



Phenotype Characteristics of Diiti Cattle in the Coastal Region of Tomini Bay-Gorontalo, Indonesia

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Abstract: This study aims to determine the qualitative and quantitative traits of Diiti cattle in the coastal area of Tomini Bay, Gorontalo, Indonesia. A total of 201 phenotypes (qualitative and quantitative) of Diiti cattle were collected, consisting of 138 females and 63 males aged 4-5 years. Qualitative observations were focused on body color, face shape, horn, and dewlap. Quantitative traits were focused on the eight traits that were influenced by genetic and environmental factors. The methods used were descriptive and chi-square analysis. IBM Statistics SPSS 22 was used to analyze the data obtained. Female Diiti cattle had nine body colors, while the males had seven body colors. Based on the front view, male and female Diiti cattle have hexagonal, triangular, and perpendicular facial shapes of 7.94%, 49.20%, 42.68% and 36.95%, 5.80%, 57.25%, respectively. The body sizes of male and female Diiti cattle were different. The body size p-values of male and female Diiti cattle ranged between 0.00-0.063. Diiti cattle have various body colors. Female cattle were reddish white, whitish red, and white, while male cattle were black, brown, and white. Female cattle do not have a hump, and generally have a hexagonal face shape, flat face line, body size, and weight almost the same as Bali cattle, but smaller than PO cattle. Further characterization of Diiti cattle was required as basic information of Diiti cattle as Gorontalo local cattle.

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1. Introduction

Gorontalo is a province located on the Sulawesi island in Indonesia. The potential of beef cattle is 1.413% of the total cattle in Indonesia (BPS, 2021). The types of livestock that are mostly kept by farmers are Bali cattle, OngoleCross (PO), Local cattle, and exotic cattle. Dako et al., (2023) research using microsatellite DNA analysis shows that Gorontalo local cattle are closely related to PO cattle. This was explained such that these cattle underwent genetic drift and inbreeding a long time ago. In addition, there has also been crossbreeding with Bali cattle, so there's a separate cluster formed that is different from PO cattle and Bali cattle.

One of Gorontalo's local livestock is Diiti cattle, which are kept by many breeders. Known for a long time, Diiti cattle are closely related to PO cattle. These cattle experienced genetic decline due to long inbreeding, as well as livestock trade outside the area which caused a decrease in the quality. From the 2000s up to now, there has been a change in policy towards the development of Bali cattle from the start of the formation of the Province of Gorontalo. The problem arose during the Bali cattle policy period that the breeders crossed Diiti cattle with Bali cattle and PO cattle, without realizing that they had performed the simplest livestock breeding process at the community group level, and that caused uncontrolled inbreeding. The breeding process has been going on for a long time, to increase the numbers and reserves of livestock to be used. These transformations resulted in a decrease in productivity, body shape, and linear body size of the cattle.

The phenotype range of Diiti cattle is not clearly known, but the differences are clearly visible when compared with Bali and PO cattle. For this reason, important phenotypes must be known in these cattle. Based on the phenotype, each animal can be observed and measured, especially the phenotype which is influenced by genetics and the environment. To describe the characteristics of local cattle in Indonesia, some researchers have used color patterns (Azis et al., 2022), body size (Heryani et al., 2018; Laya et al., 2020), and body weight (Abdullah et al., 2006; Budiarto et al., 2013). Mustefa et al., (2020), used the same thing to describe local cattle from Ethiopia.

Breeding and development of Diiti cattle in Gorontalo is very beneficial for increasing the genetic quality, sustainability, and economic value of livestock. Realization of livestock development requires initial information about qualitative characters, size, shape, and phenotypic range that can be used as a basis for classifying, selecting, breeding, and standardizing Diiti cattle, as one of the local cattle breeds in Indonesia. The initial step was performed specifically on local cattle located in the coastal area of Tomini Bay, Gorontalo. This study aims to determine the qualitative and quantitative characteristics of Diiti cattle in the coastal area of Tomini Bay, Gorontalo, Indonesia.

2. Material and Methods

All procedures related to animal use in this study were approved by the Animal Care and Use Committee of Brawijaya University under regulation number 145-KEP-UB-2022. This research was carried out using the observation method and field observations in the Kabil Bone District (Bonebolango Regency), Batudaa Pantai subdistrict, and Biluhu subdistricts (Gorontalo Regency), with the consideration that they are located in the Tomini Bay area and have sufficient numbers of beef cattle. A total of 201 phenotypes of Diiti cattle were collected from November 2022 to May 2023 (qualitative and quantitative), each consisting of 138 females and 63 males aged 4-5 years. Phenotypic observations were focused on body color, face shape, and Dewlap, while quantitative traits were focused on the eight traits that are influenced by the environment, and the four traits that are influenced by genetics, namely body length (Bl), chest circumference (cc), body height (Hb), hip height (Hh), hip width (Hw), Chest width (Cs), Inside Chest (Dc), Dewlap Length (Wl), Dewlap width (Dw), Head length (Hl), Head width (Hhi), and BodyWeight (Bb).

Measurements of qualitative traits were performed according to the directions of Aguantara et al. (2019), the quantitative phenotypes were performed according to the directions of Asmare et al. (2021); Ikhsanuddin et al. (2018); and Safriyanto et al. (2022). The dominant value of body skin color is tested by the Chi-square analysis.

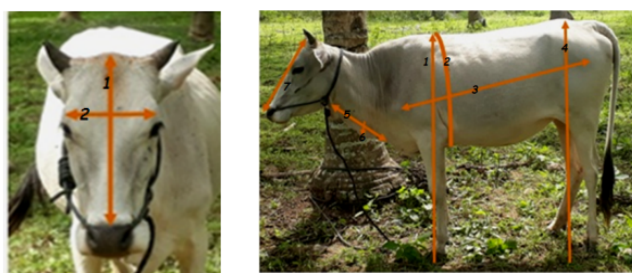


Figure 1. Body size measurement of Diiti cattle.

2.1. Statistical analysis

The descriptive analysis and chi-square analysis were used to test the qualitative traits, while descriptive analysis was used to test the quantitative traits. The data analysis is performed by IBM statistic SPSS 22 statistical package.

3. Results and Discussion

3.1 Qualitative traits

Local cattle in Indonesia are very diverse, especially in their phenotypic appearance. One of the local livestock of Gorontalo is Diiti cattle (Safriyanto et al., 2022). The phenotypic characteristics of Diiti cattle along the coast of Tomini Bay and Gorontalo are varied greatly based on the qualitative characteristics. According to FAO (2009), livestock body color is categorized into 2 parts, namely colored and colorless. Colorless/without pigment is white, while colored is a color other than white or has pigment. The color diversity of Diiti cattle is shown in Table 1.

Table 1. Diversity of qualitative traits in female and male Diiti cattle

Qualitative trait	Female		Male					
	138	PF (%)	Chi-Square		63	PF (%)	Chi-Square	
			X _{count}	X _{table}			X _{count}	X _{table}
Body Color								
1 White	39	28.26	6.94/36.64		16	25.4	3.808/32.67	
2 Brown	7	5.07			12	19.05		
3 Brick red	15	10.87			3	4.76		
4 Black	6	4.35			12	19.05		
Body color pattern								
1 Gray	13	9.42			4	6.35		
2 Black-white	16	11.59			6	9.52		
3 Dark brown	14	10.14			8	12.7		
4 Whitish brick red	27	19.57			0	0		
5 Cream	1	0.72			0	0		
6 Reddish-Black	0	0			2	3.17		
Vaginal Color								
1 Black	110	80.43			-	-	-	
2 Reddish	28	19.57			-	-	-	
Eyelids color								
1 Black	133	96.38	Dominant		63	100	Dominant	
2 White	5	3.62			0	0		
Eye hair color								
1 Redish brown	41	29.71			16	25.4		
2 White	72	52.17	Dominant		32	50.79	Dominant	
3 Black	25	18.12			15	23.81		
Tail hair								
1 Black	134	97.1	Dominant		63	100	Dominant	
2 White	4	2.89			0	0		
Dewlap								
1 Dewlaped	138	100	Dominant		63	100		
2 Dewlapless	0	0			0	0		
Horn								
1 Hornless	0	0			16	25.4		
2 Horned	138	100			47	74.6		
Horn direction								
1 V-shaped horn	71	51.45	Dominant		44	93.62	Dominant	
2 U-shaped horn	48	34.78			2	4.26		
3 Horns straight to the side	6	4.35			1	2.13		
4 Horns Curved backwards	5	3.62			0	0		
5 Forward curved horns	8	5.8			0	0		

Table 1. Diversity of qualitative traits in female and male Diiti cattle (continued)

Qualitative trait	Female			Male		
	138	PF (%)	Chi-Square xcount xtable	63	PF (%)	Chi-Square xcount xtable
Shape face of Front view						
1 Hexagon	51	36.95	Dominant	5	7.94	Dominant
2 Triangular	8	5.8		31	49.21	
3 Perpendicular	79	57.25		27	42.86	
Shape face of Side view						
1 Convex	35	25.36	Dominant	42	66.66	Dominant
2 Flat	103	74.64		21	33.34	
Hump						
1 Humped	0	0	Dominant	0	0	Dominant
2 Humpless	138	100		63	100	

Note: PF: Phenotype Frequency.



Figure 2. Diiti cattle (a. Female, and b. Male).

3.1.1 Body color profile of Diiti cattle

Table 1 shows that the female Diiti cattle had nine body colors, while the males had eight body colors. Chi-square analysis revealed that there was no dominant body color in male and female cattle. This shows that the body color of Diiti cattle varies and the distribution of skin color is even in the three research locations. The body color of Diiti cattle was mostly white, Whitish brick red, and blackish-white.

The body color diversity of local cattle in Indonesia was reported by Agustriadi et al. (2019). The color of Kuantan cattle was white (38%), brownish white, brick red (33%), and brownish red (16%). Kuantan cattle were white, gray, black, and brick red. Pasundan cattle have four body colors, namely brick red, cream, black, and brown (Naufal et al., 2016). Katingan cattle have nine body color variations (Utomo, 2016), and the dominant color was brownish white (Misrianti et al., 2018), while the body color of local cattle in the Kaur area had no dominant color in the population, and all cows have horns. The body colors of Aceh cattle were predominantly dark, including black, brown, black-brown, and brick red.

The body color and body color patterns of Diiti cattle were identified as having different thermal colors among the cattle in the population. This was due to gene coherence in the inbreeding of Bali, Ongole Cross (PO), and Diiti cattle, where the genes and alleles for body color complement each other between loci. Body pigmentation can be reduced in line with reduced melanocyte activity. White body color in cattle indicates that cows lack melamine, black and brown are regulated by eumelanin, and sorrel, red, and yellows are regulated by pheomelanin (Joerg et al., 1996). Locus Extension (E) plays a role in the occurrence of body color variations in cattle.

3.1.2 Horn of Diiti cattle

Based on Table 1, male and female Diiti cattle were dominant for horns. Female cattle generally have horns. Bulls with horns were 74.60% and bulls without horns were 25.40%. There are four forms of horns found in male and female Diiti cattle including V-shaped horns, U-shaped horns, horns straight to the side, and horns curved backward. The most dominant horn directions found were V-shaped horns, respectively 93.62%(males) and 52.17% (females). The shape of the horns of Diiti cattle was different in the Kuantan cattle, Male Kuantan cattle from Benai Regency were generally 53% hornless (Misrianti et al., 2018). The dominant horn shape of Katingan cattle in West Kalimantan was curved forward (Utomo, 2016), while Aceh and PO cattle have horns in the form of a small hump (Abdullah et al., 2006). Female Bali cattle from Atinggola District, Gorontalo dominantly have downward curved horns (100%) (Gobel et al., 2021), while dominant males have upward curved horns (76.71%) (Domili et al., 2021).

3.1.3 Dewlap of Diiti cattle

Dewlap is the skin that hangs along the lower neck to the chest in cattle. Male and female Diiti cattle have dewlap (100%). The dewlap width in males was wider than in females. Local cattle in Indonesia generally have a dewlap, especially cattle produced from female cattle who have been inseminated with exotic cattle, for example, male and female Pasundan, Aceh cattle, PO cattle, and Madura cattle have Dewlap (Budiarto et al., 2013; Mukhtar et al., 2015; Utomo, 2016; Said et al., 2017; Misrianti et al., 2018; Putra et al., 2020; Domili et al., 2021; Gobel et al., 2021; Masduqi et al., 2021).

3.1.4 Face shape of Diiti cattle

Based on the side view, the face shape consisted of three shapes, namely concave, flat, and convex. According to researchers Gelaye et al. (2022); Mustefa et al. (2020), and Masduqi et al. (2021), the faces of cattle in Indonesia, Ethiopia, America, and Europe are convex and flat.

They investigated the cattle from the right or left side view, but there was no information about the shape of the cattle's face when viewed from the front. Based on the front view, male and female Diiti cattle have hexagonal, triangular, and perpendicular facial shapes of 7.94%, 49.20%, 42.68% (males) and 36.95%, 5.80%, 57.25% (females), respectively.

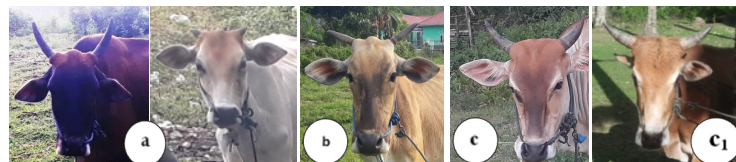


Figure 3. The Face shape of Diiti Cattles: a. Hexagon (female), b. Rectangular perpendicular (female), c. Triangular prism (female) and c1. Triangular prism (male).



Figure 4. The Face shape of Diiti Cattles a. Convex (male), b. Flate (female).

Based on the side view, male and female Diiti cattle have flat and convex facial profiles of 33.34%, 66.66%, and 74.64%, 25.36%, respectively. The results of this study differed from Aceh cattle which have concave face shapes in males and females with percentages of 80.65% and 90.57% (Masduqi et al., 2021). The facial shapes of Rustaqi local cattle (Iraq) were flat. The face shapes of Hill cattle were short and concave (Pundir et al., 2012). Face profiles of Kenana cattle were straight (83.7%). The facial profiles of the native Ethiopian bulls range from flat to slightly concave (Getaneh et al., 2019; Baye et al., 2022).

3.2 Quantitative traits

3.2.1 Body size profile of Diiti cattle

Characteristics of body shape and morphometrics are related to variations and changes in livestock size, including body size and body weight. The genetic existence of livestock in an area makes these livestock adapt to their environment to survive. The diversity of Diiti cattle body sizes in the coastal area of Tomini Bay was explained in Table 2.

Table 2. Characteristics of body size of male and female Diiti cattle in the Tomini Bay area, Gorontalo, Indonesia

	Male			Female		
	Mean	SD	SE	Mean	SD	SE
Body length (Bl)	113.75	7.26	0.91	111.11	7.48	0.64
Chest circumference (Cc)	140.67	8.31	0.71	137.32	7.81	0.66
Height body (Hb)	112.15	5.23	0.66	109.26	5.90	0.50
Hip height (Hh)	112.78	4.64	0.59	110.95	4.60	0.39
Hip width (Hw)	33.06	4.46	0.56	34.45	3.05	0.26
Chest width (Cw)	27.99	3.45	0.44	25.72	3.42	0.29
Deep chest (Dc)	56.87	5.29	0.67	53.76	5.20	0.44
Dewlap length (Dl)	49.22	8.21	1.03	33.48	7.59	0.65
Dewlap width (Dw)	15.83	4.28	0.54	10.35	5.24	0.45
Head length (Hl)	41.61	3.10	0.39	40.59	2.85	0.24
Head width (Hhi)	19.61	2.84	0.36	18.34	3.00	0.26
Body weight (Bw)	210.86	35.61	4.49	193.15	31.76	2.70

SD: Standart Deviation, SE: Standart Error.

Descriptive analysis showed that the Bl of male and female Diiti cattle were 113.75 ± 7.26 and 111.11 ± 7.48 , respectively. The Cc of male and female Diiti cattle were 140.67 ± 8.31 cm and 137.32 ± 7.81 cm, respectively. The Hb of male and female Diiti cattle was 112.15 ± 5.23 cm and 109.26 ± 5.90 cm, respectively. Hh of male and female Diiti cattle were 112.78 ± 4.64 cm and 110.29 ± 4.60 cm, respectively. The Dc male female Diiti cattle were 56.87 ± 5.29 cm and 53.76 ± 5.20 cm, respectively. Dl values of male and female Diiti cattle were 49.22 ± 8.21 cm and 33.48 ± 7.59 cm, respectively. The Dw of male and female Diiti cattle were 15.83 ± 4.28 cm, and 10.35 ± 5.24 cm, respectively. Hl and Hhi of male and female Diiti cattle were 41.61 ± 3.10 - 40.59 ± 2.85 cm and 19.61 ± 2.84 - 18.34 ± 3.00 , respectively. The Bw of male and female Diiti cattle in this study were 210.86 ± 35.61 and 193.15 ± 31.76 kg.

Male and female Diiti cattle have a smaller body length compared to Jabres, PO, and Rancah cattle. The body length of male and female Jabres cattle was 125.8 ± 5 cm, and 119.2 ± 5 cm (Utomo, 2016). PO female cattle 128.10 ± 66.7 , while bulls 123.97 ± 11.58 - 156.1 ± 13.75 cm (Hilmawan et al., 2017; Laya et al., 2020), Rancah Cattle 123.52 ± 35.81 cm. The body lengths of male and female Diiti cattle were longer than those of Aceh and Sumatra cattle. Local male cattle from West Sumatra have a body length of 112.40 and 110.7 cm. Male and female Aceh cattle have a body length of 103.60 and 102.90 cm.

According to Domili et al. (2021), Zulkarnaiin Gobel et al. (2021), and Margawati et al. (2019), the body length measurements of local cattle for male and female Bali Cattle were 98.73 ± 10.31 cm and 101.62 ± 6.04 cm. Meanwhile, Bali cattle and crosses between Bali cattle and limousines (Linbal and Sinbal) have body lengths of 110.95 ± 5.89 , 132.48 ± 6.39 , and 136.25 ± 10.73 cm, respectively (Baliarti et al., 2023).

The body height of the male and female Diiti cattle were 112.15 ± 5.23 cm and 109.26 ± 5.90 cm. The body height of local cattle in other areas of Indonesia was different from that of Diiti cattle. Several research results on the body height of Rancah, PO, Bali, Aceh, and Katingan cattle in Indonesia i.e. Rancah local cattle have a height of 115.21 ± 4.48 cm, while female PO cattle have a body height of 128.10 ± 6.77 cm and male PO cattle have a body height of 124.74 ± 6.70 - 148.90 ± 6.78 cm (Hilmawan et al., 2017; Laya et al., 2020). The body height of female Diiti cattle was the same size as Bali cattle. Female Bali cattle height was 110.00 ± 4.24 cm (Budiarto et al., 2013; Wilastra et al., 2021), 109.52 ± 5.94 cm (Gobel et al., 2021). Female Aceh cattle and Katingan cattle have a lower height than female Diiti cattle Aceh cattle height was 99.32 ± 4.59 cm (Sari et al., 2021), and Katingan cattle was $102.63 \pm$

4.90 cm (Utomo, 2016). The average final weight (kg) for fattened PO and Bali cattle were 285.96 and 274.44, respectively (Aditya et al., 2013)

The reason for the population difference was more due to genetic and environmental factors, where inbreeding was more common in cattle within one population, and between adjacent populations. Cattle body size is a descriptive picture of the genetic potential of cattle in a population. The growth and development of cattle bodies were influenced by genetics and the environment (Ciptadi, 2015; VMA Nurgiartiningsih, 2023). There are more interbreeding, and livestock-rearing techniques between populations. Livestock that have superior genetics that are reared in an unfavorable environment will be affected for the growth and development of these livestock, while livestock that have poor genetics will provide maximum growth and development if reared in a good environment. The phenotype of cattle is influenced by genetics and the environment (Hardjosubroto, 1994), while Putra (2020) stated that variations in the productivity of crossbreed cattle are caused by differences in mating parents, so according to Utomo et al., (2011) the offspring produced have different body sizes. Agung et al. (2019), and Priyanto et al. (2015) state that Indonesian local cattle belong to the Zebu cattle family, and have different body sizes and diversity values as a result of genetic mixing with other cattle.

Conclusion

Diiti cattle is one of the local Gorontalo cattle with phenotypes of various body colors in both males and females. Generally, female Diiticattles have white, reddish white, and brownish white colors, and male Diiti cattle have black, brown, white, and reddish brown colors. Male and female Diiti cattle have hexagonal, triangular, rectangular, and wavy face shapes. Therefore, further characterization of Diiti cattle in the study area and the whole Gorontalo area is required as basic information on Diiti cattle as Gorontalo local cattle.

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