



# Morphometric Characters of Madura Cattle Beef Type and Population Structure in Guluk-Guluk District, Sumenep Regency

Nafis Satya Athaya<sup>1,\*</sup> and Kuswati Kuswati<sup>1</sup>

<sup>1</sup> Faculty of Animal Science, Universitas Brawijaya, Malang 65145, Indonesia

\* nafisatyathaya@student.ub.ac.id

**Abstract.** This research focused on the morphometric characters and population structure of Madura cattle. A total of 176 cattle were sampled by observation, measurement, and direct interviews with cattle owners. The observed variables are population structure, qualitative and quantitative characteristics. The results showed that the Madura cattle population in Guluk-guluk District was 246 head, consisting of 64 heifer calves (26.02%), 55 heifer (22.35%), 87 cows (35.36%), and 40 bulls (16.25%). Quantitative characteristics including the average height of the hump of cows at  $124.68 \pm 6,26$  cm, body length  $126.39 \pm 11,41$  cm, chest girth  $157.50 \pm 11,65$  cm, hip height  $121.82 \pm 4,69$  cm, head index of  $40.95 \pm 2,68$  cm and  $17.33 \pm 1,70$  cm. The dominant qualitative traits were red coat color, white markings, upward horn orientation, and the presence of a dorsal stripe and dewlap. Approximately 68% of the cattle met the phenotypic criteria of the Indonesian National Standard (SNI) for Madura cattle, highlighting their potential as a breeding population. It is concluded that the quantitative characteristics of Madura cattle that meet the Indonesian National Standard (SNI) number 7651:2 of 2023 are as follows: 10.57% for class I, 15.38% for class II, 16.34% for class III, while 57.69% do not meet the standard. Cattle that meet these SNI classifications are considered to have superior breeding potential, as they are more likely to produce offspring that exhibit the distinctive qualitative traits of the Madura cattle breed.

**Keywords:** Madura cattle, population structure, qualitative and quantitative characteristic.

## 1 Introduction

The population of beef cattle in Indonesia is notably high, totaling 18.610.148, with 4.933.451 of these cattle originating from East Java [1]. Cattle from Madura Island contribute the largest proportion of beef cattle in East Java, representing 21.62% of the total population. Livestock productivity can decline due to poor feed management, inadequate maintenance practices, and insufficient disease control. Given that meat is a crucial animal protein source for meeting the nutritional needs of Indonesia's population, protein deficiency can have long-term negative impacts on human resource quality. The per capita protein availability in Indonesia is 83.65 grams per day, which

© The Author(s) 2025

I. Subagiyo et al. (eds.), *Proceedings of the 11th International Conference of Innovation in Animal Science (ICIAS 2024)*, Advances in Biological Sciences Research 49,

[https://doi.org/10.2991/978-94-6463-880-6\\_15](https://doi.org/10.2991/978-94-6463-880-6_15)

represents a decrease of 0,52 grams from 2021 [1]. Despite this, Indonesia still faces a meat shortage and must rely on imports to meet the population's dietary requirements.

Animal characteristics, particularly in cattle breeding, are shaped by a complex interplay of genetic and environmental factors. Quantitative traits, such as growth rate or milk production, are influenced by multiple genes and are significantly affected by environmental conditions.

In contrast, qualitative traits, like coat color or horn presence, are typically determined by one or a few gene pairs and are less susceptible to environmental influences. This distinction is crucial in understanding how different traits are inherited and expressed in livestock populations.

Despite its importance, detailed studies on the morphometric characteristics and population structure of Madura cattle remain limited. Most existing research focuses more on performance aspects, leaving a gap in the understanding of the phenotypic and structural attributes of this local breed. Therefore, comprehensive data on these characteristics are urgently needed to support genetic improvement and conservation strategies.

Practically, this research is expected to provide baseline information for developing breeding systems, identifying superior individuals, and preserving the unique characteristics of Madura cattle in accordance with the Indonesian National Standard (SNI). Furthermore, the results of this study can inform livestock management strategies and regional policy development, especially in areas such as Guluk-Guluk District, which has high potential for the sustainable development of local cattle. Madura cattle are an indigenous breed in Indonesia known for their adaptability and cultural significance, especially in traditional bull races and farming systems. However, the characterization of their morphometric traits and population structure remains limited. Comprehensive data on these traits are essential not only for conservation but also for genetic improvement and selection programs.

This study seeks to fill the research gap by providing a detailed description of both quantitative and qualitative characteristics of Madura cattle in Guluk-Guluk District. The findings are expected to support breeding decisions, inform livestock management practices, and contribute to local policy development related to animal genetic resources.

## **2 Materials and Methods**

The research was conducted from August 26 to October 1, 2023, in the Guluk-Guluk District, Sumenep Regency, Madura. A total of 176 Madura cattle were sampled based on availability and accessibility, representing approximately 66.76% of the local breeding population according to preliminary census data collected in Guluk-Guluk District. Sample collection utilized incidental sampling, while location selection employed purposive sampling through an initial census of breeding cattle in the district.

Additional research information was sourced from secondary data, including district and subdistrict records, inseminator documentation, district profiles, Central

Statistics Agency (BPS) data, and other relevant sources. Research materials consisted of specialized recording forms designed to collect data matching specific cattle research criteria. The research toolkit included measurement tools such as rulers, measuring tapes, paper, writing implements, and a recorder.

The research methodology centered on direct observation, measurement, and interviews with cattle owners selected as research samples. Interviews were conducted using questionnaire assistance, with data from measurements meticulously recorded and entered into tables for comprehensive analysis and calculation. Data consistency was ensured by having the same researcher conduct all physical measurements and structured interviews, using a standardized questionnaire. The study examined variables including livestock population structure, qualitative characteristics, and quantitative characteristics.

### 3 Results and Discussion

#### 3.1 Population Structure

The cattle population structure in the Guluk-Guluk District is categorized based on gender and age. Livestock age is divided into three groups: adult (cattle that have reached productive age, typically over 2 years old), young (weaned cattle between one and two years old), and calf (calves aged 0-12 months, usually still nursing from their mothers) [2]. The population structure of Madura cattle based on research findings can be examined in the Table 1.

**Table 1.** Population Structure

No	Status	Male		Female		Total	
		Total	%	Total	%	Total	%
1	Calf	30	12.20	64	26.02	94	38,23
2	Young	5	2.03	55	22.36	60	24,38
3	Adult	5	2.03	87	35.36	92	37,39
	Total	40	16.26	206	83.74	246	100

Based on Table 1, the total number of Madura cattle is 246, comprising female calves (64 heads, 26.02%), heifer (55 heads, 22.35%), and cow (87 heads, 35.36%). The percentage of cow is significantly higher than bull, primarily because farmers predominantly raise cow for Sonok purposes. Adult female cattle (cow) intended as breeding stock require specific care to prepare for pregnancy. Most traditional farmers prefer to maintain the heifers as replacement stock, typically selling male calf after weaning. This aligns with [3] perspective that the cow population is the primary factor in cow-calf production. Regions with numerous cow can be considered to have a robust population, as the number of cow significantly influences calf birth rate [4].

Table 1 reveals that bulls of Madura cattle constitute 16,26% of the population. Bulls are typically maintained by farmers for breeding purposes and are selected for their superior qualities. Producing high-quality Madura cattle requires breeding males with excellent qualitative and quantitative traits to pass on to subsequent generations. Farmers employ two breeding methods: natural mating using breeding bulls and artificial insemination (AI) with inseminator assistance. Semen used for AI is collected from breeding bulls at the Singosari Artificial Insemination Center (BBIB), where it is processed and distributed to farmers through artificial insemination. In the research location, farmers predominantly prefer artificial insemination for breeding, consistent with [5] observation that many farmers sell young male cattle and opt for artificial insemination.

### 3.2 Qualitative Characters

Livestock productivity is influenced by two primary factors: genetic and environmental variables. Genetic factors encompass breed, age, and sex of the livestock, while environmental factors include feed, management practices, climate, and disease prevalence [6]. The interaction between environmental and genetic factors can reveal the distinctive characteristics of a specific breed. Madura cattle have qualitative characteristics that can be directly observed in the field. Observable aspects include body shape, such as eye shape, ear shape, hair between the horns, horn direction, hump, and muscle structure. Body color and head color can also be observed, and these observations help in studying the variation in qualitative characteristics of Madura cattle in accordance with SNI 7651-2 (2023). The qualitative characteristics of female Madura cattle are listed in Table 2.

Based on the data analysis in Table 2, the color characteristics of several body parts of Madura cattle show a specific pattern. In the field, Madura cattle were classified by color into brick red, brown red, and paddy yellow. The study results indicate that Madura cattle in Guluk-Guluk District are predominantly brown red, with a percentage of 60.79%, while brick red and paddy yellow colors have percentages of 29.54% and 9.65%, respectively. This finding is supported by research [7], which states that paddy yellow is the least common color among Madura cattle. According to the quality standards for female Madura breeding cattle, the dominant breeding stock color is brick red. In this study, brick red represents only 29.54% but meets the requirements as breeding stock.

Specifically, there is also a dominance in the dorsal stripe color. The analysis shows that the dorsal stripe color is present in 59.1% of all cattle. The back stripe, often black or known as an eel stripe, is one of the qualitative requirements for Madura cattle breeding stock.

This is supported by [8] who state that the dorsal stripe in Madura cattle results from crossbreeding with *Bos sondaicus*. Additionally, [9] explains that most beef cattle typically have a dorsal stripe, dewlap, outward-pointing horns, black eye rings, and hair between the horns. The dorsal stripe in Madura cattle consists of black/dark colors, which are darker than the body color, and sometimes the dominant color on

the body. In this study, cattle with a dorsal stripe were generally darker than the body color, as shown in Figure 1.

**Table 2.** Qualitative Characteristics of Female Madura Cattle.

No	Characteristic	Feature	PI <sub>0</sub> (n)	PI <sub>2</sub> (n)	PI <sub>4</sub> (n)	PI <sub>6</sub> (n)	PI <sub>8</sub> (n)	Total	Percentage
1	Body Color	Brick red	18	7	8	8	11	52	29.54
		Brown red	25	18	19	16	29	107	60.79
		Paddy yellow	5	2	2	4	4	17	9.65
2	Dorsal stripe	Present	27	18	18	16	25	104	59.1
		Absent	21	9	11	12	19	72	40.9
3	Color Boundary	Smear	45	27	28	28	44	172	97.72
		Clear	3	0	1	0	0	4	2.28
4	Black Ring Eye	Present	44	23	28	27	44	166	94.31
		Absent	4	4	1	1	0	10	5.69
5	Muzzle Color	Black	48	27	29	28	42	174	98.86
		White	0	0	0	0	1	1	0.57
		Pink	0	0	0	0	1	1	0.57
6	Horns	Present	25	25	29	28	43	150	85.22
		Absent	23	2	0	0	1	26	14.78
7	Ear Shape	Small	35	15	19	21	29	119	67.61
		Upright	5	2	2	1	3	13	7.39
		Others	8	10	8	6	12	44	25
8	Hump	Present	36	27	27	26	40	156	88.63
		Absent	12	0	2	2	4	20	11.37
9	Dewlap	Present	41	27	29	28	41	167	94.88
		Absent	7	0	0	0	2	9	5.12
10	Muscle between Front Legs	Present	12	15	12	14	29	82	46.59
		Absent	36	12	17	14	15	94	53.41
11	Tail Hair	Black	41	24	18	24	34	141	80.12
		Mix	7	3	11	3	10	34	19.32
		Pink	0	0	0	1	0	1	0.56



**Fig. 1.** Variations of the Dorsal Stripe of Madura Cattle

Another distinctive feature of Madura cattle is the dewlap. Cattle used for contests or sonok cattle typically have more folds in the dewlap. The more folds in the dewlap, the more attractive and valuable the cattle. [10] explains that Pesisir cattle also share similar characteristics with Madura cattle, such as having a small hump and a dewlap. The muscle structure between the front legs is also a unique feature of Madura cattle. [7] states that the muscles between the front legs form because, when Madura cattle are displayed, the front legs are positioned approximately 15 cm higher than the back legs.

### 3.3 Quantitative Characters

Quantitative characteristics represent measurable traits that are valuable for both economic assessments and early selection processes [11]. In this study, the quantitative characteristics of Madura cattle were determined through body measurements of female specimens. The mean body measurements of female Madura cattle across different age groups are detailed in Table 3.

**Table 3.** Mean Body Measurements of Female Madura Cattle Across Different Age Groups

Quantitative Characters	Mean Body Measurements (cm)				
	PI <sub>0</sub> (48)	PI <sub>2</sub> (27)	PI <sub>4</sub> (29)	PI <sub>6</sub> (28)	PI <sub>8</sub> (44)
Hump height	103.56±10.25	114.78±7.45	118.03±8.89	118.17±9.74	124.68±6.26
Body length	98.42±10.11	112.00±10.43	117.28±8.54	119.25±13.97	126.39±11.41
Chest girth	118.35±15.62	136.33±11.31	148.38±11.75	145.67±17.69	157.50±11.65
Hip height	104.10±10.61	114.48±7.13	121.66±8.35	117.67±7.20	121.82±4.69
Head length	32.40±4.93	37.56±3.65	38.52±3.15	40.08±3.65	40.95±2.68
Head width	15.04±1.88	16.30±1.77	16.76±1.60	17.58±2.11	17.33±1.70

Based on Table 3, it can be concluded that the average body size of Madura cattle varies across different age groups. This variation is influenced by factors affecting growth, including nutrition and age. This is supported by [12] who explain that achieving maximum livestock production requires a high-nutrition environment and feed. In measurements of withers height, Madura cattle of ages PI<sub>0</sub>, PI<sub>2</sub>, PI<sub>4</sub>, PI<sub>6</sub>, and PI<sub>8</sub> show that the average withers height differs across these age levels. Compared to

SNI 7651-2 (2023), the minimum average withers height for female Madura cattle over two years old is 121 cm, while the study results have an average of  $124.68 \pm 6.26$  cm. The female calves in the study have an average withers height of  $103.56 \pm 10.25$  cm, which meets the minimum standard according to SNI, where the withers height for female calves is 103 cm. This indicates that the cattle in Guluk-Guluk District meet the minimum withers height standard set by SNI.

Table 3 shows that the average body length of female Madura cattle at PI6 and PI8 is  $119.25 \pm 13.97$  cm and  $126.39 \pm 11.41$  cm, respectively. Based on the minimum size requirements established by SNI 7651-2 (2023), these sizes meet the requirements for Madura cattle breeding stock, with a minimum limit of 122 cm for cattle over two years old. The minimum body size standards for female Madura cattle are specified in SNI 7651-2 (2023), with a minimum body length of 122 cm (PI4 and PI6). The minimum withers height is 121 cm (PI4 and PI6), and the minimum chest circumference is 150 cm (PI4 and PI6). The values  $148.38 \pm 11.7$  and  $145.67 \pm 17.69$  meet these criteria and exceed the minimum figures in SNI 7651-2 (2023).

According to Table 3, the head length measurement of Madura cattle at PI0 shows a value of  $32.40 \pm 4.39$  cm, which is the smallest measurement compared to other age groups. This is due to the fact that as the cattle age, their body size also increases. Madura cattle can be considered to meet the breeding requirements of SNI 7651-2 of 2023 if their body length, withers height, and chest circumference exceed the standards set by SNI. According to SNI 7651-2 (2023), Madura cattle are classified into three breeding classes: Class I as *sonok* cattle, Class II as *taccek* cattle, and Class III as beef cattle. Table 6 shows that only 4.8% of PI0 Madura cattle meet the requirements as *sonok* breeding stock out of 48 head, while at PI2 it is 3.84% out of 27 head, and at PI4 it is 1.92% out of 29 head. Class II for Madura cattle represents the *taccek* type, and their numbers are fewer than those in Class I because many cattle do not meet the breeding requirements for Madura cattle according to SNI 7651-2 (2023).

A significant portion of the Madura cattle population sampled in Guluk-Guluk District (57.69%) did not meet the Indonesian National Standard (SNI) for phenotypic characteristics. This finding points to an underlying issue in current breeding and livestock management systems. One of the contributing factors is the traditional management system widely practiced by local farmers, where feed provision is based on availability rather than nutritional planning. Farmers typically provide dry leaves and grasses as primary feed, which are adapted to the natural resources available in Guluk-Guluk District. Such limited and non-formulated feeding practices may hinder optimal growth and development, reducing the number of cattle that can meet the desired phenotypic standards.

The lack of controlled mating, structured selection processes, and sufficient support for genetic improvement further exacerbates the situation. If left unaddressed, this could negatively impact the genetic quality of future generations and hinder efforts to preserve the unique identity of Madura cattle. These findings suggest an urgent need for strategic intervention in feeding management and selective breeding efforts at the local level.

## 4 Conclusion

The quantitative characteristics of female Madura cattle seed that meet the Indonesian National Standard (SNI) number 7651:2 of 2023 are class I at 10.57%, class II at 15.38%, class III at 16.34%, and those that do not meet the standard at 57.69%..

**Acknowledgments.** We are thankful to the Faculty of Animal Science, Brawijaya University for support the facilities, and the farmers of Madura cattle in Sumenep, Madura.

**Disclosure of Interests.** The authors have no competing interests to declare that are relevant to the content of this article.

## References

1. Badan Pusat Statistik (BPS). *Peternakan Dalam Angka 2023 Volume 8, 2023*. Badan Pusat Statistik, Jakarta. (2023)
2. Nurlaila, S., B. Kurnadi, M. Zali dan H. Nining. Status Reproduksi dan Potensi Sapi *Sonok* di Kabupaten Pamekasan. *Jurnal Ilmiah Peternakan Terpadu*. 6(3) :147-154. (2018)
3. Priyanto, D., B. Arsana dan Chairunnas. Analisis Performa Produksi Sapi Pedaging di Kawasan Sumber Ternak Pensuplai Wilayah Konsumen. *Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner*. TPV-2020:205-223. (2020)
4. Susanti, A. E., N. Ngadiyono., dan Sumadi. Estimasi Output Sapi Potong di Kabupaten Banyuwangi Provinsi Sumatera Selatan. *Jurnal Peternakan Sriwijaya*. 4(2): 34-43. (2015)
5. Kusuma, S. B., N. Ngadiyono., dan S. Sumadi. Estimasi Dinamika Populasi Dan Penampilan Reproduksi Sapi Peranakan Ongole Di Kabupaten Kebumen Provinsi Jawa Tengah. *Buletin Peternakan*. 41(3):230. (2017)
6. Ciptadi, G., Aulanni'am., A. Budiarto dan Y. Oktanella. *Genetika dan Pemuliaan:Peternakan-Veteriner*. Malang : UB Press. (2019)
7. Herviyanto, D., Kuswati., dan G. Ciptadi. Identifikasi Karakteristik Sapi Betina Madura Tipe *Taccek*. *Ternak Tropika Journal of Tropical Animal Production*. 21(2) :83–92. (2020)
8. Pradana, A. P. I. W. Busono dan S. Maylinda. Characteristics of Madura Cows in Different Altitudes at Pamekasan. *Ternak Tropika Journal of Tropical Animal Production*. Vol. 16(2): 64-72. (2015)
9. Lutvanyah, S., D. Perwitasari., dan A. Farajallah. (2017). Morphological Characters Comparison of *Sonok* and Madura Cattle. *Jurnal Ilmu Pertanian Indonesia*. 22(1):67–72. (2017)
10. Putri, A. E., A. Farajallah dan D. Perwitasari. The Origin of Pesisir Cattle Based on D-Loop Mitochondrial DNA. *Biodiversitas*. 20(9):2569–2575. (2019)
11. Gushairiyanto, G., dan D. Depison. Karakteristik Kuantitatif Sapi Bali Menggunakan Analisis Komponen Utama di Kabupaten Merangin dan Muaro Jambi, Provinsi Jambi. *Jurnal Sain Peternakan Indonesia*. 16(1):74–79. (2021)
12. Dhita, N.T., M.D.I. Hamdani dan K. Adhianto. Karakteristik Kualitatif dan Kuantitatif Sapi Peranakan Ongole dan Sapi Simpo Jantan pada Gigi Seri Berganti 2 di Kecamatan terbaggi Besar Kabupaten Lampung Tengah. *Jurnal Riset dan Inovasi Peternakan*. 1(2):28-32. (2017)

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

