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Evaluation of Fresian Holstein Crossbred Dairy Cow Milk Production Based On Temperature Humidity Index (THI)

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ABSTRACT : *This research aims to determine the influence of interaction between the environment with genetic of FH Cross on the milk production. The materials used were four female FH Cross dairy cows in the third lactation period. The research site is located at an altitude of 187 meters above sea level, indicating relatively high levels of temperature and humidity. The average temperatures range between 23-30°C and the humidity levels range between 63-86%. Both elevated temperature and humidity can have an influence on milk production. The findings of this study indicate that the cowsheds Temperature Humidity Index (THI) falls within the mild stress category. The milk production results for FH Cross dairy cows ranged from 3-6 liters per head per day in the morning, and 1.5-3 liters per head per day in the afternoon. However, it should be noted that this production level is still below the genetic standards. Other factors such as feed, management practices, and animal health also play a role in milk production. Regression analysis suggests a correlation between THI and milk production, although this correlation is not statistically significant. This lack of statistical significance may be attributed to the influence of various other factors on milk production, such as feed type and management practices. Therefore, it can be concluded that the THI condition of the barn is one factor that needs to be considered to increase the milk production of FH Cross dairy cows.*

Keywords: correlation, milk production, dairy cows, temperature humidity indeks

ABSTRACT :

Penelitian ini bertujuan untuk mengetahui pengaruh interaksi antara lingkungan dengan genetik FH Cross terhadap produksi susu. Materi yang digunakan adalah empat ekor sapi perah betina FH Cross pada periode laktasi ketiga. Lokasi penelitian terletak pada ketinggian 187 meter di atas permukaan laut, yang mengindikasikan tingkat suhu dan kelembaban yang relatif tinggi. Suhu rata-rata berkisar antara 23-30°C dan tingkat kelembapan berkisar antara 63-86%. Suhu dan kelembaban yang tinggi dapat mempengaruhi produksi susu. Hasil penelitian menunjukkan bahwa Temperature Humidity Index (THI) di kandang sapi termasuk dalam kategori stres ringan. Hasil produksi susu sapi perah FH Cross berkisar antara 3-6 liter per ekor per hari pada pagi hari, dan 1,5-3 liter per ekor per hari pada siang hari. Namun, perlu dicatat bahwa tingkat produksi ini masih di bawah standar genetik. Faktor-faktor lain seperti pakan, praktik manajemen, dan kesehatan hewan juga berperan dalam produksi susu. Analisis regresi menunjukkan adanya korelasi antara THI dan produksi susu, meskipun korelasi ini tidak signifikan secara statistik. Kurangnya signifikansi statistik ini dapat disebabkan oleh pengaruh berbagai faktor lain terhadap produksi susu, seperti jenis pakan dan manajemen pemeliharaan. Oleh karena itu, dapat disimpulkan bahwa kondisi THI kandang merupakan salah satu faktor yang perlu diperhatikan untuk meningkatkan produksi susu sapi perah FH Cross.

Kata kunci: korelasi, produksi susu, sapi perah, temperature humidity index

INTRODUCTION

Friesian Holstein Crossbred (FH Cross) is one of the dairy cows in Indonesia resulting from the crossbreeding of Friesian Holstein (FH) dairy cows with local cows. These cows are selectively bred for their ability to produce a substantial quantity of milk. Milk, a rich source of high-quality nutritional elements such as protein, fat, carbohydrates, minerals, and vitamins, is vital for human health and growth. Its perfect nutritional composition serves as an excellent medium for human growth, making milk highly susceptible to bacteria from milking to consumption, rendering it prone to spoilage (Satria, Erina, & Winarso, 2019).

FH cattle exhibit significantly higher milk production compared to other dairy breeds, with those raised in high-altitude areas yielding greater milk production tha n those in lowland regions (Mariana, Sumantri, Apri Astuti, Anggraeni, & Gunawan, 2019). The ability of cattle to produce milk is fundamentally influenced by results, genetic factors, and environmental factors (Novitasari, Hutasoit, Rozi, & Rohmah, 2023). Environmental factors contribute about 70% to milk production, as these factors can be categorized into two main types: external and internal. External factors originate from outside the body, including climate, feed provision, and husbandry management. On the other hand, internal factors are related to the biological aspects of lactating cows, lactation duration, dry period, empty period, and calving interval (Panduardi, Sailul Haq, & Sandy Prayogo, 2022).

For FH dairy cows, the higher the altitude of the dairy farming location, the better the milk production outcomes, reaching optimal results at an elevation of 750 meters above sea level (Lake & Purwantiningsih, 2020). The research facility is situated at an elevation of 187 meters above sea level in a lowland region with temperatures ranging from 25 to 31°C and humidity between 55 and 90%. This research aims to determine the influence of interaction between the environment with genetic of FH Cross on the milk production. The environment is one of the decisive factors for the high or low production of dairy cow milk. Heat stress, which can induce stress in livestock, can trigger various other factors that hinder the milk extraction process. Environmental elements such as temperature and humidity play a crucial role in this context.

MATERIALS AND METHODS

Materials

The materials used were female FH Cross dairy cows in the third lactation period, totaling 4 cows with an age range of 4 to 5 years. The equipment utilized during the observation and evaluation of milk production included books, writing tools, plastic measuring cups, buckets, and a thermohygrometer for measuring the temperature and humidity of the cowshed.

Methods

The method employed during the observation involves observational techniques. Recording the daily milk production of dairy cows is performed after the milking process is completed. Temperature and humidity measurements in the cowshed are conducted after the milking activity. The observed parameters in this study consist of temperature and humidity, Temperature Humidity Index (THI), and the daily milk production quantity (morning and noon milking period). This research utilizes two analytical methods. Descriptive analysis is applied to examine data on temperature, humidity, THI, and milk production. Descriptive analysis does not involve comparing or linking variables but solely describes individual variables. It is used to interpret the analysis results.

Table 1. Guidelines for Degree of Correlation

Coefficient	The level of correlation
0,00 – 0,199	Very low
0,20 – 0,399	Low
0,40 – 0,599	Medium
0,60 – 0,799	Strong
0,80 – 1.000	Very strong

Source: (Sugiyono, 2006).

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Table 2. Temperature, Humidity, and Cowshed THI

Milking Period	Average Temperature (°C)	Average Humidity (%)	Average THI
Morning (04:30 WIT)*	23	86	72,46
Aftenoon (13.00 WIT)	30	63	79,83

*: West Indonesian Time (WIT).

To understand the relationship between the milk production variable and the THI value, regression analysis is conducted. The regression equation follows the model proposed by (Hijriani et al., 2016), with the equation Y representing the dependent variable (predicted value) and X as the independent variable. Correlation test calculations are performed using IBM SPSS version 29 software. The criteria for measuring the strength of a relationship between two variables are as follows Tabel 1.

RESULT AND DISCUSSION

Temperature, Humidity, and Cowshed THI

The results showed that the temperature and humidity in the cowshed, which has an altitude of 187 meters above sea level, ranged from 23 to 30°C with humidity ranging from 63 to 86%. This condition is relatively hot air temperature with high humidity can cause a negative impact on production and reproduction capabilities (Atrian & Shahryar, 2012). Fresian Holstein (FH) dairy cows require the location of cowsheds at an altitude of 750 meters above sea level to produce milk with optimal results (Lake & Purwantiningsih, 2020). In addition, dairy cows will produce well in a comfortable environment. With a maximum limit of temperature and humidity of 5-25 °C (Dash et al., 2016) 55-60% (Heraini, Priyo Purwanto, & Hadari Nawawi, 2019).

Outside these conditions, dairy cows will experience heat stress so that production can decrease (Bouk, Citrawati, & Sikone, 2022). From the results of this observation, it can be said that the location of the cowshed still does not meet the ideal value of temperature, humidity, and height of the cowshed for lactating dairy cows. One of the factors that can reduce milk production in dairy cows is heat stress (Mabjeesh, Sabastian, Gal-Garber, & Shamay, 2013). Other parameters that show physiological changes and livestock behavior. The characteristics of cattle experiencing excessive heat stress are decreased appetite, decreased metabolism, increased drinking water consumption, increased heat expenditure in the livestock body, increased livestock body temperature, respiratory frequency, and heart rate (Santana, Bignardi, Pereira, Stefani, & El Faro, 2017).

The environment is one of the factors influencing the productivity of dairy cattle. The optimal genetic potential of a dairy cow will not be achieved if external factors such as unfavorable environmental conditions are present. One of the environmental factors hindering the expression of genetic traits in livestock is the microenvironment (Lestari, 2022). The primary constraints in the microenvironment are temperature, air humidity, solar radiation, and wind speed (Adhyatma et al., 2020). To optimize the capabilities of dairy cattle, efforts should be made to control the environmental conditions within the microenvironment.

The average Temperature Humidity Index (THI) value in cowsheds ranged from 72-80. This indicates that the level of stress experienced by Fresian Holstein dairy cows is in the mild

Table 3. Milk Production

Description	Milk Production (liters)							
	Cow 1		Cow 2		Cow 3		Cow 4	
	Morning	Noon	Morning	Noon	Morning	Noon	Morning	Noon
Total/month	188,65	98,10	128,75	83,70	121,30	64,60	93,00	49,50
Total/day	6,28	3,27	4,29	2,79	4,04	2,15	3,10	1,65
Average/head/day	9,55		7,80		6,19		4,75	

stress category. In the relationship between dairy cows and THI values, temperature and humidity, dairy cows with THI values less than 72 will feel comfortable. Dairy cows will experience mild stress with THI values around 72-80. Dairy cows experience moderate stress if they get a THI value of 80-89. While dairy cows that get a THI value of around 90-97 will experience severe stress (Sabekti Pratama, Mustofa, Paramita Lokapirnasari, Srianto, & Utama, 2019). The physiological response of livestock experiencing excessive heat stress has the characteristics of decreased appetite, decreased metabolism, increased drinking water consumption, increased heat expenditure in the livestock body, increased livestock body temperature, and increased respiratory frequency and heart rate (Santana et al., 2017).

Another factor that can affect the high temperature value in the cowshed is the roof of the cowshed which absorbs heat. The roof of the cowshed used is asbestos material that easily absorbs solar radiation so that it can increase the heat load in the cowshed so that livestock become uncomfortable under certain conditions. The selection of the roof of the cowshed also affects the temperature conditions in the cowshed so that the maintenance of FH Cross dairy cows, should choose a roof that is able to reflect and absorb radiation to reduce the heat transfer process into the cowshed (Arnold Palulungan & Tety Hartatik, 2013). In addition, the level of cowshed density also needs to be a concern. Cowshed density can affect and increase the THI value through the release of metabolic heat of the cattle's own body (Nugraheni, Hartanto, & Harjanti, 2020).

Milk Production

The table 3 showed that the milk production of Friesian Holstein Crossbred (FH Cross) cows ranges from 3 to 6 liters per head per day in the morning. During afternoon milking, the milk production amount reaches 1.5 to 3 liters per head per day. The observed cows are in their third lactation period. Cow number 1 has higher production compared to the others because it is in the early lactation phase, around 2 months after calving, and is in excellent physical condition. Cow number 1 is approximately four years old, as evident from the fully developed four pairs of lower jaw teeth. Cow number 2 has lower milk production than cow number 1 because it is in the mid-lactation phase, around the beginning of the 5th month, with a normal condition. The estimated age of cow number 2 is the same as cow number 1, around 4 years old, based on the fully developed lower jaw teeth.

Cow number 3 has slightly lower milk production than cow number 2 but is not significantly different. This is because it is in the mid-lactation phase at the end of the 5th month, and its condition is normal. The estimated age of cow number 3 is the same as cow number 1 and 2, with fully developed lower jaw teeth. Cow number 4 has the lowest milk production compared to the others because it is approaching the dry period, and it has previously suffered from mastitis, although it has recovered. However, its milk production has not returned to the level before mastitis. The estimated age of cow number 4 is 5 years, observed from fully

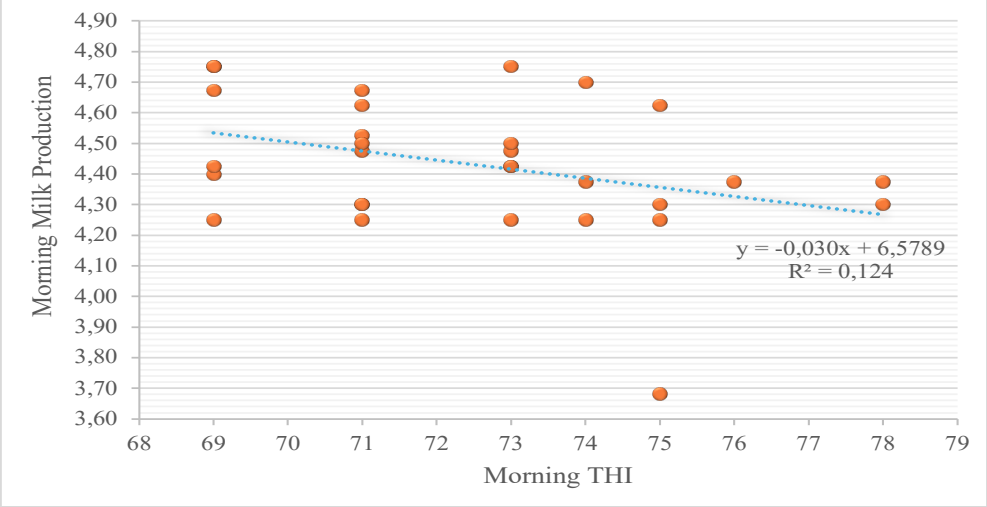

Figure 1. Morning THI with milk production graph

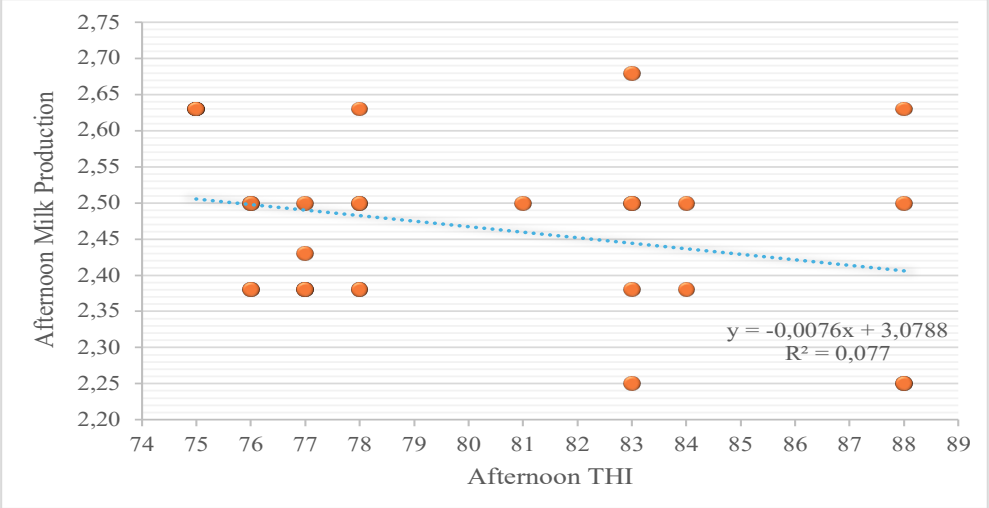

Figure 2. Afternoon THI with milk production graph

developed teeth that are more worn compared to others.

The dairy cattle used are Friesian Holstein Crossbred, where these dairy cows exhibit excellent performance in terms of milk production capabilities in tropical climates. However, there are various factors that can influence milk production, such as environmental temperature, genetics, feed, management practices, lactation period, milking frequency, dry period, and animal health conditions (Adi, Harjanti, & Hartanto, 2020).

According to (Komala, Arifiantini, Sumantri, & Tumbelaka, 2015), the genetic capability of Friesian Holstein Crossbred cows in Indonesia is around 10 liters per head per day. Based on this comparison, the milk production results are still considered low. Factors influencing milk production include genetics at 30% and environmental factors at 70% (Christi & Tanuwiria, 2019).

The Correlation Relationship of THI with Milk Production

Regression analysis is employed as a tool to ascertain the relationship between two or more variables to determine the milk production outcomes in dairy cows concerning THI values. The regression equation utilizes the model proposed by **(Hijriani et al., 2016)**, with the equation where Y is the dependent variable (predicted value) and X is the independent variable. The results of the correlation relationship between production and processed THI data are as follows:

The results obtained from the graph in Figure 1, with (X) representing the morning Temperature Humidity Index (THI) value and (Y) representing morning milk production, reveal a scatter plot with a regression line. The analysis indicates that the morning THI value does not have a significant effect on morning milk production ($p>0.05$), as the obtained significance value is 0.058. The correlation coefficient value between the morning THI value variable and morning milk production is denoted by a multiple R value of 0.350, suggesting a weak relationship between variables X and Y. The coefficient of determination (R^2) is 0.124, indicating that the morning THI value variable accounts for 12.4% of the variability in morning milk production, while the remaining percentage is influenced by other factors. Moreover, the regression coefficient value of the milk production variable (b) is negative, specifically -0.030. This implies that for each increase in THI value by one point, the milk production will decrease by 0.030 liters.

Similarly, the graph depicted in Figure 2 illustrates a non-significant correlation between afternoon THI values and milk production ($p>0.05$), with a significance value of 0.138. The correlation coefficient between the afternoon THI variable and milk production is reflected in the multiple R value of 0.278, indicating a weak relationship between variables X and Y.

The coefficient of determination (R^2) for this variable is 0.077, suggesting that afternoon THI values contribute to 7.7% of the variation in milk production, while other factors play a more substantial role. The regression coefficient for afternoon milk production (b) is negative at -0.0076, indicating that a one-point increase in THI value corresponds to a decrease of 0.0076 liters in milk production.

The production of cow's milk in the cowshed shows a significant but not substantial impact. Despite the production not meeting daily standards, this can be attributed to various factors, including feed. Livestock feed consists of forage and concentrates, including finely ground corn husks, cassava peels, coffee husks, cassava peels, rice bran, tofu residue, mineral mix, and vetamix. In lowland areas, cattle tend to consume less forage compared to highland areas. According to (Amalia Nurfitriani et al., 2021), cattle in lowland areas with high temperature and humidity experience a decrease in feed consumption, leading to a reduced appetite. In contrast, cattle in highland areas with lower temperatures exhibit an increased appetite. (Huda, Ndaru, Ridhowi, & Andri, 2019) emphasizes that high-quality and easily digestible forage is crucial for the development of livestock, contributing to increased milk production.

Milking is performed twice a day, in the morning at 03:30 AM and in the afternoon at 12:30 PM, with a milking interval of 10, 12, or 14 hours, and the mandatory milking interval is the same. Milk production decreases with longer milking intervals. Cows are milked in the morning from 05:00 to 06:00 AM and in the afternoon from 03:00 to 04:00 PM (Maya Sari, Widyaswara, & Pramonodjati, 2021). Milking is divided into three phases: pre-milking, milking, and post-milking, all of which influence the resulting milk production (Pramono, Indriarta, & Cahyadi, 2023).

CONCLUSION

The conclusion drawn from this observation is that the Temperature Humidity Index (THI) in the cowsheds at the research site still does not meet the ideal THI value for lactating dairy cows. The results of the regression correlation between cowshed THI and milk production indicate an influence, but it is not significant, likely due to various other factors affecting milk production.

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