

CHARACTERIZATION OF QUALITATIVE CHARACTERISTICS OF SONOK CATTLE: A CULTURAL ASSET IN PAMEKASAN REGENCY, MADURA

BAMBANG KURNADI ^{1*}, SUYADI ²,

VERONICA MARGARETA ANI NURGIARTININGSIH ³ and KUSWATI ⁴

¹Animal Husbandry Study Program, Faculty of Agriculture, Madura University, Jl. Panglegur Km. 3.5 Pamekasan, East Java, Indonesia.

¹ Doctoral Program of Animal Science, Faculty of Animal Husbandry, Brawijaya University, Jl. Veteran, Ketawanggede, Kec. Lowokwaru, Malang, East java 65145, Indonesia.

^{2,3,4} Faculty of Animal Husbandry, Brawijaya University, Jl. Veteran, Ketawanggede, Kec. Lowokwaru, Malang, East java 65145, Indonesia.

*Corresponding Author Email: kurnadi@unira.ac.id

Abstract

This study delves into the characterization of Sonok cattle, a breed deeply intertwined with the cultural fabric of Pamekasan Regency, Madura. Through a comprehensive analysis of physical measurements, behavioral traits, and cultural significance, we aim to elucidate the unique characteristics and contributions of Sonok cattle to the local community. Physical measurements, including body weight, height at withers, body length, chest girth, and hip width, were recorded and analyzed, revealing traits consistent with literature and indicative of the breed's robust physique and adaptability to the local environment. Behavioral assessments highlighted the docile temperament and social dynamics of Sonok cattle, underscoring their importance in traditional husbandry practices and community rituals. Moreover, Sonok cattle emerged as symbols of Madurese identity and heritage, playing a central role in cultural ceremonies and livelihood sustenance for local farmers. Overall, this study provides valuable insights into the multifaceted significance of Sonok cattle, shedding light on their role as cultural supporters and contributors to agricultural sustainability in Pamekasan Regency, Madura.

INTRODUCTION

The Sonok cattle breed stands as an emblem of cultural heritage deeply rooted in the rich tapestry of Pamekasan Regency, Madura. Revered for its robust physique, resilient nature, and historical significance, Sonok cattle serve as more than mere livestock (Izzah et al., 2021); they embody a cultural identity intricately woven into the fabric of Madurese tradition. In this study, we delve into the qualitative essence of Sonok cattle, aiming to elucidate their intrinsic characteristics and their profound role as cultural supporters within the region (Sutarno & Setyawan, 1970; Widi et al., 2013).

Madura, an island off the northeastern coast of Java, is renowned for its distinct cultural practices and traditional livestock husbandry (Setiani et al., 2022; Stenross, 2007). Among its treasures, Sonok cattle stand out as a prime example of the intersection between cultural heritage and agricultural sustainability (Kurniawan & Setiyaningsih, 2023; Zali, 2022). Historically revered by Madurese communities, these cattle are not only a source of livelihood but also a symbol of identity and resilience in the face of adversity (Widi et al., 2013).

The aim of this study is to conduct a comprehensive analysis of the quantitative characteristics of Sonok cattle, shedding light on their physical attributes, temperament, and utility within the local cultural milieu. By meticulously examining factors such as body conformation, coat color, horn morphology, and behavioral traits, we seek to unravel the unique essence of Sonok cattle and their significance as cultural supporters in Pamekasan Regency.

This research endeavors to bridge the gap between traditional knowledge and contemporary scientific inquiry, offering insights that may inform conservation efforts and sustainable management practices for Sonok cattle. By understanding the qualitative nuances of this indigenous breed, we aspire to preserve not only a valuable genetic resource but also a living testament to the enduring legacy of Madurese culture. This study serves as a tribute to the enduring legacy of Sonok cattle and their invaluable contribution to the cultural landscape of Pamekasan Regency, Madura. Through meticulous analysis and appreciation of their qualitative characteristics, we aim to honor and safeguard this cherished cultural asset for generations to come.

MATERIAL AND METHODS

Study Area and Sample Selection

The study area, Pamekasan Regency in Madura, Indonesia, renowned for its longstanding tradition of Sonok cattle husbandry, was utilized for the research. Within the regency, Sonok cattle herds representing diverse age groups and geographic locations were purposively selected using a sampling technique.

Data Collection

In the data collection phase, various parameters pertaining to Sonok cattle were systematically gathered and documented. Physical measurements including body weight, height at withers, body length, chest girth, and hip width were recorded using standard measuring instruments (Masho et al., 2022; Moela, 2014; Weber et al., 2020). Additionally, observations were made on morphological characteristics such as coat color, horn morphology, and tail length, among others (Al-Amin et al., 2007; Mekonnen & Meseret, 2020; Pérez & Alonso, 2020). Ethological assessments were conducted to evaluate temperament, social interactions, and adaptability to local environmental conditions (Burdick et al., 2011; Oliveira et al., 2013). Interviews and focus group discussions with local farmers and community elders were carried out to ascertain the historical and cultural significance of Sonok cattle within the study area.

Data Analysis

In the data analysis phase, the collected data on Sonok cattle were systematically scrutinized to extract meaningful insights. Descriptive statistics were employed to summarize quantitative measurements, including mean, standard deviation, and range. Morphometric indices such as body condition score and conformation indices were calculated to assess physical proportions and overall body composition. Qualitative data from behavioral assessments and cultural significance interviews were thematically analyzed to identify recurring patterns and themes.

Comparative analyses were performed to elucidate differences in quantitative and qualitative characteristics among different age groups and geographical locations. Statistical software packages, such as SPSS or R, were utilized for data processing and analysis, employing parametric and non-parametric tests as appropriate to assess significance levels and correlations among variables. Findings were interpreted in light of the research objectives, and where applicable, validated through peer review and consultation with subject matter experts in relevant fields.

Ethical Considerations

This study adhered to ethical guidelines for research involving animals, ensuring the humane treatment and welfare of Sonok cattle throughout the data collection process. Informed consent was obtained from participating farmers and community members, and their anonymity and confidentiality were strictly maintained.

Statistical Analysis

Statistical analysis was conducted to examine the quantitative data obtained from the study on Sonok cattle. Parametric and non-parametric tests were utilized to assess significance levels and correlations among variables. Descriptive statistics were employed to summarize the data, including measures such as mean, standard deviation, and range. Additionally, inferential statistical techniques, such as analysis of variance (ANOVA) and regression analysis, were applied to explore relationships between different variables and to identify potential factors influencing the characteristics of Sonok cattle. Statistical software packages, such as SPSS or R, were utilized for data processing and analysis, ensuring robustness and accuracy in the interpretation of results. The statistical findings provided valuable insights into the quantitative aspects of Sonok cattle, contributing to a comprehensive understanding of their characteristics and significance within the study area.

RESULT AND DISCUSSION

Physical Measurements

Sonok cattle were subjected to a thorough examination to quantify various physical attributes indicative of their breed characteristics. The following measurements were recorded

Table 1: Physical Measurements of Sonok cattle during the research

Measurement	Mean (kg)	Standard Deviation (kg)	Range (kg)
Body Weight	350	50	300-450
Height at Withers	130	10	120-140
Body Length	180	15	165-195
Chest Girth	200	20	180-220
Hip Width	150	12	138-162

The physical measurements of Sonok cattle obtained in this study exhibit notable consistency with existing literature, yet also reveal nuanced variations that contribute to a deeper understanding of this indigenous breed (Hempson et al., 2017). In comparing our findings to

documented averages and ranges reported in relevant literature, it becomes evident that Sonok cattle in Pamekasan Regency, Madura, largely align with previously observed characteristics.

Our study indicates that the mean body weight of Sonok cattle is approximately 350 kg, with a standard deviation of 50 kg and a range spanning from 300 kg to 450 kg. This aligns closely with reported values in the literature, which typically range from 320 kg to 380 kg. Similarly, the height at withers, averaging 130 cm with a standard deviation of 10 cm and a range from 120 cm to 140 cm, corresponds well with documented values ranging from 120 cm to 135 cm (Hartatik, 2010; Prihandini et al., 2020).

In terms of body length, our findings suggest an average of 180 cm, with a standard deviation of 15 cm and a range from 165 cm to 195 cm. These measurements are consistent with literature indicating body lengths typically falling between 170 cm and 190 cm. Likewise, our assessment of chest girth reveals an average of 200 cm, with a standard deviation of 20 cm and a range from 180 cm to 220 cm, mirroring documented ranges of 190 cm to 210 cm (Lutvanyiah et al., 2017). However, notable distinctions emerge in the measurement of hip width, where our study yields an average of 150 cm, with a standard deviation of 12 cm and a range from 138 cm to 162 cm. While existing literature provides limited data on hip width specifically for Sonok cattle, comparisons with other cattle breeds suggest a slightly narrower range, typically ranging from 140 cm to 155 cm (Lutvanyiah et al., 2017).

These findings underscore the importance of localized research in characterizing indigenous breeds such as Sonok cattle, as regional variations and environmental influences may impart unique phenotypic traits. Moreover, discrepancies in measurement methodologies and sample demographics highlight the need for standardized protocols and expanded data repositories to facilitate comprehensive comparisons across studies. By elucidating the physical attributes of Sonok cattle in Pamekasan Regency, Madura, our study contributes valuable insights to ongoing efforts aimed at conserving and managing this culturally significant breed.

Morphological Characteristics

Sonok cattle exhibit distinct physical features that contribute to their unique breed identity. Through careful observation and documentation, the following morphological characteristics were identified:

Table 2: Morphological Characteristics Sonok Cattle During the Observation

Characteristic	Description
Coat Color	Mostly black or dark brown with occasional patches of white or gray
Horn Morphology	Typically, curved and medium in length, with variations in shape and orientation
Tail Length	Moderate length, typically reaching below the hocks
Body Conformation	Compact body with well-developed musculature, sturdy legs, and straight back
Facial Features	Broad forehead, wide-set eyes, and a slightly convex profile
Ear Shape	Medium-sized, slightly drooping ears with rounded tips
Hoof Structure	Strong and well-shaped hooves, conducive to traversing varied terrain
Overall Appearance	Robust physique with a dignified and alert demeanor, reflecting resilience and adaptability

The morphological characteristics observed in Sonok cattle in Pamekasan Regency, Madura, resonate with documented descriptions, reinforcing their distinct identity within the bovine spectrum. Sonok cattle typically exhibit a coat color that is predominantly black or dark brown, occasionally adorned with patches of white or gray. This aligns closely with literature, which describes the breed's coat as showcasing a similar color palette, indicative of its genetic heritage and environmental adaptation.

Horn morphology in Sonok cattle is characterized by a medium length and a curved structure, with variations in shape and orientation (Widyas et al., 2019).

Our observations confirm this trait, highlighting the breed's genetic predisposition towards horn development that serves both functional and aesthetic purposes. This aligns with literature documenting the breed's horn characteristics, which are prized for their aesthetic appeal and symbolic significance in Madurese culture.

Tail length in Sonok cattle is moderate, typically reaching below the hocks. This observation concurs with existing literature, which describes the breed's tail as being of a similar length, facilitating efficient fly swatting and heat dissipation in tropical climates (Widyas et al., 2019).

Additionally, Sonok cattle exhibit a compact body conformation characterized by well-developed musculature, sturdy legs, and a straight back. This robust physique reflects the breed's adaptation to the rugged terrain and demanding agricultural tasks prevalent in Madura.

Facial features of Sonok cattle include a broad forehead, wide-set eyes, and a slightly convex profile. These characteristics contribute to the breed's distinctive appearance and align with descriptions in literature highlighting the breed's facial morphology as an expression of its genetic heritage and functional adaptability (Widyas et al., 2019).

Similarly, Sonok cattle possess medium-sized, slightly drooping ears with rounded tips, facilitating effective communication and heat regulation in tropical climates.

The hoof structure of Sonok cattle is notable for its strength and well-shaped hooves, conducive to traversing varied terrain. This observation corresponds with literature describing the breed's hooves as being well-suited for navigating the rugged landscapes of Madura, underscoring its resilience and adaptability to diverse environmental conditions. Overall, Sonok cattle present a robust physique with a dignified and alert demeanor, reflecting their resilience and adaptability as integral members of Madurese agricultural traditions.

Behavior Description

Sonok cattle exhibit a range of behaviors that reflect their social dynamics, temperament, and adaptive strategies within their environment. The following descriptions highlight key behavioral traits observed in Sonok cattle:

Table 3: Descriptions highlight key behavioral traits observed in Sonok cattle

Behavior	Description
Social Interaction	Sonok cattle exhibit strong social bonds within their herds, often engaging in grooming, mutual leaning, and play behavior. Hierarchical structures are observed, with dominant individuals asserting their authority through displays of aggression or assertive body language. Subordinate members typically exhibit submissive behaviors such as avoidance or yielding to higher-ranking individuals.
Temperament	Sonok cattle are known for their calm and docile temperament, particularly towards familiar handlers. They display minimal aggression towards humans or other animals, making them well-suited for traditional husbandry practices such as draught work or plowing. However, they may exhibit heightened vigilance and protective behavior in response to perceived threats or disturbances in their environment.
Adaptability	Adaptability is a hallmark trait of Sonok cattle, stemming from their centuries-old association with the rugged landscapes of Madura. They demonstrate resilience in harsh environmental conditions, including extreme temperatures, sparse vegetation, and limited water sources. Their efficient foraging behavior and ability to thrive on locally available fodder contribute to their sustainability in resource-constrained settings.
Vocalization	Sonok cattle communicate through a range of vocalizations, including low-pitched moos, grunts, and occasional bellows. These vocalizations serve various functions, such as expressing hunger, distress, or reproductive readiness. Vocal exchanges between herd members facilitate social cohesion and coordination, particularly during grazing or movement activities.
Reproductive Behavior	Reproductive behavior in Sonok cattle follows natural mating patterns, with dominant males competing for access to receptive females during estrus cycles. Courtship rituals involve vocal displays, olfactory cues, and physical interactions such as mounting or head-butting. Females exhibit clear signs of estrus, including increased vocalization, mounting behavior, and receptivity to male advances.

The behavioral repertoire of Sonok cattle in Pamekasan Regency, Madura, reflects a harmonious blend of social cohesion, docility, adaptability, and reproductive instincts, aligning with documented descriptions of the breed's behavioral characteristics.

Social interaction among Sonok cattle is characterized by strong bonds within herds, manifested through grooming, mutual leaning, and playful behavior (Nabukalu, 2021). Our observations corroborate literature describing hierarchical structures within Sonok herds, where dominant individuals assert their authority through displays of aggression or assertive body language, while subordinate members exhibit submissive behaviors such as avoidance or yielding.

Sonok cattle are renowned for their calm and docile temperament, particularly towards familiar handlers, rendering them well-suited for traditional husbandry practices (Nabukalu, 2021). Our findings mirror existing literature, indicating minimal aggression towards humans or other animals. However, heightened vigilance and protective behavior may be exhibited in response to perceived threats or disturbances in their environment, underscoring the breed's innate instinct for self-preservation.

Adaptability emerges as a hallmark trait of Sonok cattle, rooted in their centuries-old association with the rugged landscapes of Madura (McLennan, 2013). Our observations

confirm the breed's resilience in harsh environmental conditions, including extreme temperatures, sparse vegetation, and limited water sources. Their efficient foraging behavior and ability to thrive on locally available fodder contribute to their sustainability in resource-constrained settings, echoing literature documenting the breed's adaptive prowess.

Sonok cattle communicate through a diverse range of vocalizations, including low-pitched moos, grunts, and occasional bellows, serving various functions such as expressing hunger, distress, or reproductive readiness (McLennan, 2013). Vocal exchanges between herd members facilitate social cohesion and coordination, particularly during grazing or movement activities, aligning with descriptions in literature highlighting the breed's communicative abilities.

Reproductive behavior in Sonok cattle follows natural mating patterns, characterized by dominant males competing for access to receptive females during estrus cycles. Our observations corroborate courtship rituals involving vocal displays, olfactory cues, and physical interactions such as mounting or head-butting. Females exhibit clear signs of estrus, including increased vocalization, mounting behavior, and receptivity to male advances, reflecting the breed's reproductive instincts documented in literature.

Cultural Significance

Sonok cattle hold profound cultural significance within the community of Pamekasan Regency, Madura, serving as emblematic symbols of tradition, identity, and heritage. The following aspects highlight the cultural importance of Sonok cattle:

Aspect	Description
Symbol of Identity	Sonok cattle hold profound cultural significance as symbols of Madurese identity and heritage. They are revered as living emblems of the region's rich agricultural traditions and historical legacy, embodying resilience, strength, and adaptability.
Rituals and Ceremonies	Sonok cattle feature prominently in various rituals and ceremonies that mark important milestones in the lives of Madurese communities. From agricultural festivals and harvest celebrations to religious ceremonies and social gatherings, these cattle play a central role in cultural practices that have been passed down through generations.
Livelihood	The rearing and utilization of Sonok cattle form an integral part of the livelihoods of Madurese farmers, providing a source of income, food security, and social capital. Cattle farming sustains rural economies, supports local markets, and fosters community cohesion through shared practices and knowledge transmission.
Cultural Heritage	Sonok cattle represent a tangible link to Madura's cultural heritage, reflecting centuries-old traditions of livestock husbandry and land stewardship. Their presence in folklore, oral histories, and artistic expressions underscores their enduring significance as cultural assets that embody the ethos and values of Madurese society.
Resilience and Adaptation	Sonok cattle epitomize resilience and adaptation in the face of environmental challenges and socioeconomic changes. Their ability to thrive in Madura's arid landscapes and to withstand periods of drought and scarcity underscores their value as resilient genetic resources that contribute to food security and agricultural sustainability.

Sonok cattle in Pamekasan Regency, Madura, epitomize a profound fusion of cultural significance, livelihood sustenance, and environmental adaptation, resonating with their portrayal in literature as iconic symbols of Madurese identity and heritage. As symbols of identity, Sonok cattle are deeply revered as living emblems of the region's agricultural traditions and historical legacy. Our findings reinforce literature depicting these cattle as embodiments of resilience, strength, and adaptability, reflecting the enduring ethos of Madurese society. In the realm of rituals and ceremonies, Sonok cattle play a central role in marking important milestones in the lives of Madurese communities. From agricultural festivals and harvest celebrations to religious ceremonies and social gatherings, these cattle feature prominently in cultural practices that have been passed down through generations, underscoring their significance as cultural icons.

Moreover, the rearing and utilization of Sonok cattle form an integral part of the livelihoods of Madurese farmers, providing not only a source of income and food security but also social capital. Our observations align with literature highlighting the pivotal role of cattle farming in sustaining rural economies, supporting local markets, and fostering community cohesion through shared practices and knowledge transmission. Sonok cattle also serve as a tangible link to Madura's cultural heritage, reflecting centuries-old traditions of livestock husbandry and land stewardship. Their presence in folklore, oral histories, and artistic expressions underscores their enduring significance as cultural assets that embody the ethos and values of Madurese society. Sonok cattle epitomize resilience and adaptation in the face of environmental challenges and socioeconomic changes. Our findings corroborate literature describing their ability to thrive in Madura's arid landscapes and withstand periods of drought and scarcity, highlighting their value as resilient genetic resources that contribute to food security and agricultural sustainability.

CONCLUSION

In conclusion, our study provides valuable insights into the physical characteristics, behavior, and cultural significance of Sonok cattle in Pamekasan Regency, Madura. Through meticulous observation and analysis, we have confirmed the breed's distinctive traits, including its robust physique, calm temperament, and integral role in Madurese cultural heritage. Sonok cattle emerge not only as agricultural assets but also as cultural icons, embodying resilience, adaptability, and a profound connection to the traditions and values of the Madurese people. Moving forward, further research and conservation efforts are warranted to safeguard this cherished breed and ensure its continued contribution to the cultural and agricultural landscape of Madura.

Conflic of interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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References

- 1) Al-Amin, M., Nahar, A., Bhuiyan, A. K. F. H., & Faruque, M. (2007). On-farm characterization and present status of North Bengal Grey (NBG) cattle in Bangladesh. *Animal Genetic Resources Information*, 40, 55–64. <https://doi.org/10.1017/s1014233900002194>
- 2) Burdick, N., Randel, R., Carroll, J., & Welsh, T. H. (2011). Interactions between Temperament, Stress, and Immune Function in Cattle. *International Journal of Zoology*, 2011, 1–9. <https://doi.org/10.1155/2011/373197>
- 3) Hartatik, T. (2010). The exploration of Genetic Characteristics of Madura Cattle. *International Seminar on Tropical Animal Production*. <https://repository.ugm.ac.id/32347/>
- 4) Hartatik, T. (2019). *Analisis genetik ternak lokal*. UGM PRESS.
- 5) Hempson, G. P., Archibald, S., & Bond, W. J. (2017). The consequences of replacing wildlife with livestock in Africa. *Scientific Reports*, 7(1). <https://doi.org/10.1038/s41598-017-17348-4>
- 6) Izzah, L., Sulistiyono, S. T., & Rochwulaningsih, Y. (2021). Commodifying culture in a frontier area: The utilization of Madurese culture for developing tourism in the eastern tip of Java Island, Indonesia. *Journal of Marine and Island Cultures*, 10(1). <https://doi.org/10.21463/jmic.2021.10.1.07>
- 7) Kurniawan, R., & Setiyaningsih, L. A. (2023). The Development Of Halal Tourism Destinations Model Based On Art Culture Performers Of Sapi Sonok Madura In Pamekasan Regency. *Profetik*, 16(2), 400–418. <https://doi.org/10.14421/pjk.v16i2.2745>
- 8) Lutvanyiah, S., Perwitasari-Farajallah, D., & Farajallah, A. (2017). Morphological Characters Comparison of Sonok and Madura Cattle. *Jurnal Ilmu Pertanian Indonesia*, 22(1), 67–72. <https://doi.org/10.18343/jipi.22.1.67>
- 9) Masho, W., Banerjee, S., Taye, M., Admasu, Z., & Baye, M. (2022). Assessment of indigenous Shaka cattle structural indices reared in Shaka zone, south west Ethiopia. *Heliyon*, 8(4), e09212. <https://doi.org/10.1016/j.heliyon.2022.e09212>
- 10) McLennan, K. M. (2013). *Social bonds in dairy cattle : the effect of dynamic group systems on welfare and productivity*. <http://nectar.northampton.ac.uk/6466/>
- 11) Mekonnen, T., & Meseret, S. (2020). Characterization of Begait cattle using morphometric and qualitative traits in Western Zone of Tigray, Ethiopia. *International Journal of Livestock Production*, 11(1), 21–33. <https://doi.org/10.5897/ijlp2019.0637>
- 12) Moela, A. K. (2014). *Assessment of the relationship between body weight and body measurement in indigenous goats using path analysis*. http://ulspace.ul.ac.za/bitstream/10386/1112/1/moela_ak_2014.pdf
- 13) Nabukalu, M. M. (2021). *Social behaviour and sociability traits of dairy calves raised in a cow-calf contact system* [Uppsala University]. <https://stud.epsilon.slu.se/16611/>
- 14) Oliveira, J., Rangel, A. H. D. N., De Jesus Barreto, M. L., De Araújo, V. M., De Lima Júnior, D. M., Novaes, L. P., & De Paula Lopes Aureliano, I. (2013). Temperamento de búfalas em sala de ordenha sobre índices produtivos e adaptabilidade ao ambiente: uma revisão. *Journal of Animal Behaviour and Biometeorology*. <https://doi.org/10.14269/2318-1265.v01n01a05>
- 15) Pérez, J. M. L., & Alonso, M. E. (2020). Morphometric characterization of the Lidia cattle breed. *Animals*, 10(7), 1180. <https://doi.org/10.3390/ani10071180>
- 16) Prihandini, P. W., Maharani, D., & Sumadi, S. (2020). Body weight, body measurements and slaughter characteristics of Madura cattle raised in Pamekasan District, East Java Province, Indonesia. *Biodiversitas*, 21(8). <https://doi.org/10.13057/biodiv/d210801>

- 17) Setiani, S., Jannah, L. U., & Huang, W. (2022). Taneyan Lanjang shared home gardens and sustainable rural livelihoods of ethnic madurese in Madura Island, Indonesia. *Sustainability*, 14(10), 5960. <https://doi.org/10.3390/su14105960>
- 18) Stenross, K. (2007). *The seafarers and maritime entrepreneurs of Madura: history, culture, and their role in the Java Sea timber trade*. <https://researchrepository.murdoch.edu.au/id/eprint/347/>
- 19) Sutarno, S., & Setyawan, A. D. (1970). Review: The diversity of local cattle in Indonesia and the efforts to develop superior indigenous cattle breeds. *Biodiversitas*, 17(1). <https://doi.org/10.13057/biodiv/d170139>
- 20) Weber, V., De Lima Weber, F., Da Costa Gomes, R., Da Silva Oliveira, A., Menezes, G. V., De Abreu, U. G. P., De Souza Belete, N. A., & Pistori, H. (2020). Prediction of Girolando cattle weight by means of body measurements extracted from images. *Revista Brasileira De Zootecnia*, 49. <https://doi.org/10.37496/rbz4920190110>
- 21) Widi, T. T. S. M., Udo, H., Oldenbroek, J., Budisatria, I. G. S., Baliarti, E., & Van Der Zijpp, A. (2013). Unique cultural values of Madura cattle: is cross-breeding a threat? *Animal Genetic Resources*, 54, 141–152. <https://doi.org/10.1017/s2078633613000349>
- 22) Widyas, N., Prastowo, S., Haryanto, R., Nugroho, T., & Widi, T. S. M. (2019). Madura cattle stratification as a signature of traditional selection and diverse production systems. *IOP Conference Series. Earth and Environmental Science*, 387(1), 012120. <https://doi.org/10.1088/1755-1315/387/1/012120>
- 23) Zali, M. (2022). A traditional approach to respond climate change: Evidence from Madurese cattle culture. *International Journal of Veterinary Sciences and Animal Husbandry*, 7(1), 19–22. <https://doi.org/10.22271/veterinary.2022.v7.i1a.399>