ISSN: 0852-3681
E-ISSN: 2443-0765

Jurnal Ilmu-Ilmu Peternakan 32(3): 328 – 339
Available online at http://jiip.ub.ac.id

The Correlation of Microclimate on Milk Productivity and Lactation Percentage of Friesian Holstein Dairy Cattle in Balai Pengembangan Ternak Sapi Perah Hijauan Pakan Ternak (BPTSP HPT) Cikole

Muhammad Dimas Rachmawanto*[1)], Afton Atabany[2)] and Bagus Priyo Purwanto[3)]

[1)]Sekolah Pascasarjana, Departemen Produksi dan Teknologi Peternakan
Jl. Agatis, Kampus Dramaga, Bogor 16680
[2)]Departemen Produksi dan Teknologi Peternakan, Fakultas Peternakan
Jl. Agatis, Kampus Dramaga, Bogor 16680
[3)]Sekolah Vokasi, Institut Pertanian Bogor
Jl. Kumbang No. 14 Bogor 16151

Submitted: 10 February 2021, Accepted: 6 December 2022

ABSTRACT: External and internal factors can affect the body of livestock. External factors consist of climate, offering feed, and maintenance management. Internal factors include the biological aspects of lactating dairy. This research was conducted to see the microclimate relationship between milk production and the proportion of lactation. This study aims to identify and evaluate Friesian Holstein dairy cattle productivity based on the microclimate in BPTSP HPT Cikole. This study used the survey method to obtain secondary data. The regression and correlation test was used to analyze data. Results showed 111 Holstein dairy cattle productivity based on the amount of milk, and lactation proportion fluctuated from 2017 to 2019. Based on regression analysis showed a significant effect between temperature and precipitation on the proportion of lactation with R^2 values of 46,74% and 78,08%. The regression results and the impact of microclimate in general on milk production had no significant effect. It was proven that BPTSP HPT Cikole was successful in overcoming the effects of microclimate changes. In conclusion, that temperature, humidity, precipitation, and THI do not affect the production of Friesian Holstein cow's milk at BPTSP HPT Cikole. Based on the regression analysis results, precipitation significantly affects the proportion of lactation with an R^2 value of 78.08%.

Keywords: *Fresian holstein*; Microclimate; Milk production; Lactate percentage

*Corresponding Author: mdrachmawanto@gmail.com

DOI: 10.21776/ub.jiip.2022.032.03.03

INTRODUCTION

Dairy cattle milk production in Indonesia has not yet been able to meet the national milk needs because it can only meet about 23%, thus importing milk as much as 77% (BPS, 2019). Data Ditjen PKH (2018) shows that fresh milk produced by FH cattle with cultivation in Indonesia is partly centered on the island of Java. The largest FH cattle population is in the Provinces of East Java (283,311 heads), Central Java (134,721 heads), and West Java (119,349 heads) of the national population. These data show that the national dairy cattle population is still concentrated in Java, which is 97.87%, so the dairy cattle population outside Java is only around 2.13%.

Dairy cattle will produce well in comfortable environmental conditions, with the maximum and minimum limit values of air temperature and relative humidity being in the comfort zone value, according to (Suherman et al., 2013). The appearance of FH dairy cattle production is a critical temperature value of 27ºC, while the ideal relative humidity is 55%. Nardone et al., (2010) added that Dairy cattle outside the zone would experience heat stress which will cause a decrease in milk production and quality. Atrian and Shahryar (2012) state that cows experiencing heat stress will reduce milk production by 0.6 to 1.4 kg every time the air temperature increases by 1ºC. FH cattle are required to adapt to achieve high productivity so that they can approach and even match the productivity of FH cattle in their country of origin. Management factors significantly affect livestock productivity. Poor management can cause dairy cattle productivity to decrease and vice versa. If management treatment is appropriately regulated, it will be followed by high productivity.

The tropical climate in Indonesia is the biggest challenge in optimizing milk production. Indonesia is a tropical country that has fluctuating environmental temperature and humidity conditions. The ecological temperature becomes slightly lower, and the humidity becomes higher when entering the rainy season. The opposite happens when entering the dry season which the temperature will increase and the humidity will decrease. Temperature and humidity in the tropics are still much higher compared to the environment in temperate climates. The external environment is a factor that affects the livestock body from the outside, such as climate, feeding, and rearing management.

In contrast, the internal environment is the biological aspect of lactating cows. The evaluation of dairy cattle productivity based on milk production, lactation percentage, and microclimate at the Balai Pengembangan Ternak Sapi Perah dan Hijauan Pakan Ternak (BPTSP HPT) Cikole in 2017-2019 has not been carried out, so the aim of the research want to evaluate the microclimate relationship related to temperature, humidity, and precipitation. Precipitation on milk production and lactation percentage.

MATERIALS AND METHODS

This research was conducted in November 2020 at the Balai Pengembangan Ternak Sapi Perah dan Hijauan Pakan Ternak (BPTSP HPT), Lembang, Bandung Regency West, West Java. The materials in this study are dairy cattle population data, productivity records on milk production, namely monthly milk production, and FH dairy cattle raised from 2017 to 2019 at BPTSP HPT Cikole. Additional data used in this study were temperature, humidity, and precipitation from January 2017 to December 2019, which were obtained from the Balai Penelitian Tanaman dan Sayuran (Balitsa) Cikole, Lembang, West Java.

The data that has been collected will then be selected according to the needs of data processing. The processed data includes milk production, which is influenced by microclimate, and the percentage of lactation, which is influenced by a microclimate. Determination of the season refers to BMKG with the stipulation that the start of the rainy season is based on the amount of precipitation in one basis (10 days) equal to or more than 50 mm followed by the following basis, while for the dry season in one basis (10 days) less than 50 mm followed by several subsequent bases.

The data processing method uses descriptive analysis, regression, and correlation. Regression analysis was used to determine the relationship between two or more variables based on the microclimate on milk production and lactation percentage. Correlation analysis was used to determine the form of the relationship between the microclimate on milk production and the rate of lactation. The regression equation uses a mathematical model according to Hijriani, Muludi, and Andini (2016) with the equation Y = a + bX, where Y is the dependent variable (predicted value), X is the independent variable, a is a constant and b is the regression coefficient. Correlation interpretation, according to Astuti (2017).

Table 1. Interpretation of correlation

Big r x y	Interpretation
0.00	There is no correlation between variables
0.01 – 0.20	The relationship between correlation variables is very weak
0.21 – 0.40	The relationship between the correlation variables is weak
0.41 – 0.70	The relationship between the correlation variables is moderate
0.71 – 0.99	The relationship between the correlation variables is strong
1.00	The relationship between variables is a perfect correlation

RESULT AND DISCUSSION

Microclimate conditions of the research site

The environment is a factor that can directly affect the productivity of dairy cattle. The genetic superiority of an animal cannot be visualized optimally if environmental factors are not appropriate. One of the environmental factors that often becomes an obstacle to the genetic expression of an animal is the microenvironment (Suherman et al., 2013). Indonesia is a tropical country with two seasons, namely the rainy and the dry seasons, and has a variety of average microclimate conditions. The importance of environmental conditions affecting the productivity of dairy cattle is summarized in Table 2.

The average environmental temperature from 2017 to 2019 was 19.9°C, 20.3°C, and 22.6°C, while the average humidity was 86.9%, 86.9%, and 88.4%. The precipitation that occurred in the same year was 165.3 mm/month, 140.9 mm/month, and 99.3 mm/month, respectively. The average environmental temperature (Ta), humidity (RH), and precipitation (CH) in the last three years have different values.

The descriptive analysis results show that the ambient temperature in the Cikole Lembang area increases yearly, followed by an increase in humidity, but precipitation tends to decrease. The microclimate conditions at BPTSP HPT Cikole have a number that is fairly comfortable for Friesian Holstein dairy cattle to live and produce milk because the temperature conditions are still in the range of 19-22 °C (Yani and Purwanto, 2006) even if the humidity conditions do not meet the set standards Berman (2005) which is below 55%.

These limiting factors cause livestock to make physiological and behavioral adjustments (Novianti, Purwanto, and Atabany 2013), so livestock productivity in tropical countries, especially Indonesia, is lower than in sub-tropical countries.

Table 2. The microclimate of the research site

Month	Temperature Air (°C)			Humidity Air (%)			Precipitation (mm/month)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Jan	18.7	19.9	19.8	86.0	86.0	86.0	56.0	107	141
Feb	20.2	20.4	20.4	84.0	87.0	87.0	222	104	68.0
Mar	20.9	20.4	20.1	88.0	88.0	88.0	380	268	264
April	20.9	20.3	18.4	88.0	87.0	87.0	159	211	338
May	20.9	20.3	19.06	88.0	88.0	92.0	16.5	141	53.5
Jun	19.0	19.8	20.2	83.0	83.0	88.0	81.0	53.5	0
Jul	19.4	20.5	19.2	86.0	86.0	88.0	29.5	0	0
Aug	19.9	20.3	27.1	88.0	87.0	88.0	0	0	0
Sep	19.7	20.8	26.9	87.0	90.0	90.0	62.5	13.5	0
Oct	19.7	20.3	26.5	88.0	87.0	88.0	410	63.5	72.5
Nov	19.6	20.5	27.1	88.0	87.0	89.0	463	453	114
Des	20.1	20.4	27.1	89.0	87.0	90.0	102	275	140
x	19.9	20.3	22.6	86.9	86.9	88.4	165.3	141	99.3

Source: Microclimate data of Balai Penelitian Tanaman Sayuran Cikole

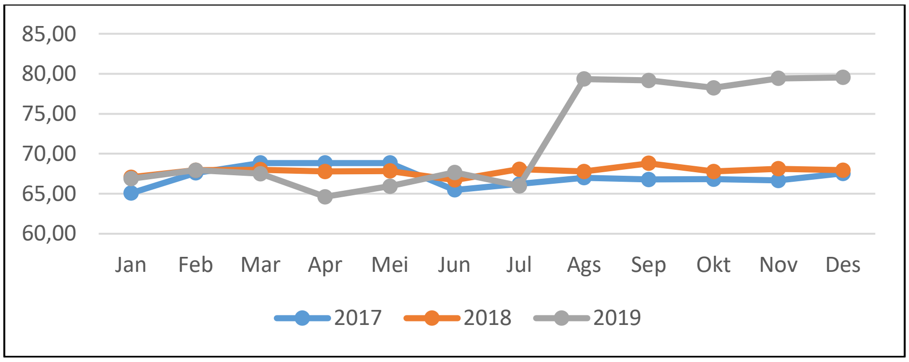

Figure 1. Temperature Humidity Index research location

Humidity at the study site is not a good condition for Friesian Holstein Dairy cattle. Still, the results of the THI calculation in Figure 1 using the formula THI = 0.8Tab + RH (Tab-14.4) + 46.4 (Bulitta, Aradom and Gebresenbet 2015) It is shown in this study that in general, the environmental conditions are comfortable and do not cause stress to livestock. Still, there was an increase in THI from August to December 2019, which caused the THI value to be above the comfort zone. In 2017, the THI number was 65.06-68.84. In 2018 it was 67.05-68.80, and in 2019, 64.60-79.56. The average THI value that was said to be comfortable was below 72. High THI causes increased salivary and respiratory production and decreased appetite (Novianti, Atabany, and Purwanto 2013).

Lactation percentage and milk production

The percentage of lactation in Table 3 was highest in 2017, then decreased in 2018, and increased in 2019. The rate of lactation cattle at BPTSP HPT Cikole shows a number that fluctuates every month. Lactation percentage is one of the important factors in dairy cattle production (Khotimah, 2011), the relatively low percentage of lactation has an impact on decreasing production, so the percentage of lactation must be increased because the farm is said to be in good condition if all the cattle are mature female cows with an ideal composition of 85% lactating cattle and 15% dry cage cattle (Priyanti et al. 2009). Anggraeni et al. (2008) a good composition of dairy cattle when the percentage of lactating cows is 60% of the cattle kept. The rate of lactating cows at BPTSP HPT Cikole is less than 50%, which means that 50% of cows are available to feed other cows. These results show that there are no advantages or disadvantages. Some of the approaches could be made in livestock efficiency so that milk productivity can be increased, one of which is regulating the reproduction of dairy cattle.

Cattle will produce more milk after giving birth (Enting et al., 1997) which is not easy because of the reproductive problems, especially since they have low pregnancy. Consequently, the length of empty time is getting longer, which causes the lactation time to increase (Sughiri, Hermawan, and Indrijani, 2015). Percentage of lactating cows Table 3 in BPTSP HPT Cikole shows a monthly number.

Table 3. Percentage of lactating and dry cattle

Month	2017			2018			2019		
	Lac	Dry	n	Lac	Dry	n	Lac	Dry	n
Jan	43.80	23.22	67.02	40,10	28.36	68.46	54.17	7.29	61.46
Feb	45.14	21.00	66.14	42.13	24.87	67	58,12	3.14	61.26
Mar	47.94	18.11	66.05	42.77	23.65	66.42	46.57	15.01	61.58
April	51.51	14.72	66.23	43.26	21.37	64.43	52.69	15.59	68.28
May	51.90	14.15	66.05	41.92	21.72	63.64	46.04	19.57	65.61
Jun	45.29	21.45	66.74	39.34	24.21	63.55	41.72	20.86	62.58
Jul	44.08	22.27	66.35	39.43	25.42	64.85	39.47	22.39	61.86
Aug	43.63	21.08	64.71	37.52	25.82	63.34	39.77	21.90	61.67
Sep	44.82	22.17	66.99	38.52	25,19	63.71	42.71	22.86	65.57
Oct	44.83	21.67	66.5	40.54	25.89	66.43	42.55	21.56	64.11
Nov	44.00	22.74	66.74	44.03	22.25	66.28	46.81	19.56	66.37
Des	40.87	26.44	67.31	43.83	20.76	64.59	46.81	19.56	66.37
x	**46.65**	**20.75**	**66,40**	**41.11**	**24.13**	**65.24**	**46.45**	**17.44**	**63.89**

Source: BPTSP HPT Cikole recording data
Information: - Lac: Lactation

Monthly milk production will describe the amount of production based on daily milk production. The combined average daily milk production in Table 4 at BPTSP HPT Cikole for three years is 12.32 liters per head per day. According to Makin and Suharwanto (2012), the total production of FH cattle in West Java produces milk production of 7-15 kg /day, which shows the daily milk production at BPTSP HPT Cikole is similar. Average daily total milk production in 2017 (12.81), 2018 (12.01), and 2019 (12.14) liters per head per day. Daily milk production per year does not change much, meaning that microclimate's effect on milk production (in 12 liters) has no significant impact. Suwarno and Mushawwir (2019) explained that the climatic factors of the livestock environment, especially the microclimate (temperature and humidity) became a limiting factor for dairy cattle productivity, very high temperatures or outside the dairy cattle comfort zone (15-22°C) would cause stress to physiological stress which resulted in increased the use of energy by livestock for the process of environmental adjustment so that it will have an impact on productivity.

Milk production per lactation period of dairy cattle that changes every month is influenced by various factors such as age at production, parity, genetics, length of lactation time, the intensity of milking, and the physiology of the cattle themselves. Milk production per lactation period of dairy cattle that changes every month is influenced by factors such as age at production, parity, genetics, and length of lactation time. Enting, et al. (1997) added that the livestock population, feed, season, maintenance management, and the farm environment would largely determine the milk production produced on a farm. Monthly and daily milk production is presented in Table 4.

Table 4. Average monthly and daily milk production in liters

Month	2017		n	2018		n	2019		n
Jan	37,654	14.63	83	33,703	13.26	82	41,847.52	12.98	104
Feb	31,348	13.02	86	31,142	13.40	83	40,435	13.01	111
Mar	34,976	12.54	90	31,835	12.08	85	33,619	12.05	90
April	33330	11.34	98	28,944	11.35	85	34,956	11.89	98
May	35,965	12.11	99	29,272	11.76	83	28.148	11.73	80
Jun	34,961	12.27	95	25,599	10.94	78	22,440	11.00	68
Jul	34,234	11.87	93	28,474	12.09	76	24,363.21	11.73	67
Aug	34,660	12.98	89	30,726	13.30	77	26,737.50	12.92	69
Sep	35.004	12.55	93	28,702	12.27	78	26,284,20	12.34	71
Oct	36,100	12.80	91	31,065	12.07	83	28155.75	12.11	75
Nov	37,773	12.15	89	30,907	10.84	95	28,463,70	12.01	79
Des	35,495	13.47	85	31,747	10.78	95	29,314.53	11.97	79
Average	**35.125**	**12.81**	**91**	**30.176**	**12.01**	**83**	**30,397**	**12.14**	**83**
Combined average daily milk production per head in three year								**12.32**	

Source: BPTSP HPT Cikole recording data

Microclimate relationship to daily milk production

The relationship between temperature and daily milk production Table 5 in 2017 has a regression equation Y = 26.150 – 0.670X with an R^2 value of 26% and no significant effect. This equation shows that when there is an increase in temperature in the cage environment, it will cause a decrease in milk production by 0.670 liters per head. Atrian and Shahryar (2012) mention that high environmental temperatures will cause heat to accumulate in the body of livestock. This results from the heat production process that is not balanced with the release of heat to the environment.

This impacts decreasing feed consumption, thereby increasing drinking water consumption, redistribution of blood flow, reduced immunity, and changes in endocrine function, causing a decrease in milk production (Marai et al., 2007). The R^2 value of 26% means that there are other factors of 74% that can affect milk production. The r value of 0.51 means that the close relationship between temperature and milk production is moderate. The regression equation between temperature and milk production in 2018 and 2019 has no significant effect. The 2018 regression equation is Y = 12.852 – 0.041X with R^2 0.0134%, which means that the effect of temperature on milk production is only 0.0134%, and 99.98% is another factor. The r-value of 0.01 is a fragile relationship. The regression equation in 2019 yields Y = 11.371 + 0.034X with R^2 4.8%, which means another effect on milk production is 95.2%, and the r-value 0.22 is a weak relationship. The results of the regression analysis between microclimate and milk production are presented in Table 5.

Regression analysis between humidity and daily milk production Table 5 in 2019 has a linear equation Y = 24,494 – 0.139X with R^2 14% and no significant effect. This equation means that every time there is an increase in humidity, milk production will decrease by 0.139 liters per head. The R^2 value of 14%

means that moisture has an effect on reducing milk production, and 86% is another factor that affects milk production. The r value of 0.38 means that the relationship between humidity and milk production is weak. The 2017 regression equation is Y = 10.391 + 0.027X with R^2 0.29%, which means the influence of other factors on milk production is 99.71%, and r value 0.05 is a very weak relationship. In 2018 the regression equation obtained was Y = 1.361 + 0.122X with R^2 4.45%, which influences milk production, and 95.55% other factors other than humidity affect milk production. The r-value of 0.21 is the level of a weak relationship.

Table 5. Microclimate relationship to daily milk production

	Interaction	Equality	R^2	r	P-val	Note
ta						
2017	Ta VS PSH	Y = 26.150 – 0.670X	26	0.51	0.08	tn
2018	Ta VS PSH	Y = 12,852 – 0.041X	0.0134	0.01	0.97	tn
2019	Ta VS PSH	Y = 11.371 + 0.034X	4.8	0.22	0.49	tn
Combined	Ta VS PSH	Y = 12.870 – 0.026X	0.54	0.07	0.66	tn
RH						
2017	RH VS PSH	Y = 10.391 + 0.027X	0.29	0.05	0.86	tn
2018	RH VS PSH	Y = 1.361 + 0.122X	4.45	0.21	0.51	tn
2019	RH VS PSH	Y = 24,494 – 0.139X	14	0.38	0.22	tn
Combined	RH VS PSH	Y = 14.385 – 0.023X	0.22	0.04	0.78	tn
CH						
2017	CH VS PSH	Y = 12,593 + 0.0013X	5.3	0.23	0.46	tn
2018	CH VS PSH	Y = 12,548 – 0.003X	31	0.55	0.06	tn
2019	CH VS PSH	Y = 12,143 + 0.0009X	0.0003	0.001	0.99	tn
Combined	CH VS PSH	Y = 12.356 – 0.0002X	0.15	0.03	0.81	tn
THI						
2017	THI VS PSH	Y = 37,363 – 0.365X	14	0.49	0.10	tn
2018	THI VS PSH	Y = 8.720 + 0.048X	0.07	0.02	0.93	tn
2019	THI VS PSH	Y = 10,749 + 0.019X	4.55	0.21	0.50	tn
Combined	THI VS PSH	Y = 13.369 – 0.015X	0.53	0.07	0.67	tn

Information:
- PSH (daily milk production)
- P-val (regression test level 5%)
- tn (no significant effect) (P>0.05)

Based on the regression analysis results, the relationship between precipitation and daily milk production Table 5 in 2018 has a linear equation Y = 12,548 – 0.003X with R^2 30% and no significant effect. This means that every time there is an increase in precipitation in a livestock area, it will reduce milk production by 0.003 liters per head. The R^2 value of 30% means that the decrease in milk production is influenced by precipitation, and 70% is another factor. The r-value of 0.55 indicates a moderate correlation between precipitation and daily milk production.

The regression equation between precipitation and milk production in 2017 and 2019 has no significant effect, but the increase in precipitation in that year causes daily milk production to increase. The 2017 regression analysis is Y = 12,593 + 0.0013X with an R^2 value of 5.3%, which means that the effect of 2017 precipitation on milk production is only 5.3%, and many other factors are 94.7%, the r-value of 0.23 is the level of a weak relationship. In 2019 the regression equation Y = 12.143 + 0.0009X with R^2 0.0003% showed that the effect of precipitation on milk production that year was minimal and mainly influenced by other factors. The r value of 0.001 is a very weak relationship.

The THI value (Figure 1) from August to December 2019 showed a high number of around 79%. This figure increased compared to August to December 2017 and 2018. The increase in the THI value caused daily milk production (August-December 2019) to experience a decrease compared to 2017. The average daily milk production from August to December 2017, 2018, and 2019 was 13.19 liters, 11.85 liters, and 12.27 liters per head. West (2003) states that an increase in heat load caused by a combination of temperature and humidity can increase body temperature and respiration frequency, resulting in reduced feed consumption and milk production. Regression analysis between THI and milk production in 2017 obtained a regression equation Y = 37,363 – 0.365X with an R^2 value of 14% and no significant effect. This shows that every increase in THI will reduce milk production by 0.365 liters per head. The R^2 value of 14% is the effect of THI on the decrease in milk production; the other 86% is another factor.

The r value of 0.49 explains the weak relationship between THI and milk production. The results of the 2018 and 2019 regression analyses have no significant effect. The regression equation for 2018 is Y = 8.720 + 0.048X with R^2 0.07%, which indicates that the impact of THI in that year is 0.07%, and 99.93% is another factor. The r-value of 0.02 is a very weak relationship. In 2019 the THI regression equation with milk production was Y = 10.749 + 0.019X with R^2 4.55% meaning the effect is very small, so 95.45% is another influential factor. The closeness of the relationship in 2018 is weak because the r value is only 0.21. An increase in daily milk production accompanied the rise in THI in 2018 and 2019. Although the effect was minimal, this indicates an improvement in maintenance at BPTSP HPT Cikole. Based on the results of microclimate analysis of daily milk production (Table 5), the results are mixed, there are times when there are positive results, which means there is an increase in production in a certain year, but there are also negative results, which means there is a decrease in milk production. Those results showed that the reduction in milk production means that the increase in milk production has only a slight effect on the microclimate. Still, the reduction in milk production due to the microclimate is more significant. The results of the regression and correlation of the effect of microclimate in general on milk production did not have a significant effect, so it can be concluded that BPTSP HPT Cikole can cope with changes in microclimate on livestock productivity to maintain milk production (within 12 liters per head per day).

The relationship of a microclimate to the percentage of lactation

The results of the regression analysis of the microclimate relationship to the rate of lactation are presented in Table 6.

The relationship between temperature and lactation percentage Table 6 in 2017 has a regression equation Y = -15.37 + 3.06X with an R^2 value of 46.74% and has a significant effect. The equation shows that a decrease in temperature in the environment will cause an increase in the percentage of livestock lactation. The R^2 value of 46.74% is the effect of temperature on the lactation rate, and 53.26% is another factor. The r value of 0.68 means that the close relationship between temperature and the percentage of lactation is sufficient. The regression equation between temperature and lactation percentage in 2018 and 2019 has no significant effect. The 2018 regression equation is Y = 20.35 + 1.02X with R^2 1.53%, which means the impact is minimal, and the r value 0.12 is a close relationship with very weak. In 2019 the resulting regression equation was Y = 59.84 – 0.591X with R^2 14.89%, which means that the effect of temperature on the percentage of lactation is 14.89% and 85.11% of other factors, the r-value of 0.38 means the level of relationship the weak.

DOI: 10.21776/ub.jiip.2022.032.03.03

Table 6. Relationship of a microclimate to the percentage of lactation

	Interaction	Equality	R^2	r	P-val	Note.
Ta						
2017	Ta VS %LAK	Y = -15.37 + 3.06X	46.74	0.68	0.01	n
2018	Ta VS %LAK	Y = 20.35 + 1.02X	1.53	0.12	0.70	tn
2019	Ta VS %LAK	Y = 59.84 – 0.591X	14.89	0.38	0.21	tn
Combined	Ta VS %LAK	Y = 46.86 – 0.11X	0.41	0.06	0.71	tn
RH						
2017	RH VS %LAK	Y = 29.84 + 0.18X	1.05	0.1	0.75	tn
2018	RH VS %LAK	Y = 27.73 + 0.153X	1.32	0.11	0.72	tn
2019	RH VS %LAK	Y = 172.94 – 1.430X	15.58	0.39	0.20	tn
Combined	RH VS %LAK	Y = 39.26 + 0.05X	0.05	0.022	0.89	tn
CH						
2017	CH VS %LAK	Y = 45.66 – 0.01X	0.0025	0.005	0.98	tn
2018	CH VS %LAK	Y = 39.15 + 0.013X	78.08	0.88	<0.01	Sn
2019	CH VS %LAK	Y = 43.56 + 0.029X	29.18	0.54	0.07	tn
Combined	CH VS %LAK	Y = 43.18 + 0.009X	7.31	0.27	0.11	tn
THI						
2017	THI VS %LAK	Y = -69.03 + 1.70X	44.04	0.66	0.02	n
2018	THI VS %LAK	Y = 6.98 + 0.50X	1.44	0.12	0.70	tn
2019	THI VS %LAK	Y = 71.64 – 0.385X	15.07	0.38	0.21	tn
Combined	THI VS %LAK	Y = 48.9975 – 0.06X	0.38	0.06	0.72	tn

Information:
- P-val (regression test level 5%)
- tn (no significant effect) (P>0.05)
- n (significantly significant) (P<0.05)
- Sn (very significant effect) (P<0.01)

The relationship between humidity and lactation percentage Table 6 in 2019 has the equation Y = 172.94 – 1.430X with an R^2 value of 15.58% and has no significant effect. This has a negative relationship because every time there is an increase in humidity, it will inhibit the rise in the percentage of lactation by 1.430%. The effect of humidity on the rate of lactation based on R^2 is 15.58%, and other factors affecting the lactation percentage are 84.42%. At the same time, the r-value of 0.39 explains a weak relationship between humidity and the lactation rate. The 2017 and 2018 regression equations have no significant effect, and the results of the regression equations are Y = 29.84 + 0.18X with an R^2 value of 1.05 and an r-value of 0.1, in 2018 Y = 27.73 + 0.153X with an R^2 1.32% and r 0.11.

Environmental factors, which include temperature, humidity, and dairy farming management, have a significant effect on reproductive efficiency, and this is because temperature and humidity also participate in stress levels in livestock (West, 2003). The effect of heat stress will be at risk of decreasing the conception rate (CR) and having an effect on fertility (Schüller et al. 2016), reducing embryo development and threatening embryo viability (El-Wishy, 2013). Another effect is the effect on metabolism to release heat in the body for cooling to occur, and this will make Dairy cattle pant so that it critically changes the carbonate balance to bicarbonate which is needed for maintaining blood pH. The gasping effect is caused by dairy cattle losing bicarbonate in saliva with a decrease in salivary pH, which will change the effect of fermentation in the rumen. This causes changes in the acid balance which negatively affects fertility which affects reproductive performance (Samal, 2013).

The results of the regression analysis between precipitation and lactation percentage Table 6 in 2018 shows the equation Y = 39.15 + 0.013X, and it can be explained that every time there is an increase in precipitation, the lactation percentage will increase by 0.013%. The R^2 value is 78.08%, meaning that precipitation significantly influences the percentage of lactation, and 21.92% is another factor and has a very significant effect.

The r value of 0.88 means that the close relationship between precipitation and the percentage of lactation has a strong or high relationship. This is presumably because high precipitation affects the growth of forage which is helpful as dairy cattle feed, Suwignyo et al., (2010) that the availability for the procurement of forage grass during the dry season for ruminant feed is minimal, but on the contrary, when entering the rainy season, the availability of forage grass is well available so that it will have an impact on meeting the need for feed consumption for dairy cattle so that the productivity of dairy cattle will not be disturbed. Gwazdauskas (1984) mentions that during high precipitation, the pregnancy rate is more than 70%, but when the precipitation is less than 20 mm, the pregnancy rate is less than 25%. The majority of the breeding season in Australia occurs during winter or autumn.

At the same time, in Indonesia, there is no specific time for the breeding season. Still, based on the results of the study, it is shown in Table 3 that the highest percentage of lactation is dominated by months of high precipitation, according to Table 2. The regression equation between precipitation and lactation percentage in 2017 is Y = 45.66 – 0.01X with R^2 of 0.0025%, which means the effect is minimal, and the r-value of 0.005 is there is no relationship between the two. In 2019 Y = 43.56 + 0.029X with R^2 29.18%, meaning that the effect of precipitation on the percentage of lactation is 29.18%, and 70.82% is another factor. The r-value of 0.54 is the moderate closeness of the relationship. The results of the regression analysis between THI and lactation percentage Table 6 in 2017 shows the equation Y = -69.03 + 1.70X with an R^2 value of 44.04% and has a significant effect. This equation means that each decrease in THI will increase the percentage of lactation by 1.70% per year. The R^2 value of 44.04% implies that THI influences the effect of increasing the share of lactation, and 55.96% is another factor. The r-value of 0.66 indicates the relationship between THI and lactation rate is a moderate level of closeness. In 2018 the resulting regression equation was Y = 6.98 + 0.50 with an R^2 of 1.44%, which means the effect is minimal, and the r-value of 0.12 is a very weak relationship. The regression equation in 2019 is Y = 71.64 – 0.385X, with R^2 15.07%. The effect of THI on the percentage of lactation and 84.93% is another factor r value 0.38 is a weak relationship.

Based on the results of the microclimate analysis of the percentage of lactation in Table 6, there are different results. There are times when there are positive results, which means an increase in the percentage of lactation in a specific year, but there are also negative results, which means a decrease in lactation rate. Combined, the decrease and increase in the percentage of lactation indicate that microclimate parameters affect the reduction and increase in the portion of lactation. The regression results and correlation of microclimate's effect on the combined reduction in lactation presentation had no significant impact. Still, microclimate development on increasing lactation presentation by precipitation in 2018 had a considerable impact. BPTSP HPT Cikole can mitigate changes in microclimate on livestock productivity to maintain the percentage of lactation (in the range of 41-46% per year).

CONCLUSIONS

The average milk production in Cikole is 12.32 liters per head per day. Production from year to year is low and does not change every year. Temperature, humidity, precipitation, and THI did not affect the milk production of Friesian Holstein cattle at

BPTSP HPT Cikole. Based on the regression analysis results, precipitation significantly affects the percentage of lactation with an R^2 value of 78.08%.

REFERENCES

Anggraeni, A., Fitriyani, Y., Atabany, A., & Komala, I. 2008. Penampilan produksi susu dan reproduksi sapi friesian holstein di Balai Pengembangan Perbibitan Ternak Sapi Perah Cikole Lembang. Seminar Nasional Teknologi Peternakan dan Veteriner, (137-145). Bogor, Indonesia.

Astuti, C. C. 2017. Analisis korelasi untuk mengetahui keeratan hubungan antara keaktifan mahasiswa dengan hasil belajar akhir. *Journal of Information and Computer Technology Education, 1*(1), 1-7. doi: 10.21070/jicte.v1i1. 1127.

Atrian, P., & Shahryar, H. A. (2012). Heat stress in dairy cows (a review). *Res In Zoology, 2*(4), 31-37. https://doi: 10.5923/j.zoology.20120204.03.

Badan Pusat Statistik. 2019. Sttistik Indonesia 2019. Jakarta (ID): Badan Pusat Statistik. Diakses 8 Januari 2021, dari https://www.bps.go.id-Sea-Delt.

Berman, A. 2005. Estimates of heat stress relief needs for Holstein dairy cows. *Journal of Animal Science, 83,* 137-145. https://doi.org/10.2527/2005.836 1377x.

Bulitta, F. S., Aradom, S., & Gebresenbet, G. 2015. Effect of transport time of up to 12 hours on welfare of cows and bulls. *Journal of Service Science and Management, 8*(2), 161-182. https:// doi.org/10.4236/jssm.2015.82019.

Direktorat Jenderal Peternakan & Kesehatan Hewan. 2018. *Statistik Peternakan dan Kesehatan Hewan* 2018. Jakarta (ID): Direktorat Jenderal Peternakan dan Kesehatan Hewan Kementerian Pertanian RI. Diakses 5 Juli 2020, dari https://ditjenpkh..pertanian.go.id/buku-statistik-peternakan-dan-kesehatan-hewan-tahun-2018.

El-Wishy, A. B. 2013. Fertility of holstein cattle in a sub-tropical climate of Egypt. *Iranian Journal Applied Animal Science, 3*(1), 45-51. https://www.researchgate.net/publication/286417490.

Enting, H., Kooji, D., Dijkhizen, A. A., Huirne, R. B. M., & Noordhuizen-Stasses, E. N. 1997. Economic losses due to clinical lameness in dairy cattle. *Livestock Production Science, 49,* 259-267. https://doi.org/10.1016/S0301-6226(97)00051-1.

Gwazdauskas, F. C. 1984. Effect of climate on reproduction in cattle. *Journal of Dairy Science, 68*(6), 1568-1578. https://doi.org/10.3168/jds.S0022-0302(85)80995-4.

Hijriani, A., Muludi, K., & Andini, E. A. 2016. Implementasi metode regresi linier sederhana pada penyajian hasil prediksi pemakaian air bersih PDAM way rilau kota Bandar Lampung dengan sistem informasi geografis. *Jurnal Informatika Mulawarman, 11*(2), 37-42.

Khotimah, K. 2011. Identifikasi populasi dan kualitas susu sapi perah pada anggota kube psp maju mapan desa kemiri kecamatan jabung kabupaten malang. 2011. *GAMMA*, *7*(1), 32-38.

Makin, M., & Suharwanto, D. 2012. Performa sifat-sifat produksi susu dan reproduksi sapi perah fries holland di jawa barat (Milk production and reproduction performance of FH dairy cattle in west java). *Jurnal Ilmu Ternak*, *12*(2), 39-44. https://doi.org/ 10.24198/jit.v12i2.5128.

Marai, I. F. M., El-Darawany, A. A., Fadiel, A., & Abdel-Hafez, M. A. M. 2007. Physiological traits as affected by eat stress in sheep. A review. *Small Ruminant Research*, *71*, 1-12. https://doi.org/10.1016/j.smallrumres. 2006.10.003.

Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S., & Bernabucci, U. (2010). Effects of climate changes on animal production and sustainability of livestock systems. *Livestock Science*, *130*(1–3), 57–69. https://doi.org/10.1016/j.livsci.2010.02.011.

Novianti, J., Purwanto, B. P., & Atabany, A. 2013. Respon fisiologis dan produksi susu sapi perah FH pada pemberian rumput gajah (Pennisetum purpureum) dengan ukuran pemotongan yang berbeda. *Jurnal Ilmu Produksi dan Teknologi Peternakan, 1*(3), 138-146.

Priyanti, A., Nurtini, S., & Firman, A. 2009. *Analisis Ekonomi dan Aspek Sosial Usaha Sapi Perah.* Bogor (ID): Pusat Penelitian dan Pengembangan Peternakan.

Samal, L. 2013. Heat stress in dairy cows: reproductive problems and control measures. *International Journal of Livestock Research*, *3*(3), 14-23. ISSN 2277-1964

Schüller, L., Burfeind, O., & Heuwieser, W. (2016). Effect of short- and long-term heat stress on the conception risk of dairy cows under natural service and artificial insemination breeding programs. *Journal of Dairy Science*, *99*, 1–7. https://doi.org/10.3168/jds.2015-10080

Sughiri, L., Hermawan, & Indrijani, H. 2015. Perbandingan performa produksi sapi perah friesian holstein impor dengan keturunannya (studi kasus di PT. UPBS Pangalengan). *Students e-journals, 4*(2), 1-11.

Suherman, D., Purwanto, B. P., Manalu, W., & Permana, I. G. (2013). Model Penentuan Suhu Kritis Pada Sapi Perah Berdasarkan. *Jurnal Sain Peternakan Indonesia*, *8*(2), 121–138. https//doi.org/10.31186/jspi.id.8.2.121-138.

Suwarno, N., & Mushawwir, A. 2019. Model prediksi metabolit melalui jalur glikogenesis berdasarkan fluktuasi mikroklimat lingkungan kendang sapi perah. *Jurnal Ilmu dan Industri Peternakan*, *5*(2), 97-107. https://doi.org/10.24252/jiip.v5i2.11886.

Suwignyo, B., Agus, A., Utomo, R., Umami, N., Suhartanto, B., & Wulandari, C. 2016. Penggunaan fermentasi pakan komplet berbasis hijauan pakan dan jerami untuk pakan ruminansia. *Jurnal Pengabdian Kepada Masyarakat, 1*(2), 255-264.

West, J. W. (2003). Effects of heat-stress on production in dairy cattle. *Journal of Dairy Science*, *86*(6), 2131–2144. https://doi.org/10.3168/jds.S0022-0302(03)73803-X.

Yani, A., & Purwanto, B. P. (2006). Pengaruh iklim mikro terhadap respons fisiologis sapi peranakan Fries Holland dan modifikasi lingkungan untuk meningkatkan produktivitasnya, *Jurnal Media Peternakan*, *29*(56), 35–46.