Bone Raya sub-district show the eel/back line consisting of: 1) thick back line with a percentage of 32.81%. 2) medium back line with a percentage of 46.88%. 3) thin back line of 20.31%. The highest percentage of back lines in the Bone Raya sub-district was medium back lines at 46.88%. The results of this research are the same as research by Bansi et al. (2021) on the eel line in the island group, Maluku province, i.e., Bali cattle has a medium eel line on the West Seram island group and South Seram island group has a thin back line. Gobel et al. (2021) stated that the eel stripes in the Atinggola subdistrict, North Gorontalo Regency, were black with thick, medium, and thin stripes.

CONCLUSION

The body size of female Bali cattle in Bone Raya District has an ideal body size. The dominant body color is brick red. The dominant horn shape is U-shaped and curves backward. Good maintenance can create the qualitative and quantitative characteristics of Bali cattle as in their native region so that the economic value of livestock can increase.

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