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Characteristics of Morphology, Reproductive and Physiological Response of Swamp Buffalo on Different Lands in West Aceh Regency

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ABSTRACT

Swamp buffaloes are among the most sought-after livestock for meat production in West Aceh Regency. Therefore, an analysis of their production and reproduction is necessary to determine the direction for potential development. The objective of this research is to analyze the characteristics of morphology, reproductive efficiency, and physiological response of swamp buffaloes in different plains in West Aceh Regency. The study was conducted in West Aceh Regency on different plains, including coastal plains and undulating plains, from May to September 2023. The variables measured include quantitative traits, reproductive efficiency, and physiological response, evaluated based on rectal temperature, with a total of 200 animal samples and 100 respondents. The analysis used multiple linear regression and t-test. The research results indicate that the most common quantitative traits such as body length, chest width, chest circumference, hip width, and body weight are influenced (P<0.05) by different plain conditions. Productive performance in terms of age at first marriage variable and reproductive efficiency is influenced (P<0.05) by different plain condition. The physiological response of buffaloes shows that rectal temperature is influenced (P<0.05) by different plain conditions. These both conditions also impacted the quality of swamp buffaloes' meats that could impact the income of breeders.

KEYWORDS

swamp buffalo; morphology; reproductive efficiency; physiological response; plains.

INTRODUCTION

The livestock subsector makes a significant contribution to livelihoods and food security in various parts of the world, but its performance is less than optimal in several developing countries, including swamp buffalo in Indonesia. In developing countries like Indonesia, animal husbandry provides a valuable source of food, income and employment. This is because it is supported by a tropical climate along with forests and wetlands which facilitate the opportunity for breeders to raise swamp buffalo. Swamp buffalo serves as a food source to support the achievement of the national meat self-sufficiency target. His contribution plays an important role in realizing a stable meat supply for the nation.

The difference between coastal plains and undulating plains also has an influence on the income of swamp buffaloes breeders in West Aceh in developing countries like Indonesia, animal husbandry provides a valuable source of food, income and employment. This is because it is supported by a tropical climate along with forests and wetlands which facilitate the opportunity for breeders to raise swamp buffalo.

Swamp buffalo is a type of meat-producing livestock that is very adaptable to tropical humid environmental conditions, so it is widely bred. Swamp buffalo is a type of strong worker, a type of potential meat animal, has high adaptability to changes in temperature and air temperature, capability for low quality feed, relatively resistant to internal and external parasites, good productivity. Aceh Province, especially West Aceh Regency, is one of the areas with the largest population of swamp buffalo in Aceh Province. Based on data from Badan Pusat Statistik Aceh Barat or West Aceh Regency Central Statistics Agency (2022), the number of buffalo in West Aceh Regency in 2021 will be 21,517 head. The high population of buffalo in West Aceh Regency is due to the high public demand for buffalo meat compared to other livestock meat. The buffalo population in 2021 will decrease compared to 2020.

The buffalo population in 2021 was 21,517, while the buffalo population in 2020 was 25,345. The decline in the buffalo population in West Aceh Regency is likely caused by low levels of buffalo productivity and reproductivity. West Aceh Regency Most of the area is on the coast. The climatic conditions in coastal areas have low rainfall and hot temperatures, so the quality of the forage grown in coastal areas is low. This condition affects the physiology of buffalo livestock. The physiological condition of buffalo has an influence on reproduction. Several factors that influence the reproductive ability of female buffalo are the environment, maintenance management, feed availability, and air temperature. Increasing the swamp buffalo population can be done by improving buffalo performance, including optimizing reproduction, body weight based on body shape and size, good and adequate feed, genetics and the environment, so that a local buffalo population with the best quality is obtained.

RESEARCH METHODS

This research was carried out in West Aceh Regency on different plains, namely on undulating plains (Pante Ceureumen and Sungai Mas Districts) and coastal plains (Arongan Lambalek and Samatiga) for five months starting from preparation in making research proposals, surveying field data, then continuing with data analysis, up to writing a thesis. Time allocation from May-September 2023.

Data Types and Sources

The data collected in this research is primary and secondary data. Primary data was obtained from interviews and direct observations with breeders using a prepared questionnaire. Data collected through interviews included breeder data, age at first marriage, age at first calving, length of pregnancy, calving interval, number of births, and number of deaths. Secondary data is data that does not directly provide data to data collectors, but through other people or through documents. Secondary data sources for this research were obtained from the West Aceh Regency Livestock and Plantation Service, livestock journals, textbooks and the internet. Data obtained in the field is then processed mathematically, tabulated and then explained descriptively.

Data collection technique

Data collection is by direct observation, interviews, and recording which is carried out in accordance with the list of questions or questionnaire that has been prepared. Sampling in this research used purposive sampling technique

Morphological Characteristics of Swamp Buffalo

Morphometric measurements were carried out in the morning before grazing or in the afternoon after grazing. The procedure for measuring buffalo morphometry is as follows: The samples are adult male and female buffalo aged 3-8 years as many as 200 swamp buffalo with a male to female ratio of 50: 50 for each plain. Measurements were carried out accompanied by officers from the West Aceh Regency Livestock and Plantation Service, community leaders and breeders. The data obtained is then tabulated.

Reproductive Performance of Swamp Buffalo

Reproductive performance was carried out through an initial survey to determine the research location and direct observation in the field (interviews using a structured questionnaire) to collect primary reproductive data from interviews with 50 breeders and 50 livestock for each plain studied. The research was accompanied by official officers from the regional technical executive unit of the West Aceh Regency Livestock and Plantation Service and livestock breeders. The variables measured include age at first marriage, age at first calving, length of pregnancy, calving interval, number of births, and number of deaths.

Physiological Response

Physiological analysis was used to determine the physiological condition of swamp buffalo in two different locations, namely the lowlands and the coastal plains. The data observed was rectal temperature. Rectal temperature is measured by inserting a thermometer into the rectum until a sound is heard and then the temperature is recorded. This measurement is carried out in the morning before the livestock is grazed.

Sample Determination Method

The number of farmer respondents in the breeder group taken in this study was 50 respondents in the coastal plains and slopes which were divided into 2 sub-districts in each plain, so the number of respondents for the breeder group was 100 people. Determination of the research sample is based on Arikunto (2002) which states that if there are less than 100 subjects, all of them are taken at once so that the research is population research. If the number of subjects is large, 20 - 30 percent of breeders can be taken as samples. According to Wirartha (2006) states that for research that will use statistical data a sample size of at least 30% can represent the population. If the number of subjects is large, 20 - 30 percent of breeders can be taken as samples.

The number of livestock samples used was 200 buffalo. Livestock sampling in this study used the Slovin formula because in sampling, the number must be representative so that the research results can be generalized and the calculation does not require a sample number table, but can be done using simple formulas and calculations. Slovin's formula for determining samples is as follows:

$$\mathbf{n} = \frac{N}{1+N(e)^2}$$

Information:
n = Sample size
N = Population size
e = Percentage of allowance for sampling error accuracy that can still be tolerated; e = 0.1

Data analysis method

The collected data was then analyzed using multiple linear regression analysis and t test using the SPSS 16 application. The values analyzed included:

1. Reproductive efficiency is calculated based on a formula modified by Hardjosubroto (1994), namely:

$$ER = \frac{(CI \times \sum Children)}{(UBI - UKI + CI - LB)} \times 100\%$$

Information:
ER = Reproductive Efficiency (%)
∑ children = Number of Children (tail)
UBI = Age at first calving of the buffalo studied (months)
UKI = Age at first mating of the buffalo studied (months)
CI = Calving distance for the buffalo studiedBirth (months)
LB = Pregnancy duration of the buffalo studied (months)

2. The birth rate of buffalo is calculated using the Samsuandi and Abdullah (2016) formula, namely:

$$\text{Birth Rate (\%)} = \frac{\sum \text{born buffalo}}{\sum \text{parent}}$$

3. Buffalo mortality is calculated using the Samsuandi and Abdullah (2016) formula, namely:

$$\text{Mortality (\%)} = \frac{\sum \text{dead buffalo calf}}{\sum \text{buffalo calf born}}$$

4. Morphological characteristics, reproduction and physiological responses of female swamp buffalo were analyzed using the t-test to see differences in two different plains.

$$\text{t hitung} = \frac{|\bar{X}A - \bar{X}B|}{\sqrt{\frac{(nA)(S^2A) + (nB)(S^2B)}{nA + nB} \times \left(\frac{1}{nA} + \frac{1}{nB}\right)}}$$

Information:
$\bar{X}A$ = Sample mean A
$\bar{X}B$ = Sample mean B
nA = Number of sample data A
nB = Number of sample data B
S2A = Sample variety A
S2B = Variety sample B (Boediono and Koster, 2004).

RESULTS AND DISCUSSION

Morphological Characteristics of West Aceh Swamp Buffalo

Quantitative Characteristic

Quantitative Characteristic are traits whose value or degree can be measured between one trait and another. Quantitative character is a character whose value or degree can be measured. There cannot be a clear distinction between one character and another so there are sizes from low to high. Quantitative characters are determined by more than 2 genes or several pairs of genes. Most geneticists agree that ten or more pairs of genes are involved for most of these quantitative traits. Apart from being influenced by many pairs of genes, quantitative traits are different from qualitative traits because they are often strongly influenced by the environment. Quantitative characteristics of swamp buffalo in West Aceh Regency include Body Length (cm), Width Chest (cm), Circumference Chest (cm), Width hip (cm), Body Weight (kg), can be seen in Table 1

Table 1. Quantitative Characteristics of Buffalo Livestock in West Aceh Regency on the Coastal Plain and Wavy Plain.

No.	Quantitative Characteristic	Male		Female	
		Coastal	Hilly	Coastal	Hilly
1.	L. Body	120.34±10.52^{b}	129.49±13.25^{a}	110,34±10,52^{b}	119,49±13,25^{a}
2.	W.Chest	35,05±4,87^{a}	28,82±2,73^{b}	38,55±4,99^{a}	32,34±2,74^{b}
3.	C. Chest	159,66±23,89^{b}	167,60±12,09^{a}	154,66±23,89^{b}	163,60±12,09^{a}
4.	W. Hip	47,07±4,06^{a}	38,25±4,17^{b}	52,57±4,14^{a}	43,75±4,25^{b}
5.	B. Weight	178,94±41,09^{b}	201,38±35,79^{a}	159,12±38,53^{b}	181,50±34,28^{a}

Information: L = Length, W = Width, C = Circumference, B = Body. Data processing results (2023). Different superscripts on the same row indicate a significant effect (P<0.05).

Body Length

Table 1 shows that the average body length of male buffalo in the coastal and undulating plains is 120.34 ± 10.52 cm and 129.49 ± 13.25 cm, while the average body length of female buffalo in the coastal plain and wavy at 110.34 ± 10.52 cm and 119.49 ± 13.25 cm. Both male and female gender in both plains had a significant influence (P<0.05) on buffalo body length. According to the National Standardization Agency (2011), the quantitative requirements for male and female mud buffaloes aged > 36 months are for the average body length of males and females to be 125 cm and 120 cm. Komariah et al. (2015) the average body length of male and female mud buffalo in the lowlands is 111.00 ± 8.54 cm and 108.00 ± 12.17 cm and in the highlands is 146.71 ± 4.05 cm and 165.53 ± 14 .88 cm. Research by Purohit, G et al (2019) regarding the morphological characteristics of Simeulue buffalo in Simeulue Regency, it was found that the average body length of male and female buffalo was 125.54 ± 0.96 cm and 120 ± 1.16 cm.

The average body length of male buffalo is longer than the body length of female buffalo both on coastal plains and undulating plains. Buffalo on the coastal plains have a lower average body length compared to those on the undulating plains.

Circumference Chest

Table 1 shows that the average chest width of male buffalo on the coastal and undulating plains is 35.05 ± 4.87 cm and 28.82 ± 2.73 cm, while the average chest width of female

buffalo on the coastal plain and wavy at 38.55 ± 4.99 cm and 32.34 ± 2.74 cm. Both male and female gender in both plains had a significant influence (P<0.05) on the chest width of buffalo buffaloes. This figure is lower than the results of research conducted by Abdullah, M. A. N., Tudung, M. G., and Eka, M. S. (2022) which obtained the average chest width of mud buffalo aged > 3 years for males and females in Central Aceh Regency of 48.44 ± 4.13 cm and 50.52 ± 4.83 cm. Research by Purohit, G et al (2019) regarding the morphological characteristics of Simeulue buffalo in Simeulue Regency, it was found that the average chest width of male and female buffalo was 37.32 ± 4.09 cm and 34.28 ± 2.34 cm. Komariah et al. (2015) the average chest width of male and female mud buffalo in the lowlands is 34.14 ± 4.78 cm and 38.32 ± 4.59 cm, while in the highlands it is 54.71 ± 5.82 cm and 65.60 ± 11 .04 cm.

The average chest width of female buffalo is higher than the chest width of male buffalo both on the coastal plain and on the undulating plain. Buffaloes on the coastal plains have a higher average chest width than those on the undulating plains.

Chest Width

Based on the results of research with 100 male buffaloes on the coastal plains and 100 female buffaloes on the undulating plains of West Aceh Regency, the average chest circumference results were obtained which are shown in Table 1. In Table 1 it can be seen that the average chest circumference of male buffalo buffaloes in the coastal and undulating plains were 159.66 ± 23.89 cm and 167.60 ± 12.09 cm, while the average chest circumference of female buffalo on the coastal and undulating plains was 154.66 ± 23.89 cm and 163.60 ±12.09 cm. Both male and female gender in both plains had a significant influence (P<0.05) on the chest circumference of buffalo buffaloes. According to the National Standardization Agency (2011), the quantitative requirements for male and female mud buffalo aged > 36 months are for an average chest circumference of 190 cm and 170 cm for males and females. Komariah et al. (2015) the average chest circumference of male and female mud buffalo in the lowlands is 167.29 ± 14.45 cm and 185.41 ± 16.21 cm, while in the highlands it is 163.07 ± 11.98 cm and 184.67 ± 13.44 cm.

The average chest circumference of males is higher than the chest circumference of females both on coastal plains and undulating plains. The average chest girth of buffalo on the coastal plains is lower than on the undulating plains. This is because buffalo in West Aceh Regency are only occasionally given additional feed and the management is not good, the livestock are only left to graze. However, the quantity and quality of forage on undulating plains is better than on coastal plains. According to Nuriyasa, I. M., Dewi, G. A. M. K., and Yuspardi, W. S. (2016) external factors that cause a stop or decrease in the average body height of female swamp buffalo are feed nutrition and inappropriate maintenance management. Differences in linear body sizes found between buffalo populations are principally caused by the influence of genetic, environmental factors and interactions between the two.

Hip Width

Based on Table 1, it can be seen that the average hip width of male buffalo on the coastal and undulating plains is 47.07 ± 4.06 cm and 38.25 ± 4.17 cm, while the average hip width of female buffalo on the coastal plain and wavy of 52.57 ± 4.14 cm and 43.75 ± 4.25 cm. Both male and female gender in both plains had a significant influence (P<0.05) on the hip width of buffalo buffaloes. This figure is lower than the results of research conducted by Komariah, K. Santoso, and C. I. L. Siahaan (2019) which obtained an average hip width of

mud buffalo of 51.52 ± 1.74. Komariah et al. (2015) the average hip width of male and female mud buffalo in the lowlands is 41.00 ± 4.20 cm and 47.68 ± 6.79, while in the highlands it is 59.50 ± 6.03 cm and 72.27 ± 11 .14 cm.

The average hip width of females is higher than the hip width of males both on coastal plains and undulating plains. The average hip width of buffalo on the coastal plain is higher than on the undulating plain. Female buffalo experience the growth of reproductive organs in the hips so it is clear that female mud buffalo have larger hip widths compared to male mud buffalo because female mud buffalo give birth to calves (Komariah et al., 2019).

Body Weight

Based on Table 1, it can be seen that the average body weight of male buffalo on the coastal and undulating plains is 178.94 ± 41.09 kg and 201.38 ± 35.79 kg, while the average body weight of female buffalo is 159. 12±38.53 kg and 181.50±34.28 kg. This figure is lower than the standard body weight required by the National Standardization Agency. According to the National Standardization Agency (2011), the quantitative requirements for male and female mud buffalo are > 36 months old for an average body weight of males and females of 350 kg and 250 kg. Pipiana et al. (2010), the average body weight of female buffalo on Moa Island, Maluku aged > 3 years was 53.45 ± 30.79 kg. Komariah et al. (2015) the average body weight of male and female mud buffalo in the lowlands was 295.71 ± 65.14 kg and 352.68 ± 79.79 kg, while in the highlands it was 359.93 ± 59.43 kg and 509.67 ±79.37 kg. The factors that cause variations in buffalo size are the agroecosystem which is related to the feed and external environment (temperature and humidity) as well as social culture.

Both male and female gender in both plains had a significant influence ($P<0.05$) on the body weight of buffalo. Differences in terrain can affect the body weight of buffalo both male and female in West Aceh Regency. The body weight of male buffalo is heavier than the body weight of females on the two plains. The body weight of buffalo on the coastal plain is lower than the body weight of buffalo on the undulating plain. This is because the quality and availability of forage on coastal plains is lower than on undulating plains. The air temperature on the coastal plain is higher than on the undulating plain, this influences the response of the livestock's body to adapt to its environment. This is reinforced by the opinion that the activity and environmental conditions of livestock determine the response of an animal's body to adapt. The physiological function of livestock can influence the growth rate of the livestock itself. That high THI influences the body's growth process more slowly. This is due to heat stress in the buffalo's body. Buffalo feed consumption in Egypt decreased to 9.5 kg/day due to heat stress. Reducing feed consumption results in a decrease in body weight gain in buffalo.

Reproductive Performance of Buffalo

Descriptive statistical study data on buffalo breeders in West Aceh were obtained from study data. From descriptive statistics, the result data obtained from research data includes (amount of data obtained), mean, median and standard deviation. These variables include animal age, age at first mating, age at first calving, calving interval, length of pregnancy, and reproductive efficiency as shown in Table 2.

Table 2. Average Reproductive Performance of Buffalo in West Aceh Regency.

Reproductive Performance	Lands Area (Mean±SD)	
	Coastal	Hilly
Age of Buffalo (month)	71,06±0,94	78,07±1,07
First Mating Age (month)	29,15±2,02b	30,74±2,27a
First Calving Age (month)	42,16±1,85	42,68±2,13
Calving Interval (month)	18,28±2,22	17,90±2,13
Gestation Period (month)	10,48±0,50	10,44±0,50
ER (%)	88,07±6,04a	92,39±4,42b
Number of Birth (%)	58,10±20,56	62,39±25,18
Mortality (%)	9,17±25,77	15,00±33,88

Description: Data processing results (2023). Different superscripts on the same row indicate a significant effect (P<0.05).

Age of Buffalo

The results of the research questionnaire distributed to 100 samples of buffalo breeders in West Aceh Regency obtained statistical data on the age of buffalo which can be described in Table 2 . It can be seen that the average age of buffalo on the coastal plain is 71.06 ± 0.94 months and on the undulating plain. amounting to 78.07 ± 4.42 months. According to Murti (2007), the productive age of beef buffaloes in tropical areas is 2.5 to 13 years in terms of the age at first mating, namely 2.5 years, up to the highest limit of marriage age for prospective seeds, which is 13 years. Kementerian Pertanian (2006) the special requirements for quality standards for female mud buffalo seeds are 18 – 36 months old. Specifications for breeding buffalo are 36 – 60 months old (Kementerian Pertanian, 2019).

First Mating Age

The research results obtained from 100 sample data of buffalo breeders in West Aceh Regency obtained the results of the average age of first marriage which can be described in Table 1. It can be seen that the average age of first marriage of buffalo in West Aceh Regency on the coastal plain is 29.15 ± 2.02 month while the undulating plain is 30.74 ± 2.27 month. The results of this research are faster than the Gaddi mud buffalo in Nepal, namely at the age of 48.49 months (Adhikari and Sharma, 2018). The research results of Komariah et al. (2015) obtained results that the average age at first mating of female mud buffalo in the lowlands was 29.80 ± 8.6 months and in the highlands was 24.5 ± 4.26 months. Mauliaksa (2013) found that the average age at first mating for female swamp buffalo was 31.55 months. Nardi et al., (2017) found that the age at first mating of female buffalo was 37.11 ± 0.65 months on average.

The difference between coastal and undulating plains has a significant influence (P<0.05) on the age of first mating of buffalo. The age of first marriage on coastal plains tends to be faster than on undulating plains. This is possibly because buffalo owned by breeders on the coastal plains are more controlled in terms of management. Maintenance management can include providing food and drink, administering vaccines and medicines, mating, cleaning manure, and biosecurity. The age of first marriage between the two plains is still in good condition. This is supported by the statement of Kalasariya (2012) which states that good rearing management will influence the age of first mating in buffalo. Meanwhile, according to Cruz and Borghese (2013), the main problems which are considered as limiting factors in the development of buffalo livestock include, buffalo livestock are slow to reproduce due to

low reproductive power, uncontrolled mating management of buffalo livestock, and the difficulty of providing superior males which are obstacles. in increasing population.

First Calving Age

Based on Table 1, it can be seen that the average (mean) first calving for buffalo in West Aceh Regency on the coastal plain is 42.16 ± 1.85 months, while on the undulating plain it is 42.68 ± 2.13 months. According to the Ministry of Agriculture (2014), the first calving age for Simeulue buffalo is around 2.7-2.9 years, while according to Suhendro et al., (2013), the first calving age for swamp buffalo is around 42 months. The research results of Komariah et al. (2015) obtained results that the average age at first calving of female mud buffalo in the lowlands was 41.00 ± 8.8 months and in the highlands was 36.70 ± 5.87 months. The age at first birth of buffalo in research in wet and dry land in the 1-5 year age group was 39.00 ± 8.49 months and 29.30 ± 28.38 months.

The difference between coastal and undulating plains did not have a significant effect (P>0.05) on the age of first calving in buffalo. The age at first calving between the two plains is not much different, the age at first calving on the coastal plain is faster than on the undulating plain. This is because the first mating age for buffalo on the coastal plains is faster than on the undulating plains. According to Komariah et al. (2019) the age at first giving birth is influenced by the age at which buffalo first mate. The age at first calving is influenced by many factors such as maintenance management, feed, and others. This is supported by the statement of Pipiana et al. (2010) who said that mud buffalo in Southeast Asia generally experience their first birth later than other livestock. This is caused by management factors and feed which is still of low quality. Longer ages at first calving can occur if puberty is late, this is a limiting factor in reproductive efficiency and productivity in buffalo (Darweish et al., 2016).

Calving Interval

The calving interval is the time period from when the mother gives birth to the next time she gives birth. The calving distance is influenced by the first heat after giving birth and the length of pregnancy. The longer the first heat appears after giving birth, the longer the calving distance will be and economically a short calving distance will benefit buffalo breeders.

The average calving distance obtained from research on buffalo livestock in West Aceh Regency on the coastal plain was 18.28 ± 2.22 months, while on undulating plains it was 17.90 ± 2.13 months. The research results of Abdullah et al., (2022) showed that the average calving distance for Gayo buffalo in Mesidah District, Bener Meriah Regency was 15.50 ± 0.71 months, while Suhendro et al., (2013) in their research, the average distance mud buffalo calving in Malang Regency is 16.6 ± 0.7 months. The results of Seto's research (2017) showed that the average calving distance for female mud buffalo in different environmental conditions, namely the medium plains was 16.30 ± 3.80 months and the highlands was 14.30 ± 1.80 months. The results of research by Komariah et al., (2019) showed that the birth interval (internal calving) of buffalo in research in wet and dry land in the 6-10 age group was 24.10 ± 10.39 and 15.67 ± 6.55 months.

The difference between coastal and undulating plains did not have a significant influence (P>0.05) on buffalo calving distance. The calving distance between the two plains is not much different, the calving distance on the undulating plain is faster than the calving distance on the coastal plain. This is because the type and nutrition of food on undulating plains is better than on coastal plains. This is in accordance with the statement of Siregar (2012), the

use of feed and good maintenance management will influence the age at first mating and the length of pregnancy for buffalo buffaloes. Apart from that, the low calving interval is influenced by feed factors, buffalo are only grazed without being given additional feed such as concentrates. Parlato and Zicarelli (2016) stated that extensive rearing of buffalo will affect the length of the calving interval and if maintained well, the calving interval can reach 11 to 12 months. Weaning time for calves can also affect calving intervals in buffalo. The initial separation of buffalo calves from their mothers aims to speed up re-mating after giving birth (Abdullah et al., 2022).

Gestation Period

The duration of pregnancy is the number of days between the last marriage and the birth of the child. The average length of pregnancy obtained from research on buffalo livestock in West Aceh Regency on the coastal plain was 10.48 ± 0.50 months, while on the undulating plain it was 10.44 ± 0.50 months. According to the Ministry of Agriculture (2014), the gestation period for female Simeulue buffalo is around 310-325 days (10-11 months). The research results of Samsuandi et al. (2016) the gestation period for female mud buffalo in West Simeulue District, Simeulue Regency is 310-330 days or an average of 10 – 11 months. Komariah et al. (2015) found that the duration of pregnancy for female buffalo in the lowlands was 11.09 ± 0.21 months and in the highlands 11.6 ± 8.31 months.

The difference between coastal and undulating plains did not have a significant effect ($P>0.05$) on the duration of gestation for buffalo buffaloes. The duration of gestation between the two plains does not differ much, the duration of gestation for buffalo on the undulating plains is faster than on the coastal plains. This is because the quality of food and environment on undulating plains is better than on coastal plains. This is in accordance with the statement of Siregar (2012), the use of feed and good maintenance management will influence the age at first mating and the length of pregnancy for buffalo buffaloes. Apart from that, the low calving interval is influenced by feed factors, buffalo are only grazed without being given additional feed such as concentrates. Komariah et al., (2019), that differences in gestation duration in buffalo may be due to differences in rearing location and age of the livestock. According to Purohit et al. (2019) maintenance management, feed, climate, genetics and the sex of the fetus cause differences in the length of pregnancy in buffalo. Mothers who contain female fetuses have a faster gestation period compared to male fetuses.

Reproductive Efficiency of Buffalo in West Aceh Regency

Reproductive efficiency is a measure of an animal's ability to become pregnant and produce offspring. Based on Table 2, it is known that the average reproductive efficiency of buffalo on the coastal plains in West Aceh Regency is 88.07 ± 6.04% and on undulating plains 92.39 ± 4.42%. The research results of Pipiana et al. (2010) found that the average reproductive efficiency of female buffalo on Moa Island, Maluku was 70.91 ± 8.67%. Research by Mauliaksa (2013) obtained results that the average reproductive efficiency of swamp buffalo in Tempursari District, Lumajang Regency was 75.41 ± 5.04%.

The reproductive efficiency of buffalo in the coastal plains and undulating plains gave significant results ($P<0.05$). The reproductive efficiency of buffalo on undulating plains is higher than on coastal plains. This is because the type, quantity and quality of food on the undulating plains is better than on the coastal plains, although in terms of management it is better on the coastal plains. The forage on the undulating plains is more diverse than on the plains. Apart from that, the low reproductive efficiency on the coastal plains is due to high

air temperatures which can cause physiological changes in female buffalo. This is in accordance with the statement of Nuriyasa et al. (2016), which states that livestock will respond with further responses in the form of changes in hormonal, enzymatic and metabolic systems which can cause livestock to experience various disease symptoms accompanied by low production and reproductive efficiency. Reproductive efficiency in plains < 200 meters above sea level is higher because food is more available and can meet nutritional needs to support life's needs, especially for reproduction (Mauliaksa, 2013).

The duration of weaning of gudel also influences the reproductive efficiency of buffalo. The longer the age at weaning, the more inefficient the reproductive performance becomes (Pipiana et al., 2010). Hardjosubroto (1994) stated that swamp buffalo mothers have a reproductive efficiency value of less than 100% if the calving interval is more than 14 months and vice versa, if it is less than 14 months, the reproductive efficiency value will be more than 100%.

Number of Birth

The birth rate of buffalo is the number of buffalo born in one year. The birth percentage is calculated from the total number of cubs born divided by the percentage of adult females (Komariah et al., 2014). The birth rate of buffalo in the coastal plains has an average of 58.10 ± 20.56%, while in the undulating plains the average is 62.39 ± 25.18. The difference between the two plains does not have a significant effect on the birth rate of buffalo. The research results of Komariah et al. (2014) obtained results that the average birth rate for swamp buffalo in Rawa Muntai District, Kutai Kartanegara Regency, East Kalimantan was 75%. According to Marsudi et al., (2017), the average birth rate of buffalo to mothers is 36.84%.

The difference between coastal and undulating plains did not have a significant effect (P>0.05) on the birth rate of buffalo. The birth rate in this study could be said to be quite high, compared to the average percentage of births of buffalo calves in Indonesia, namely 54.69%. The factor that influences the percentage of births is the success of mating between males and females (Samsuandi and Abdullah, 2016).

Mortality

Buffalo mortality is the number of children who die divided by the number of children born in one year. Buffalo mortality on the coastal plains has an average of 9.17 ± 25.77%, while on the undulating plains the average has an average of 15.00 ± 33.88%. The difference between the two plains does not have a significant effect on buffalo mortality. The research results of Komariah et al. (2014) obtained results that the average mortality of swamp buffalo in Rawa Muntai District, Kutai Kartanegara Regency, East Kalimantan was 11%. The results of Ikun's (2018) research in Biboki Anleu District, North Central Timor Regency, showed that the average death rate for gudel was 18.8%. This is caused by being infected with a certain disease which is characterized by hair standing up, the stomach becoming enlarged, and standing unsteadily.

The difference between coastal and undulating plains did not have a significant effect (P>0.05) on buffalo mortality. Mortality in this study is quite high compared to the mortality of buffalo in Indonesia, namely 7.38%, this is because buffalo calves are attacked by infectious diseases, especially foot and mouth disease (FMD), until now this disease can still be found in West Aceh Regency. According to Komariah et al. (2014), the death rate is influenced by diseases in livestock in the form of infectious diseases, which increase the death rate and cause large losses. Illness and disease affect the child's harvest, because it can

result in non-fertilization in the uterus, fetal death, death of the child both before and after giving birth. The child mortality rate at pre-weaning age is 11% (Komariah et al., 2014).

Physiological Response of Buffalo in West Aceh

Physiological response is an indicator to assess the stress level of livestock being kept. Based on the literature of Nuriyasa et al. (2016) which states that environmental changes such as increases in temperature, humidity, wind speed and solar intensity can influence the physiological response of livestock because livestock integrate environmental conditions and then respond adaptively through physiological changes which include changes in body temperature, heart rate and increased frequency. respiration. Physiological values are the basis for clinical examination of livestock. Healthy livestock is livestock whose physiological condition is normal, while sick livestock is characterized by changes in the physiological values of the livestock's body from normal (Suprayogi et al., 2017).
Based on the results of research with 200 buffalo buffaloes in West Aceh on two plains, namely the coastal plain and the undulating plain, it can be seen in Table 3.

Table 3. Rectal Temperature of Buffalo Buffaloes in West Aceh (ºC).

No.	Gender	Dataran	Mean±SD
1.	Male	Costal	37,96±0,34[a]
		Hilly	37,48±0,19[b]
2.	Female	Costal	38,52±0,45[a]
		Hilly	38,13±0,51[b]

Description: Data processing results (2023). Different superscripts in the same column indicate significant effects.

Table 3 shows that the average rectal temperature of male buffalo on the coastal and undulating plains is 37.96 ± 0.34ºC and 37.48 ± 0.19ºC, while the average rectal temperature of female buffalo on the plains coastal and wavy at 38.52±0.45ºC and 38.13±0.51ºC. The research results of Komariah et al. (2019) regarding the differences in the physiological responses of buffalo in wetlands and drylands, obtained an average rectal temperature for female buffaloes of 38.2 ± 0.9ºC in wetlands and 38.1 ± 1.8ºC in drylands. In the research of Khongdee et al. (2011), the average rectal temperature of swamp buffalo that were buried and not buried in Thailand was 39.21 ± 0.62 ºC and 39.82 ± 0.62 ºC. In Mauliaksa (2013) research, female buffalo had the same rectal temperature of 38.3 °C under normal conditions during the day with an environmental temperature of 25 ºC. The research results of Aggarwal and Upadhyay (2013) showed that exposure to acute heat (33 – 43 °C, 40 – 60% RH) in buffalo calves aged 6 and 12 months caused a significant increase in rectal temperature, namely 3.4% and 3. 2%.

The difference between coastal plains and undulating plains in West Aceh Regency has a significant influence (P<0.05) on the rectal temperature of buffalo buffaloes. This is due to the temperature difference between the two plains, both the coastal plain and the undulating plain. Coastal plains tend to have higher temperatures than temperatures on undulating plains. This statement is in accordance with the literature (Windusari et al., 2018), which states that temperatures below 22°C and above 33°C apart from abnormal homeostatic processes, physiologically buffalo must adapt, which will have an impact on growth and reproductive efficiency. The ideal environmental temperature for buffalo is between 16–24ºC, with a maximum tolerance of 27.6ºC (Matondang, 2015). According to Recee et al., (2015) an increase in rectal temperature is caused by heat resulting from metabolism in the

body. The increase in female buffalo's rectal temperature is due to an increase in environmental temperature during the day and exposure to direct sunlight which causes the female buffalo to experience an increase in body temperature.

Temperature greatly influences buffalo in carrying out their activities, buffalo tend to prefer to soak rather than take shelter under trees. This is because when a buffalo stands under the hot sun, the animal's body can receive additional energy (heat) from radiation that is greater than the energy (heat) emitted by its body. If the air temperature is higher than the buffalo's body surface temperature, heat will be added to the buffalo by convection, but if the air temperature is lower than the buffalo's body surface temperature, the buffalo's body will lose heat. Buffaloes have less physiological adaptations than various breeds of buffaloes to hot and cold temperatures. The body temperature of a buffalo is lower than that of a cow, but buffalo skin is black so it easily absorbs heat and is rarely protected by hair. In addition, buffalo skin has one-sixth the density of sweat glands than cow skin, so buffalo overcome the heat by sweating. If they work or are pushed excessively under the hot sun, the buffalo's body temperature, pulse rate and respiration rate will be faster than cows (Windusari et al. , 2018). The behavior of buffalo during the day is to look for a place to wallow and take shelter to balance the heat in the body. Buffaloes have adaptive behavioral characteristics when their body temperature increases, such as seeking shelter, wallowing in mud, and/or submerging themselves in water (Brijesh, 2016).

The environment can have a direct and indirect effect on livestock. Climate, such as temperature and humidity, will significantly influence the physiological responses of livestock, such as rectal temperature, respiratory frequency and heart rate. This is in accordance with the statement from Atrian and Shahryar (2012) which states that environmental changes such as increases in temperature, humidity, wind speed and sun intensity can influence the physiological response of livestock because livestock integrate environmental conditions and then respond adaptively through physiological changes which include changes in temperature. body, heart rate, and increased respiratory rate. These also affects the quality of swamp buffalo meat. It also directly affects the income of swamp buffalo breeders. These also affects the quality of swamp buffalo meat. It also directly affects the income of swamp buffalo breeders.

CONCLUSION

1. Quantitative traits such as body length, chest width, chest depth, chest circumference, pelvic width, hip width, rump width, and body weight are influenced ($P<0.05$) by different plain conditions.
2. The difference between coastal and undulating plains has a significant influence ($P<0.05$) on reproductive performance in terms of age at first mating and reproductive efficiency. The reproductive performance of female swamp buffalo in the coastal plains tends to be faster based on variables: age at first mating (29.15 ± 2.02 months) and age at first calving (42.16 ± 1.85 months). The reproductive performance of buffalo on undulating plains tends to be faster in the variables of calving distance (17.90 ± 2.13 months), duration of pregnancy (10.44 ± 0.50 months), and reproductive efficiency (92.39 ± 4.42 %), birth rate (62.39 ± 25.18%), mortality (15.06 ± 33.88%) were higher.
3. The difference between coastal and undulating plains has a significant influence ($P<0.05$) on the physiological response of buffalo. The average rectal temperature of male and female buffalo (37.96 ± 0.34 and 38.52 ± 0.45oC) on the coastal plain was higher than on the undulating plain.

4. The difference between coastal and undulating plains has also influence on the income of swamp cattle breeders in West Aceh.

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