Jurnal Sain Peternakan Indonesia
Available at https://ejournal.unib.ac.id/index.php/jspi
DOI: https://doi.org/10.31186/jspi.id.20.1.11-18

P-ISSN 1978-3000
E-ISSN 2528-7109
Volume 20 Issue 1 January-March 2025

Physiological and Feeding Behavior Responses of Swamp Buffalo (*Bubalus bubalis*) Under Different Grazing Distances in a Silvopastoral System

D. Z. Sartono. R. Priyanto, and B. W. Putra

Faculty of Animal Science, IPB University
Jl. Agatis, Kampus IPB Darmaga Bogor 16680, Indonesia
Corresponding author: dwizuleli24@gmail.com
Revised: 2025-03-13, Accepted: 2025-03-20, Publish: 2025-03-30

ABSTRACT

Mud buffalo (Bubalus bubalis) is one of Indonesia's livestock commodities with a high potential to be developed. However, its utilization has not been optimized to the fullest. This study aims to evaluate the effectiveness of the silvopasture system in improving mud buffalo welfare based on physiological responses and feeding behavior. This study was conducted in Peguyangan Village, Bantarbolang Subdistrict, Central Java Province. Ninety-one buffalo were observed using a purposive sampling technique grouped by sex and age. Variables observed included grazing distance, environmental temperature and humidity, physiological responses, *Heat Tolerance Coefficient* (HTC) values, and feeding behavior. T-test analyzed data. The results showed the highest body temperature (38.08˚C) in adult male buffaloes with a grazing distance of 5 km. Buffaloes grazed within an 8 km radius had higher respiration rate (42.48±2.67 bpm) and travel speed (1.14 km/h), with shorter feeding duration (03:18 minute) compared to a 5 km distance (03:57 minute). HTC analysis showed low heat tolerance in both regions. Feeding behavior was observed more frequently in female buffalo. Silvopasture systems integrated with teak forests can provide adequate nutrition, with grazing distance influencing physiological adaptations.

Keywords: buffalo, feeding behavior, physiological response, silvopasture system.

INTRODUCTION

Animal husbandry is a key agricultural sector critical in supporting economic activities, particularly in rural regions (Asriany, 2016). Bantarbolang District, located in Central Java Province, is where buffalo is one of the leading livestock species raised by the local community. This sub-district has the highest buffalo population in Pemalang Regency. According to the Central Bureau of Statistics, the buffalo population in Indonesia totaled 1.19 million in 2021, with 58,186 in Central Java Province. The buffalo population in Bantarbolang Sub-district in 2019 amounted to 2,358 heads; in 2020, it increased to 2,862 heads (BPS Pemalang Regency 2021). Buffaloes, as large ruminant animals, make a significant contribution to the development of the national livestock sector because they have superior traits, such as high adaptability, the ability to utilize low-quality forage, and the ability to achieve optimal productivity (Husni et al., 2021).

In the Bantarbolang sub-district, buffaloes, such as cattle, goats, and sheep, are more commonly kept than ruminant species. This preference is primarily attributed to the cultural practices of the local community, which have been passed down through generations. The tradition of grazing buffalo under teak forests has been a long-standing agricultural practice in the village. The silvopasture system is a form of agroforestry that integrates the forestry and livestock sectors in one land management unit (Ma'ruf, 2017). This system combines the presence of teak forests with the rearing of mud buffaloes (Bubalus bubalis), where livestock are allowed to roam freely and graze under teak forest stands. Natural vegetation is used as the primary feed source without causing forest degradation by applying a rotational grazing system to maintain ecosystem sustainability (Kenny, 2019). Silvopasture systems offer a range of ecological and economic benefits, including reducing heat stress in livestock, which contributes to improved animal performance and welfare. In addition, these systems play a role in improving soil physical and chemical properties by increasing organic matter content (Vadila et al., 2023).

Bantarbolang sub-district is one of the areas with great potential for buffalo development due to its vast land area, availability of natural feed, high buffalo population, and favorable climate. This potential is supported by the geographical condition of the Bantarbolang Sub-district, which is almost surrounded by teak forests, making it a strategic location for developing a silvopasture-based buffalo rearing

system by grazing under teak stands. Proper grazing management is required to support optimal buffalo productivity so that the development of buffalo farming in this region can contribute to ecological sustainability and community welfare. To support buffalo productivity, this study aims to evaluate the effectiveness of the silvopasture rearing system in improving livestock welfare based on physiological responses and feeding behavior patterns of mud buffaloes.

MATERIALS AND METHODS

This research was conducted at the Rimba Jaya buffalo farm, Peguyangan Village, Bantarbolang District, Pemalang Regency, Central Java Province, from January to February 2024.

Materials and tools

The materials used in this research were 91 mud buffaloes (*Bubalus bubalis*) raised with a semi-intensive system. The sample used in this study used a purposive sampling technique based on Sugiyono (2001), with 91 buffaloes classified by sex and age. The group consists of 21 male and 20 female buffaloes aged I_3, 20 female buffaloes aged 1_2, and 30 buffaloes aged 1_0 (15 males and 15 females). Each sample was marked with a code number on its body parts. The tools used are a mobile phone, Avenza maps - offline Mapping 5.1.1 application, mobile phone camera with 12 MP resolution, digital thermometer and hygrometer, infrared thermometer, counter, stopwatch, and marker.

The method used in this research is a direct observation method conducted at the Rimba Jaya buffalo farmer group, Peguyangan Village, Pemalang Regency, with a semi-intensive grazing system. Buffalo grazing starts at noon, starting at 12.00, and continues until the afternoon at 18.00 WIB. Buffalo grazing tracking was conducted in grazing areas with a radius of ± 5 km and ± 8 km. The distance was determined from the grazing area with the most extensive land and abundant forage resources.

Primary data was collected by directly observing and measuring buffalo cattle, including direct observation of grazing tracks, using the Avenza maps version 5.1.1 application on a mobile smartphone. Environmental temperature and humidity were measured by placing a digital thermometer and hygrometer for 10 minutes to get consistent data; measurements were made in the morning at 08.00 WIB, in the afternoon at 12.00 WIB, and in the afternoon at 16.00 WIB. Buffalo feeding behavior was observed using the One Zero method at 15-minute intervals with observed feeding and rumination activities in two grazing areas at a distance radius of 5 km and 8 km, and direct measurements were made on the physiological responses of buffaloes, including body surface temperature and respiratory rate. Body surface temperature and respiratory rate were measured three times in the morning, afternoon, and evening. Respiratory rate was measured by observing abdominal movements for 1 minute.

Data Analysis

The t-test was used to see the average difference in physiological responses and feeding behavior of buffaloes grazed at a distance radius of 5 km and 8 km in the male and female sex categories and age levels. The t-test formula, according to Soeprajogo (2020), is as follows:

$$t = \frac{\overline{X1} - \overline{X2}}{\sqrt{\frac{S1^2}{n1}\frac{S2^2}{n2}}}$$

Information:

$\bar{x}_1$ and $\bar{x}_2$= On average, buffalo are grazed within a radius of 5 km and 8 km

S_1^2 and S_2^2= sample variance of 5 km and 8 km

N^1 and N^2 = lots of buffalo sample data at a distance of 5 km and 8 km

Physiological adaptability in livestock is assessed using the Heat Tolerance Coefficient, which is calculated based on body temperature using the formula outlined by Benezra Suharsono (2008). The calculation of the frequency percentage of eating behavior is performed using the formula according to Martin and Bateson (1988).

RESULTS AND DISCUSSION

Geographical and Grazing Tracking

Peguyangan Village is situated on the northern coast of Java Island, at coordinates 109° 17 30" – 109° 40'30" East Longitude and 8° 52'30" – 7° 20 11" South Latitude. The village is located at an elevation of 100 meters above sea level (masl) and covers a total area of 779.8 hectares, of which 498 hectares are designated state forest land. Buffalo farming constitutes a key sector in

the economic development of Peguyangan Village. This sector is supported by favorable environmental conditions that facilitate the implementation of an integrated grazing system within teak forest areas, known as the silvopasture system. The practice of buffalo husbandry in the village has been sustained for generations since 1960, primarily through the formation of structured livestock groups, which optimize herd management and resource utilization.

The breeder community in Peguyangan Village consists of 11 to 15 livestock groups, with individual ownership ranging from 10 to 25 buffalo per pen. These breeder groups have established a structured livestock complex utilizing a colony cage system, where enclosures are positioned near the teak forest area. The grazing activities are regulated and managed by Perhutani, which oversees the permitting process and enforces specific restrictions that must be adhered to by livestock breeders. Implementing the silvopasture system integrates forestry and livestock management practices, fostering a sustainable interaction between grazing activities and forest ecosystems.

The predominant livestock species in Peguyangan Village is the mud buffalo (*Bubalus bubalis*), a local breed that has demonstrated strong adaptability to Indonesia's humid tropical climate (Krisnandi, 2017). Bantarbolang District has the highest buffalo population in Pemalang Regency, with a recorded total of 2,682 buffalo in 2020 (BPS 2021). A diverse range of plants growing beneath the teak canopy is a source of forage, including grasses and legumes. According to previous research, multiple forage plant species were identified within the teak forest grazing area of Peguyangan Village in 2018.

Based on the identification results reported by Khomsa (2018), three major plant groups were found to thrive in the teak forest ecosystem. These include grass species (13 identified species), legume species (2 identified species), and rumbah species (15 identified species). These forage resources are abundant and sufficient to meet the dietary requirements of buffalo, except for certain woody rumbah species, which are less palatable.

Buffalo grazing tracking is done with the Avenza Maps mapping application, developed by Avenza Systems Inc. This application makes it easy for farmers to map grazing areas, help farmers to determine the boundaries of grazing areas, avoid unproductive areas, track livestock movements with GPS tracking, mark areas with better feed to optimize grazing rotations, record grazing distances, record travel duration, travel speed and measurement of polygonal areas (Supriyanto, 2020). The results of grazing tracking data carried out in this study are then processed with ArcGIS software. ArcGIS was used to convert the data obtained from Avenza Maps into a digital map representation. The results of livestock grazing tracking in the form of data and maps are presented in Table 1 and Figure 1.

Table 1. Travel and feeding time of buffalo cattle while on pasture.

Variabel	Grazing Radius	
	5 Km	8 Km
Buffalo grazing duration (hours)	04:54	05:06
Grazing travel time (hour)	01:11	01:16
Buffalo feeding time (hour)	03:57	03:18
Speed (Km/h)	1.05	1.41
Land area (Ha)	19.00 Ha	21.17 Ha

Information: Km/h = kilometers/hour; Ha = Hectare.

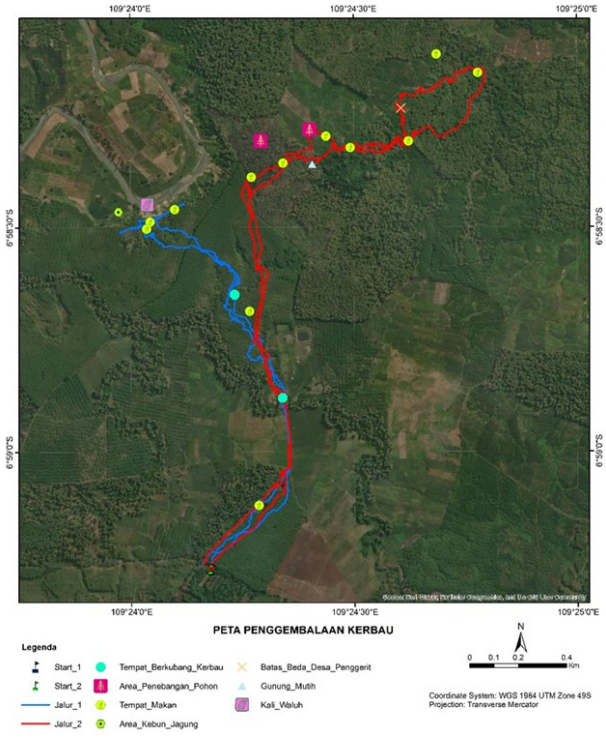

Figure 1. Buffalo grazing path map

Based on the recorded data of livestock movements within a 5 km grazing radius, the total grazing duration was 4 hours 54 minutes, with an average speed of 1.05 km/h. The average travel time was 50 minutes, while the buffalo feeding

time totaled 4 hours and 18 minutes. In contrast, within an 8 km grazing radius, the total grazing duration was 5 hours and 6 minutes, with an average speed of 1.41 km/h. The average travel time was recorded at 1 hour and 19 minutes, and the buffalo feeding time lasted 3 hours and 47 minutes.

The analysis revealed that the travel duration was longer at the 8 km radius, with a 29-minute difference in travel time compared to the 5 km radius. Conversely, buffalo feeding time was longer at the 5 km radius, lasting 4 hours 18 minutes. This difference can be attributed to variations in grazing distances, where areas with a 5 km radius offer closer access, resulting in shorter travel times and more time for feed consumption.

Temperature and Humidity

The intensity of heat and humidity in the maintenance environment measures temperature and humidity in the environment. Temperature and humidity in Peguyangan Village are 24-36 ^{o}C with 86-34% humidity (BPS 2023). The average temperature, humidity, and THI values in the morning, afternoon, and evening at the research location can be seen in Table 2.

Table 2. Environmental temperature and humidity, and THI calculations during grazing

Environmental Parameters	Distance Grazing 5 Km			Distance Grazing 8 Km		
	Morning	Afternoon	Evening	Morning	Afternoon	Evening
Temperature (˚C)	26.87±0.52	36.48±1.02	31.30±0.78	27.10±0.36	35.75±1.16	30.02±0.52
Humidity (%)	68.50±1.05	54.67±6.98	74.83±4.17	71.17±4.02	60.50±6.66	72.83±3.06
THI	71.89±0.64	81.10±2.29	79.28±1.05	72.95±0.47	82.17±1.19	77.87±1.87
Stress Category	Normal	Moderate heat stress	Mild heat stress	Normal	Moderate heat stress	Mild heat stress

Information: THI (*Temperature Humidity Index*); THI categories refer to Bullita et al. (2015)

The environmental temperature and humidity analyzed were the microenvironment around the cages and grazing areas. The temperature and humidity in the 5 km grazing area during the day and evening were higher than in the 8 km grazing area. The average daytime temperature at the 5 km grazing radius reached 36.48 ± 1.02°C, with an average relative humidity of 54.67 ± 6.98 %. In contrast, in the morning, the average temperature around the drum at this radius was lower at 26.87 ± 0.52°C, with a higher average relative humidity of 68.50 ± 1.05%. According to Marai (2010), tolerable and comfortable temperatures for buffalo range from 38.2-38.4°C. The combination of high temperature and humidity can trigger heat stress experienced by buffalo.

Physiological Response

Temperature and humidity are two interrelated climatic factors that significantly influence livestock production. These two factors can affect the heat balance in the livestock body, water balance, energy balance, and the behavior of the livestock itself. The physiological response is an indicator that can be used to assess the stress level experienced by livestock (Abdurrahan, 2017). The results of observations on the physiological responses of buffalo cattle in the grazing area at a grazing radius of 5 km and 8 km are presented in Table 3. The response of buffalo to changes in temperature and humidity during the day showed changes in temperature fluctuations.

Table 3. Body surface temperature in mud buffaloes at grazing radius of 5 km and 8 km

Gender	Age	Body Temperature (°C) Morning		P-value	Body Temperature (°C) Afternoon		P-value	Body Temperature (°C) Evening		P-value
		5 km	8 km		5 km	8 km		5 km	8 km	
Male	1_3	35.63±0.43	34.83±0.83	0.046*	38.09±0.38	37.52±0.55	0.010*	35.36±0.33	34.93±0.58	0.033*
Female	I_3	35.12±0.43	35.46±0.45	0.065	37.69±0.45	38.02±0.36	0.045*	35.29±0.46	34.83±0.46	0.020*
Female	I_2	35.21±0.36	34.57±0.47	0.058	37.88±0.48	37.42±0.66	0.036*	35.28±0.43	34.85±0.66	0.075
Male	1_0	34.80±0.57	34.17±0.45	0.013*	36.96±0.43	36.30±0.62	0.038*	35.41±0.42	34.75±0.40	0.008**
Female	I_0	34.76±0.54	33.99±0.72	0.031*	36.83±0.39	36.27±0.59	0.044*	34.72±0.45	34.63±0.46	0.046*

Noted: X; Mean, sd; Standard deviation, p; significance of t-test comparison between maintenance patterns, **; very significantly different p<0.01, *; significantly different p<0.05;

This is shown in the changes in buffalo body surface temperature conditions during the day at a grazing radius of 5 km, reaching 38.09°C. While at a grazing radius of 8 km, the highest buffalo surface temperature reached 38.02°C. In this temperature range, the homeostatic process in buffaloes runs well because the usual temperature in buffaloes ranges from 38.2°C - 38.4°C and is in balance with the environmental temperature, which is between 22°C and 33°C. However, when the surface temperature is above 38.2°C - 38.4°C, buffaloes must adjust physiologically, affecting growth, feed consumption, production, reproductive efficiency, and behavior.

Respiration is when oxygen, taken from the air, enters the lungs through the nose and respiratory tract. Breathing frequency in buffaloes varies depending on body size, age, physical activity, fatigue, and whether or not the rumen is full. An increased respiratory rate occurs due to increased oxygen demand by the body tissues. Consequently, this can be seen when cattle perform bodily movements, basking in high air temperature or humidity. The results of observations on buffalo respiration in the grazing area are presented in Table 4.

Table 4. Physiological response of respiration in mud buffaloes at grazing radius of 5 km and 8 km.

Gender	Age	Respiratory Rate (breaths minute-^{1})		P-value	Respiratory Rate (breaths minute-^{1})		P-value	Respiratory Rate (breaths minute-^{1})		P-value
		5 km	8 km		5 km	8 km		5 km	8 km	
Male	1_3	26.00±0.86	27.00±0.81	0.012*	40.11±2.08	42.48±2.67	0.038*	32.67±1.50	34.28±1.17	0.010*
Female	I_3	26.36±1.12	27.53±0.62	0.002**	40.00±1.89	42.71±2.44	0.005**	31.09±1.75	32.71±1.82	0.029*
Female	I_2	26.58±0.90	27.31±0.70	0.023*	40.42±2.06	42.69±2.86	0.028*	34.58±1.16	32.50±1.96	0.003**
Male	1_0	22.50±1.87	24.90±1.85	0.025*	34.16±0.98	35.40±1.17	0.049*	30.66±1.21	32.10±1.44	0.062
Female	I_0	21.00±2.08	23.60±2.36	0.034*	33.57±0.53	34.50±0.97	0.037*	32.14±1.34	33.60±1.26	0.038*

Note: X; Mean, sd; Standard deviation, p; significance of t-test comparison between maintenance patterns, **; very significantly different $p<0.01$, *; significantly different $p<0.05$; breaths per minute (bpm).

Table 4 shows that the respiration value at a grazing radius of 5 km in both sexes and age levels overall has a lower value than buffaloes grazed at a radius of 8 km. This figure implies that distance affects the respiration response of buffalo, while other factors can influence the rest. Environmental temperature and longer grazing distances cause buffalo to respond by adapting physiologically through behavioral changes. Buffaloes grazed at a grazing radius of 8 km (far) will show a different physiological response from buffaloes grazed at a grazing radius of 5 km (near). The frequency of buffalo that do not often do long walks will have a standard frequency of about 23 minutes. Compared to buffalo, which often do long walks, the frequency of buffalo respiration can reach 70 minutes.

This is because buffalo traveling long distances expend more energy and require more oxygen (O_2) to remove carbon dioxide (CO_2) and heat generated from the body. The increase in respiration frequency is not too significant because, during the journey, anaerobic oxidation occurs, and this oxidation will only show a sharp increase in respiration frequency after the buffalo has recovered. Oxygen will be required during recovery to meet the increased oxidative (aerobic) metabolic activity within the muscle cells to produce ATP to replace what has already been used.

Respiratory frequency is a crucial physiological response that helps maintain body homeostasis and is closely associated with heart rate. In resting adult buffalo, the regular respiratory rate ranges from 20 to 25 breaths per minute. However, as environmental temperatures rise, respiratory frequency increases, reaching up to 70 breaths per minute under heat-stress conditions (Fahimuddi, 1975). Buffaloes are particularly susceptible to heat stress due to their relatively few sweat glands.

Heat Tolerance Coefficient is the adaptability of livestock to hot conditions or heat resistance in a region (Hermansyah, 2024). Body temperature and respiratory frequency are the basic parameters used in estimating the adaptability of livestock to the environment when facing hot conditions and thermal stress resistance (Qisthon, 2019). The increased respiratory frequency and body temperature, balanced by the heat release mechanism through evaporation, characterized by increased respiration rate, is proportional to the increase in Heat Tolerance Coefficient (Kumar et al., 2011). Livestock exposed to heat stress will reflect the response of body temperature and respiratory frequency.

The results of the study have been presented in Table 5.

The HTC value in this study shows that the grazing radius of 5 km has an average HTC value of 2.35 bpm, lower than the average HTC value of 2.41 bpm grazed with a radius of 8 km. This shows that buffaloes grazed within a radius of 8 km show that increasing grazing distance can increase the adaptability of livestock to the environment. Buffaloes grazed within an 8 km radius face more significant environmental pressures that require more intensive adaptation mechanisms. This shows that buffaloes grazed within a radius of 5 km and 8 km in this study have low heat endurance. This result differs from Ramya et al.'s research (2018), which states that the HTC value of Murrah buffaloes is the same, with a range of 2.43 bpm. Based on the Benezra Suharsono formula (2008), the condition of buffaloes in an environment is declared optimum if the HTC value obtained is equal to 2.0. The higher the HTC value obtained, the lower the heat endurance (Pribadi et al., 2021). This shows that buffaloes in this study have low heat endurance.

Table 5. Effect of grazing distance of 5 km and 8 km on Heat Tolerance Coefficient of mud buffalo

Gender	Age	Nilai Heat Tolerance Coefficient 5 km (bpm)			Nilai Heat Tolerance Coefficient 8 km (bpm)		
		Morning	Afternoon	Evening	Morning	Afternoon	Evening
Male	1_3	2.02	2.74	2.34	2.08	2.81	2.40
Female	I_3	2.06	2.72	2.27	2.14	2.80	2.34
Female	I_2	2.07	2.73	2.42	2.21	2.79	2.32
Male	1_0	2.22	2.48	2.34	2.25	2.53	2.34
Female	I_0	2.06	2.44	2.32	2.23	2.52	2.38

Feeding Behavior

Feeding activity in buffalo encompasses behaviors such as sniffing, chewing, grinding, and swallowing food. Rumination activity refers to the process of regurgitating boluses, chewing them, and subsequently swallowing. Observations of these feeding behaviors were conducted on mud buffalo at two different grazing radius 5 km and 8 km. Each buffalo was observed to assess its feeding patterns. The outcomes of these observations are depicted in Tables 6 and 7.

Table 6. Feeding and rumination activity at a 5 km grazing radius

Eating behavior	Individual Grazing Radius of 5 km					Percentage (%)
	Adult Male	Adult Female	Young Female	Calf Male	Calf Female	
Smelling Food	2.23	3.33	4.16	2.42	2.69	11.5
Chewing	7.75	7.90	8.10	6.59	6.52	28.71
Food Gruning	8.12	7.58	5.78	5.24	5.24	25.68
Food Swallowing	2.33	2.53	3.58	3.31	3.31	10.88
Ejecting Bolus	1.33	1.28	1.94	2.11	2.11	5.98
Chewing Bolus	3.34	3.56	3.63	4.14	4.14	14.74
Us Swallowing Bolus	0.53	0.33	0.86	1.04	1.04	2.47

Table 7. Feeding and rumination activity at an 8 km grazing radius

Eating behavior	Individual Grazing Radius of 5 km					Percentage (%)
	Adult Male	Adult Female	Young Female	Calf Male	Calf Female	
Smelling Food	3.87	2.24	2.67	3.92	3.23	12.64
Chewing	6.91	7.20	6.80	6.45	6.50	26.86
Food Gruning	5.67	6.00	6.27	6.44	6.53	24.52
Food Swallowing	2.41	2.46	3.08	2.00	3.32	10.53
Ejecting Bolus	1.56	1.89	1.80	0.91	1.50	6.08
Chewing Bolus	4.01	4.60	4.00	4.48	3.64	16.44
Us Swallowing Bolus	0.95	0.85	0.72	0.58	0.61	2.94

Observations at a grazing radius of 5 km showed that the most frequent feeding activity carried out by buffaloes was chewing food carried out by adult female buffaloes at 7.20 times. The lowest was carried out by male buffalo calves at 6.45 times. The high number of eating activities carried out by adult female buffaloes is because adult female buffaloes have a higher need to carry out their activities, so buffaloes will carry out more eating activities. Latupeirissa et al. (2020) said that the chewing process is the primary method used by livestock to damage the structural and cellular integrity of food, and the chewing process plays a role in preparing food for swallowing.

The most frequent feeding activity in the 8 km grazing radius was chewing activity performed by young female buffaloes 8.10 times. This is the opinion of Ibrahim et al. (2001), which states that young buffaloes will have more energy needs, reaching 188 (Kcal ME / Wt kg / d). This energy needs is the highest compared to adult buffaloes and calves. While adult male buffaloes often perform the feeding activity, the food grazing activity is 8.12 times, and the lowest chewing activity is carried out by female buffalo calves 5.24 times. The activity results show that when grabbing the forage, the buffalo will collect the food in its mouth in large quantities and then perform chewing activities.

Rumination in buffalo spends more time at night than during the day. Buffaloes spend less time ruminating than other livestock. The rumination process runs approximately 15 times a day, with each rumination lasting 1 minute to 2 hours (Latupeirissa, 2020). The observations in Tables 4 and 5 show a numerical difference between the 5 and 8 km distance radius. Rumination activity is often carried out at a grazing radius of 5 km in bolus chewing activity in adult female buffaloes 4.60 times and the lowest 3.64 times in calves.

This condition occurs because buffaloes at this grazing radius have more time foraging activities than walking to the grazing area, causing buffaloes to engage in more resting behavior while taking shelter by doing rumination activities. While at a grazing distance of an 8 km radius, the most rumination activity was chewing bolus done by male buffalo calves 4.25 times, and the lowest was done by adult male buffalo 3.34 times.

CONCLUSION

Mud buffaloes grazed under the silvopasture system at 5 km and 8 km showed different physiological responses and feeding behavior. Buffaloes grazing within a 5 km radius showed lower physiological stress, as indicated by a reduced heat tolerance coefficient (HTC) and respiration rate. In contrast, buffaloes grazing within an 8 km radius showed increased HTC and respiration rate, indicating that greater grazing distances induce more significant environmental and thermal stress, thereby reducing heat tolerance. These findings highlight the importance of optimizing grazing management in silvopasture systems to improve buffalo welfare and productivity.

ACKNOWLEDGEMENTS

The author would like to express sincere gratitude to Mr. Bagio, the leader of the Rimba Jaya group, for allowing and facilitating the research process.

REFERENCES

Abdurrahman, R. 2017. Physiological Response And Production Performance Of Female Swamp Buffaloes At Different Altitudes And Ages. IPB Repository. Bogor.

Asryani, A. 2016. Local wisdom in raising local buffaloes in Randan Batu Village, Tana Toraja Regency. J. Bulletin of Animal Nutrition and food. 12(2): 64-72.

Bulitta, F., S, Aradom S., and Gebresenbet, G. 2015. Effect of transport time of up to 12 hours on welfare of cows and bulls. J Sci Manag. 8:161–182

Hermansyah, Syamsidar, and Fattah, A., H. 2024. Physiological response of various beef cattle breeds in kajuara district bone regency. J. Tarjih Tropical Livestock. 4(1): 23-31.

Husni, Munandar, I., Arman, C. 2021. Behavior of mud buffaloes that are extensively maintained in the doro ncanga savanna field in the tambora region of Dompu Regency, West Nusa Tenggara. J. Tambora. 5(3):63-66.

Ibrahim, M., N., M., K., K., Pathirana, and J., A., D., Siriwardene. 2001. Water Buffalo in Asia. National Science Foundation. Sri Lanka.

Kenny, L., B, Burk, A., and Williams, C., A. 2019. Managing Equine Grazing For Pasture Productivity. Horse Pasture Manangement. 141-155

Khomsa, S., N. 2018. Diversity of forage species for buffalo in peguyangan village, bantarbolang sub-district, pemalang district. IPB Repository. https://repository.ipb.ac.id/handle/123456789/93482

Kumar, S., K. Ajeet., and K. Meena. 2011. Effect of heat stress in tropical livestock and different strategies for its amelioration. J of Stress Physiology and Biochemistry. 7(1): 45-54.

Kurniadi, R., Purnomo, H., Wijayanto, N., and Fuah, A., M. 2017. Livestock management model around mutis mountain forest and its impact on forest sustainability. J. of Forestry Science. 11(2): 156.

Latupeirissa, C., C., Papilaya, J., B., & Lelloltery, P., R. 2020. Chewing Behavior of MOA Buffaloes fed Local Forage on MOA Island, Southwest Maluku Regency. J. Agrinimal. 8.(1).33-38.

Ma'ruf, A. 2017. Agrosilvopasture as planned farming systems towards sustainable agriculture. J Agricultural Research Bernas. 13(2)

Marai, I., F., M, Haeeb, A., A., M. 2008. The biological function of buffalo affected by heat stress. J. Animal Science. 127:89-109.

Marta, Y. 2017. Grazing System as an Effective and Efficient Alternative for Beef Cattle Farming. J. Pastura. 5(1): 51. p11.

Pribadi, L., W, Suhardiani, R., A.,, Hidjaz, T., Ashari, M., Poerwoto, H., and Andriati, R. 2021. Physiological respons of Bali and simbal cattles on the thermal environtment of lowland and highland areas in Lombok Island. J Biologi Tropis. 21(3), 648-661.

Qisthon, A., and Hartono, M. 2019. Respons fisiologis dan ketahanan panas kambing boerawa dan peranakan Ettawa pada modifikasi iklim mikro kandang melalui pengkabutan. J Integrated Animal Science. 7(1): 206-211.

Ramya, N., C, Krishna, H., and Chandra, S., A. 2018. Oclimate alteration devices and feed additive on adaptability indices in murrah buffaloes. J. Advanced Research. 6(10): 1-5.

Soeprajogo, Purnama and N. Ratnaningsih. 2020. Perbandingan Dua Rata-Rata Uji-T. Univ. Padjajaran. Bandung.

Suharsono, S. (2008). Bionomika Ternak. Widya Padjajaran. Bandung

Supriyanto, A., Effendi, H. (2020). Panduan Lapangan Pemetaan Berbasis Android Menggunakan Avenza Maps. Balai Besar Penelitian dan Pengembangan Ekosistem Hutan Dipterokarpa. Samarinda.

Vadila, P., U., Reksiana, E., P., and Wahyudin, C., A. 2023. Analysis and development of silvopasture Agroforestry System in Bangkalan District. Seminar Nasional Agroteknologi 2022. NST Proceedings. pages 1-8.