



Phenotype Purity of Female Bali Cattle in The Coastal Area

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Abstract: The role of farmer groups are very strategic in increasing the number of Bali cattle. The existence of the group has been able to increase the number of livestock. The aim of this research is to determine the phenotypic purity of Bali Cattle raised in Kabila Bone District based on Indonesia National Standards (SNI). This research was carried out in several livestock groups in Kabilabone District, Bonebolango, ± 5 months, namely in Juli-November 2023. Method used were visual observations and body measurements. Descriptive analysis for external phenotypic appearance and quantitative. The skin color of female Bali cattle in Molotabu and Biluango Villages experienced a shift or bias from the SNI standard of 1.67-2.85 respectively, where the body skin color was dark brown to black, while other cattle have normal colors such as brick red, brown, light brown and fawn according to SNI standards. The white color pattern on the buttocks/rump mirror (CB) is a characteristic of male and female Bali cattle. The white color is circular in shape following the shape of the rear buttocks of the Bali cattle. CB circle boundaries in Bali cattle are clearly visible. The frequency of CB color boundary phenotypes in female Bali cattle is the frequency of CB with clear boundaries was 33.33-76.67%, while those with unclear boundaries was 23.33-66.67%. The highest body weight of female Bali cattle was 262.87 while the lowest was 162.0, and the standard deviation value for body weight was ±26.10. Female Bali cattle raised traditionally do not comply with SNI standards.

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INTRODUCTION

Bali cattle are widely raised and utilized to meet the economic needs of farmers in rural areas. These cattle are chosen to be raised because they are able to adapt to extreme environments, are resistant to parasites, and have a high economic value when sold. In addition, the carcass percentage is high (52-57.7%) and the fat content is low ($\pm 4\%$).

Kabilabone District is one of the coastal areas ($\pm 15-500$ MDPL) in Bonebolango Regency, Gorontalo Province Indonesia. This area is included in the Tomini Bay area. The topography of this area varies from gentle to slopes above 450 MDPL. There are 12 villages located along the coast and 4 villages are coastal tourism areas. The main livelihoods of the population are farming, raising livestock and fishing. Shofanduri (2018) describes coastal areas as having a rough texture or regosal land, so they are used for agriculture, plantations and settlements (Shofanduri, 2018).

The potential for beef cattle (Bali, local and PO cattle) in Kabilabone District is 4.50% of the total number of beef cattle in Bone Bolango Regency. Bali cattle in this area are raised traditionally or extensively (BPS, 2023). Ownership of pens is very limited and functions as a place of shelter at night. Some groups of farmers release their cattle freely. In addition, the number of cattle owned by each farmer is very limited (2-3 heads/farmer), so the performance of the livestock is less than optimal. According to the Kabilabone District Government (2023), Bali cattle are currently livestock distributed by the government through the 2008 Grant Program to livestock groups. The average increase in the number of livestock is $\pm 5.21\%$ per year. The role of farmer groups is very strategic in the development and management of livestock businesses. The group's role is able to increase breeders' knowledge in maintenance techniques, livestock health quality, and livestock productivity. Evaluation of Bali cattle development at the breeder group level is very important i.e phenotypic evaluation.

The presence of Bali cattle in coastal areas provides an overview of the adaptability of these livestock. For this reason, a study of qualitative and quantitative characteristics is needed, for example: body color, horn shape, body size, and body weight. In addition, about the nature of production and reproduction. Are there any differences with Bali cattle from various regions?

Providing Phenotypic information, which is accurate, reliable, repeatable and comparable. Phenotype information of Bali cattle, especially in the coastal areas of Tomini Bay, is greatly needed, especially information on qualitative, quantitative, production and reproductive characteristics over several generations. Phenotype evaluation can be used for conservation, breeding and growth purposes, livestock development, and basic information for livestock development policy making. Evaluation of the characteristics of Bali cattle in coastal areas is the first step in livestock development in the area.

Indonesian National Standardization (SNI) for Bali cattle (BSN, 2015) is one of the benchmarks for successful Bali cattle characterization. The SNI reference can describe whether Bali cattle raised by the community have the capabilities according to standards, or whether there are differences. The results of this evaluation can be used as a basic information for sustainable livestock breeding. The aim of the research is to determine the existence of the Bali cattle phenotype in the Tomini Bay area which is raised traditionally based on the SNI for Bali cattle.

RESEARCH METHODS

The focus of the research was on the external characteristics and quantitative characteristics of body size of female Bali cattle kept in coastal areas. This research was carried out in the Livestock Group in Kabilabone District in Juli-November 2023. Method used were visual observations and body measurements. A total of 112 female Bali cattle were grouped based on the location of data collection to determine the purity of qualitative traits. Quantitative body

measurements were grouped based on the age of the livestock and the livestock were not pregnant. The qualitative observation procedure accordance to Simanjuntak & and Robinson (2021) suggestions

$$F = \frac{A}{N} \times 100\%$$

Where:

F = Fenotipe Kualitatif

A = Number of observed traits

N = Number of bali cattle

while measuring body measurement accordance to the instructions of (Gobel, Laya, et al., 2021; Hikmawaty et al., 2014; Saputraa et al., 2020). Data analysis was descriptive analysis for external phenotypic appearance and quantitative characters accordance to (Azis et al., 2023; Dako et al., 2024)

Mean

$$M = \frac{\sum x_1}{N}$$

Where:

X = Sample average

\sum = Summation

X_1 = Vaule of Sample observation

N = Total

M = Mean

Standar of Deviasi

$$S = \sqrt{\frac{\sum (x_1 - \bar{x})^2}{n}}$$

Where:

X = sample avarage

\sum = Summation

X_1 = Vaule of Sample observation

N = Total

S = standard deviation

RESULT AND DISCUSSION

Qualitative Phenotype of Bali Cattle

Female Bali cattle are kept by breeders with the aim to produce offspring and rarely sold, while male cattle are sold if the breeder requires large amounts of finance, (Safriyanto et al., 2022; Fahan, et al, 2024). Female Bali cattle kept by breeders depict visual characteristics according to the environment in which they live. The qualitative appearance of female Bali cattle from Molotabu District, Bonebolango Regency was presented in table 1.

Body skin color

The skin color of female Bali cattle reflects the visual characteristics of the animal in its environment. The qualitative appearance of female Bali cattle from Kabilabone District, Bonebolango Regency is presented in table 1.

Table 1 Qualitative traits of Bali cattle in various locations

No	Qualitative Variable	A (60)		B (35)		C (18)	
		Ff	SNI	ff	SNI	Ff	SNI
Skin color							
1	Brick red	18.33	✓	25.71	✓	55.56	✓
2	Brown	66.67	✓	42.85	✓	22.22	✓
3	Light brown	13.33	✓	28.58	✓	22.22	✓
4	Black	1.67	✗	2.85	✗	0	
White color on the buttocks of Balinese cows							
1	Blurred	23.33	✓	68.58	✓	44.44	✓
2	Boundary	76.67	✓	31.42	✓	55.56	✓
White color on the lower legs of Balinese cows							
1	Boundary	63.33	✓	74.3	✓	66.67	✓
2	Blurred	30	✓	25.7	✓	22.22	✓
3	Boundless	6.67	✗	0		11.11	✗
Black line on the back							
1	Thick	50	✓	51.43	✓	38.89	✓
2	Medium	33.33	✓	20.00	✓	11.11	✓
3	Thin	16.67	✓	28.57	✓	50.00	✓
horn direction							
1	Curved up	20.00	✓	34.28571	✓	44.55	✓
2	Curved backward	68.33	✓	48.57143	✓	55.56	✓
3	Curved forward	3.33	✓	11.42857	✓		
4	Curved down	5.00	✓	5.714286	✓		
5	Curved sideways	3.33	✓				

Note: ff = phenotype frequency, ✓= Accordance to SNI, ✗=deviance from SNI, A=Biluango, B = Molotabu, C =Botutonuo

The skin color of female Bali cattle in Molotabu Village and Biluango Village experienced a shift or bias from the SNI standard of 1.67-2.85 respectively., where the body skin color was dark brown to black. This deviation was caused by inbreeding that occurred. High inbreeding causes the expression of the blackish brown gene which is recessive in female Bali cattle to be expressed in the next generation. The expression of blackish brown and black colors in female Bali cattle still requires accurate information to draw conclusions. Bali cattle skin color is a qualitative trait controlled by genes that carry color traits and is inherited (Abdullah et al., 2006;

Adinata et al., 2017; Dako et al., 2023; Utomo et al., 2010) and was used as the main characteristic in classifying livestock groups.

In general, the skin color of female Bali cattle in this study was brick red, brown, light brown, and fawn, respectively 10.00, 62.52, 10.34, and 3.45. Based on the SNI standards for Bali cattle, it is explained that the body color of Bali cattle consists of: brick red, brown, light brown and yellowish brown (SNI Standards, 2003). The skin color of Bali cattle is a qualitative trait that controlled by one or two pairs of genes, or slightly influenced by environmental factors (Laya et al., 2024), easily observed and often used as a marker for identification and classification of certain strains or families in livestock populations.

The results of this study on the body color of female Bali cattle different from the results of the study reported by (Gobel, Dako, et al., 2021) that female Bali cattle in the northern coast of Gorontalo did not experience deviations in body skin color, each being brick red (70.06. %), light brown (9.445%), yellowish brown (20.495%), respectively, while the qualitative coat color of female Bali cattle from Maluku Province were yellowish brown, brick red, light brown, respectively, and the dominant color was yellowish brown (Nurfaizin, 2019).

Butt Mirror Pattern

The white color pattern on the buttocks/rump mirror (CB) is a characteristic of male and female Bali cattle. The white color is circular in shape following the shape of the rear buttocks of the Bali cattle. CB circle boundaries in Bali cattle are clearly visible. The frequency of CB color boundary phenotypes in female Bali cattle is shown in table 1 Table 1 illustrates that the frequency of CB with clear boundaries was 33.33-76.67%, while those with unclear boundaries was 23.33-66.67%. This was different from the research of Nurfaizin (2019) that the frequency of the dominant CB phenotype has a clear limit of 95.16%. Andoyo et al., (2014) state that Bali cattle in Tambrau Regency, West Papua Province have a CB with a clear limit of 96.23% and an unclear limit of 3.77%. The difference in CB color patterns in the age groups 2<3 years and 3<4 years were 5.24 and 6.58% (Gobel, Dako, et al., 2021)

White Border Pattern on Legs

The white pattern on the feet or socks (Kk) of the Bali cattle appears to have a boundary separating it from the skin of the upper body. The boundaries between white and upper skin colors are divided into 3 categories, namely: bordered, faint, and borderless (Dako et al., 2024; Domili et al., 2021; Gobel, Dako, et al., 2021; Rajab, 2021). Based on table 1, female Bali cattle in coastal areas have a Kk pattern of 63.33-70.33% with clear boundaries, 22.22-30.00% Kk with vague boundaries and 6.67-11.11% does not comply with SNI. Andoyo et al., (2014) reported on Bali cattle from Inam and Jandurau Villages, Kabar District, Tambrau Regency, West Papua Province, 93.29% have dominant Kk patterns and 3.77% have Kk patterns that were not clearly visible

Back Line Pattern

Based on SNI standards, Bali cattle have a distinctive characteristic in the form of a black dorsal line on the back, this line is often called the eel line (GB) (BSN, 2015). Female Bali cattle in Kabilabone sub-district have a GB pattern on the legs and comply with SNI standard 9 table 1). The percentage of thick, medium and thin GB pattern phenotypes were 33.33-50.00%; 11.11-

33.33%; 16.67-55.56%, respectively. The results of this study are different from those reported by Nurfaizin (2019), the dorsal line has a more dominant percentage of medium lines 43.90%, and (Domili et al., 2021) Bali cattle in Atinggola District have eel lines that thick, medium and thin. This difference due to the polarization of genes carrying color traits that are expressed due to the intensity of inbreeding that has occurred over the last 20 years. Inbreeding can increase gene homozygousness. The high level of homozygous genes results in the presence of heterozygous genes carrying color traits being low.

Horn Shape

The shape of the horns is the direction in which the horns grow, from the forehead to the top of the head and pointing backwards; down; to the top; or forward (Gobel et al 2021; and Domili et al, 2021; Getaneh et al., 2019; Suryaka et al., 2024). The horns function of female Bali cattle as a means of self-defense. The shape of the horns of female Bali cattle in coastal areas is depicted in table 1. The shape of the horns of Bali cattle in the coastal areas of Kabila Bone sub-district conforms to the SNI standard for Bali cattle. The results of this study describe the percentage of horn shapes curved upwards (26.67-44.55), curved backwards forward (1.33-13.33), downwards (1.33-6.67) and sideways (1.33). According to SNI, Bali cattle have 4 types of horn shapes, namely upward curved, backward curved, forward, downward and sideways. (Nurfaizin, 2019) Female Bali cattle in Maluku Province in two groups of islands have horn shapes, namely curved upwards, curved forward, small in shape and no horns.

Phenotypic purity of Body Size

Body size is a quantitative characteristic that influenced by many genes and environmental factors, especially size traits that are economically valuable. Body length is the distance between the shoulder bones (tubercullum humeralis lateralis) to the sitting bone (tubercullum ischiadium) of Bali cattle. Economical body measurements of female Bali cattle include body length, body height, chests circumference and body weight. The four body sizes of Bali Cattle are depicted in table 2.

Table 2 Body size of female Bali cattle kept in coastal areas based on age

Var	1.5->2 years			2->3 years			3->4 years			>4 years		
	Mean	STDV	SE	Mean	STDV	SE	Mean	STDV	SE	Mean	STDV	SE
V ₁	98.33	5.92	1.53	99.57	5.38	1.12	101.42	5.13	1.05	104.55	6.30	1.90
V ₂	144.13	9.84	2.54	148.61	8.61	1.80	149.63	7.85	1.60	148.82	7.35	2.21
V ₃	105.13	3.56	0.92	106.52	3.67	0.76	108.13	3.95	0.81	108.09	4.44	1.34
V ₄	106.13	3.74	0.92	107.43	3.21	0.77	109.04	3.34	0.82	109.09	2.63	1.34
V ₅	31.53	3.74	0.97	32.83	3.21	0.67	32.04	3.34	0.68	32.91	2.63	0.79
V ₆	33.20	2.04	0.53	34.13	2.38	0.50	35.21	2.77	0.56	35.64	3.01	0.91
V ₇	58.40	5.33	1.38	59.39	4.11	0.86	59.96	2.99	0.61	58.45	4.06	1.22
V ₈	33.53	3.02	0.78	33.91	1.73	0.36	34.67	1.52	0.31	35.00	2.45	0.74
V ₉	17.27	1.03	0.27	17.43	0.84	0.18	17.29	1.57	0.32	17.45	1.04	0.31
V ₁₀	42.60	6.86	1.77	42.62	7.61	1.66	44.90	6.05	1.35	45.64	5.73	1.73
V ₁₁	4.60	0.99	0.25	4.52	0.81	0.18	4.30	0.98	0.22	4.64	0.92	0.28
V ₁₂	129.69	20.58	5.31	136.78	18.13	3.78	142.70	16.93	3.46	151.50	23.48	7.08
V ₁₃	22.13	2.77	0.72	30.26	5.86	1.22	42.00	5.87	1.20	72.00	9.30	2.80

v₁ Body length v₂ Chest circumference, v₃ Body height v₄ hip height v₅ Chest width
v₆ hip width v₇ Deep chest v₈ Head length v₉ Head width v₁₀ Panjang Gelambir
v₁₁ Lebar Gelambir v₁₂ Body weight, v₁₃ Age (Months)

Based on table 2, the average v1 of 1.5-year-old Bali cattle kept by breeders in Bone Pantai District were 98.33 ± 5.92 - 104.55 ± 6.30 , the v1 diversity value was 5.06-6.02%, this illustrates the high diversity between v1 of Bali cattle. The results of this research provide an overview of Bali cattle at the age of 24 months which are kept traditionally in coastal areas that do not comply with the provisions of the Indonesian national standard for Bali cattle. Based on the Indonesian National Standards Agency (BSNI), female Bali cattle over the age of 24 months or over 2 years are class I - III has x1 dimensions of 113.00, 107 and 101 cm respectively. (BSNI, 2015) This result was different from the research results of Gobel et al, (2021) that the average v1 of Bali cattle was 96.32 ± 9.8 cm, and lower compared to Saputra's research (2019) which had a v1 size of 116.44 ± 7.41 cm. The body height (v3) of Bali cattle kept by breeders in Bone Pantai sub-district was 107.47 ± 4.06 , while the v3 size of female Bali cattle over 24 months of age (class I - III) based on SNI was 109.00, 103.00 and 97.00 cm, respectively (BSNI, 2015). The results of this study accordance to Gobel et al., (2021) v3 Bali cattle on average, i.e. 107.81 ± 6.05 cm and slightly different from Nurfaizin et al., (2019), the body height of Bali cattle was 109.16 ± 5.2 cm. The V2 of Bali cattle kept by breeders in Bone Pantai sub-district was 149.25 ± 7.56 , while based on SNI female Bali cattle over the age of 24 months (class I - III) have a v2 size of 147.00; 135.00; and 130.00 cm, respectively (BSNI, 2015). The results of this study accordance to the research reported by Gobel et al., (2021) female Bali cattle from the north coast of Gorontalo have a v2 of 146.5 ± 17.51 cm, while Nurfaizin (2019) Balicattle from the West Seram Islands have a v2 size of 146.79 ± 11.36 cm. Body weight (v12) of Bali cattle can be converted based on body measurement values, several body measurements used to predict v12 include body length and chest circumference. The v12 Bali cattle from the Bonepantai coastal area at the age of 3-4 years was 142.70 ± 16.93 , over 4 years was 151.50 ± 23.48 , and the average body weight value was 206.03 ± 26.10 . The result was different from the body weight of female Bali cattle from Atinggola District i.e. $189.2 \pm 47,365$ cm. Research by Nurfaizin et al., (2019) shows that female Bali cattle on the islands of West Seram and South Seram have an average body weight of 176.73-180.30 kg.

CONCLUSION

Female Bali cattle raised traditionally in the coastal area of Tomin Bay do not meet the BSNI standards for Bali cattle

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