ANALYSIS OF FACTORS AFFECTING MILK PRODUCTIVITY OF DAIRY COWS IN BOYOLALI DISTRICT

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ABSTRACT

This study aims to analyze the factors affecting cow's milk productivity in Boyolali District, which is known as the largest milk producer in Central Java. Despite high production levels, milk productivity per cow in this area is still low, reaching an average of 6 liters per day. Factors analyzed include cow breed, forage feed cost, concentrate feed cost, and frequency of vitamin administration. The analytical method used was multiple linear regression. The results showed that forage feed cost and concentrate feed cost had a significant influence on milk productivity with a significance value, namely the cost of forage feed is 0.003 smaller than 0.005 and the cost of concentrate feed has a significance value of 0.007 smaller than 0.05and milk productivity was influenced by 21% by the variables studied, while 79% was influenced by other factors not explained in this study. This study is expected to provide insight for farmers and other stakeholders to improve milk productivity through better feed management and utilization of more economical feed alternatives.

KEYWORDS Milk productivity, dairy cows, multiple linear regression.

INTRODUCTION

Fresh milk is an animal food source that is rich in essential nutrients for the body. The protein, calcium, vitamin D and vitamin B12 in milk provide tremendous health benefits. Protein in milk helps build and repair body tissues, while calcium is important for maintaining strong bones and teeth (Winahyu et al., 2023). Vitamin D plays a role in calcium absorption, helping to prevent osteoporosis and maintain healthy bones. In addition, vitamin B12 found in fresh milk plays a role in the formation of red blood cells and maintaining a healthy nervous system. Regular consumption of fresh milk can boost immunity, maintain healthy bones and teeth, and ensure the balance of nutrients needed by the body (Wiranti, et al, 2022). The relatively low price of cow's milk allows people to obtain its nutritional benefits due to its high nutrient content without burdening their budgets, especially for those living in low-income areas. This reflects people's access to good nutrition.

Boyolali Regency is one of the largest milk producing centers in Central Java. Milk production in Boyolali Regency ranks first in the Central Java region. The existence of widespread dairy farms in the region is a major factor in achieving production. Through a well-organized farming system and the support of suitable natural conditions, Boyolali

Regency is able to produce large amounts of milk. This shows that Boyolali Regency has the potential for dairy farming development. Utilization of technology and proper management. Boyolali Regency can become one of the centers of dairy milk production in Indonesia and a significant contributor to meeting national milk needs.

The characteristics of dairy farmers in Boyolali Regency are still dominated by small-scale farms. The livestock business is a side job with limited sources of feed and capital, low nutritional quality of feed so that it does not meet the nutritional needs of livestock. Cattle farmers in Boyolali Regency rely on a semi-intensive system, which combines cage rearing with grazing. Dairy cattle are often kept under a traditional grazing system, where cattle are left to forage on pastures or vacant land around the village.

Dairy farming in Boyolali Regency is faced with major constraints related to feed inputs, namely the high price of concentrate feed and limited forage. The high cost of concentrate feed is a burden for farmers, especially small-scale farmers. This is exacerbated by limited forage, especially in the dry season, which forces farmers to rely on concentrate feed excessively. Dependence on concentrate feed is very high and farmers find it difficult to optimally meet their livestock feed needs, so alternatives are needed to replace concentrate raw materials with natural ingredients such as corn stover and coconut meal to reduce high feed costs. The yield of cow's milk production is greatly influenced by the quality and amount of feed given to the cow. Efforts to reduce production costs have been made by replacing concentrate raw materials with more affordable alternatives, but cow's milk productivity is still low, reaching only 6 liters of milk per day. In comparison, milk productivity in Semarang Regency averages 10 liters per day. Productivity in Semarang Regency is higher than in Boyolali Regency. Boyolali District has not been able to achieve high productivity, even though its milk production is high. High production does not necessarily indicate high productivity. This condition will certainly weaken competitiveness in the cattle farming business and milk productivity which will have an impact on farmers' income.

Based on the description of the problem above, researchers need to know what factors cause a decrease in cow's milk productivity. High and low productivity and milk production will affect the income and welfare of farmers. In-depth analysis is needed to determine the factors that affect cow's milk productivity in Boyolali Regency. It is hoped that analyzing these factors will help stakeholders, be it farmers, government, or non-governmental organizations, to identify where improvements can be made to increase cow's milk productivity in Boyolali District. A better understanding of the factors affecting milk productivity can help in the identification of more effective and targeted factors to improve livestock yields.

RESEARCH METHOD

Place and Time of Research

The researcher took the location in Boyolali Regency. This research was conducted for 6 months, from February to July. The method of taking the location is done by purposive, which is a technique of determining the research location intentionally based on certain considerations. The consideration is that the location taken has a high milk production of dairy cows number one in Central Java which is experiencing a decline in productivity. Boyolali Regency has 22 sub-districts, where 3 of them, namely Mojosongo, Tamansari and Musuk sub-districts, are milk production centers.

Data Type and Source

The types of data used in the research analysis of factors affecting cow's milk productivity in Boyolali Regency include primary data and secondary data. The explanation of each data taken is:

Primary Data

Primary data is a source of data obtained without intermediaries from other parties. Primary data is obtained from interviews using questionnaires to cattle farmers including characteristics of dairy farmers (age, education, gender, farming experience, business orientation), production factors (milk production, cost of forage feed, concentrate feed, cow breed and frequency of vitamin administration).

Secondary Data

Secondary data is a source of data obtained through intermediary media, namely related institutions in the form of records or reports that have been processed, both published and unpublished and literature from journals, manuals or libraries (Hardani et al, 2022).

Data Collection Technique

Interview, is a direct question and answer method with a specific purpose. Conversations are conducted by two people, namely the interviewer who asks questions and the interviewee who provides answers (Hardani et al, 2022). Interviews were conducted with dairy farmers in Boyolali Regency as respondents using a questionnaire.

Recall, is a technique of collecting data by recalling specific information or experiences from long-term memory. This technique can involve open-ended questions where respondents are asked to recall experiences or information freely, or it can use closed questions with answer choices provided by asking respondents to choose the most relevant or accurate option. The recall method was used to recall the productivity results, inputs (production costs) and production results of the last four months, namely January to April in 2024.

Documentation, data collection carried out through archival data related to research problems so that it can complement the information that has been obtained in the field. Documentation is obtained from records, existing reports, recordings and so on that support the implementation of research (Veronica et al., 2022). The documentation method aims to obtain secondary data in the form of cow milk production data from January to April 2024, cow genetics information and records of the type of feed given.

Population and Sample

The population in this study is all dairy farmers in Boyolali District. The total population of dairy farmers in Boyolali Regency is 22,600 farmers. Sample size is a step to determine the size of the sample to be taken in carrying out a study. The sample of this research is dairy farmers in Mojosongo, Tamansari and Musuk sub-districts. The location was chosen purposively based on the highest milk production and is the center of milk production in Boyolali Regency.

Data Analysis Method

1. Normality Test

   The normality test is used to determine whether the data is normally distributed or not. The main requirement in parametric statistical analysis is the fulfillment of normal data. If the data is normally distributed then it can be assumed that the data taken is normal (Quraisy, 2022). The normality test is measured using the SPSS one sample Kolmogorov Smirnov test, variables are said to be normally distributed if the significant value is more than or equal to 0.05. Conversely, if the significant value is less than 0.05 then the data is declared not normally distributed.
2. Multiple Linear Regression Analysis with Dummy Variables

In the cattle type variable, the dummy code for Holstein Friesian cattle is 1 and for Brown Swiss cattle it is 0. The functional influence of the independent variable on the dependent variable can be analyzed using the following mathematical function:

$$Y = \alpha + D1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \varepsilon$$

Information:

Y = Cow's milk productivity (liters/day)
α = intercept
β = Regression coefficient
X1 = Type of dairy cow (Holstein Friesian = 1 ; Brown Swiss = 0)
X2 = Cost of forage (Rp)
X3 = Cost of concentrate feed (Rp)
X4 = Frequency of vitamin administration
ε = error component

3. F Test

The simultaneous test, known as the F test, is used to determine whether the dependent variable or independent variable is influenced by data from the independent variables entered into the model simultaneously or concurrently.

If Fcount > Ftable= then the variables type of cow, type of forage, concentrate feed and frequency of vitamin administration have a joint effect on the dependent variable, namely milk productivity.

If Fcount < Ftable= then the variables of type of cow, cost of forage, concentrate feed and frequency of vitamin administration do not jointly influence milk productivity.

4. t test

The partial test, known as the t test, is used to determine how much influence individual independent variables have on the partially dependent variable. The t test formula is as follows:

$$t\ count = bi/(se(b_i))$$

Note:

bi = Regression coefficient
se = standard deviation (standard deviation)

5. Classical Assumption Test

The classic assumption test is a requirements test that is carried out before carrying out further analysis. The assumption test is used to obtain regression results that meet the BLUE (Best Linear Unbiased estimation) criteria. Classic assumption tests include the Heteroscedasticity Test and Multicollinearity Test. The explanation of each is as follows:

a. Multicollinearity Test

The multicollinearity test is a method for analyzing the existence of a linear relationship or high correlation between independent variables in the multiple regression model equation. If correlation occurs, then multicollinearity occurs. Multicollinearity analysis is carried out by looking at the value of the Variance Inflation Factor (VIF) and the tolerance used to identify whether there is a multicollinearity problem. If the If the VIF value < 5, the variables used do not have multicollinearity symptoms.

b. Heteroscedasticity Test

The heteroscedasticity test is carried out to determine whether bias occurs or not in a regression model analysis. A good regression model is that heteroscedasticity does not occur. The detection of heteroscedasticity is by

looking at the pattern of dots on the scatterplot graph on SPSS. If the dots spread with an unclear pattern below and above the number 0 on the Y axis, then there is no heteroscedasticity problem.

RESULT AND DISCUSSION

1. Regression Prerequisite Test (Normality Test)

   The normality test aims to test whether the regression model between the dependent variable and the independent variable is normally distributed or not. A good regression model is to have a normal data distribution (Artha and Intan, 2021). The normality test in this study initially had 100 respondent data with an Asymp.Sig value. (2-tailed) 0.000 is smaller than 0.05, which means that the significance value is smaller than 0.05 so that the data is declared abnormal.

   statistical test results show that the data is not normally distributed, which means there is outlier data. Outlier data is data that is very different from other data. The existence of outlier data requires the reduction of respondents who have the farthest difference value from the average or standard deviation, so that the data in this study can be normally distributed. The number of respondents eliminated in this study was 21 respondents with productivity above 50 liters/day, so that the sample in this study became 79 respondents with milk productivity between 10 liters/day to 50 liters/day tested in this study. After reducing outlier data, the number of samples tested was 79 respondents. The results of the normality test using One Sample Kolmogorov-Smirnov can be seen from the Asymp.Sig (2-tailed) value of 0.200 which is greater than 0.05, which means that the significance value is greater than 0.05 so that this data is declared normal or fulfills the assumption of normality.

2. F Test

   The F test is used to determine the significance of independent variables simultaneously. Testing the dependent variable (Y) against the independent variable (X) simultaneously using the SPSS application.

Table 1 F Test Result Value

Source: Primary Data Processed, 2024

	df	SS	MS	F	*Sig*
Regression	4	1.791.424	447,856	4,921	0,001*
Residual	74	6734247	91,003		
Total	78	8525671			

*Significance <0,05

Based on the results of the simultaneous test or F test, it is known that the calculated F value is 4.921 while Ftable is known df1 = 4 df2 = 74 with a confidence level of 95%. F table is obtained at 2.727, so Fcount 4.921 is greater than Ftable 2.727. This means that H0 is rejected and H1 is accepted. This indicates that there is a significant influence between cow breed, forage feed cost, concentrate feed cost and frequency of vitamin administration on milk productivity. Based on the F test, it means that the independent variables of cow breed, forage feed cost, concentrate feed cost and frequency of vitamin feeding together affect the milk productivity of cows.

3. T Test

   Based on the results of calculations using the SPSS program, it can be seen the relationship between the independent variables (cow type, forage feed cost, concentrate feed cost and frequency of vitamin administration) individually with the dependent variable of cow's milk productivity. Based on the results of the t test, there

are 2 variables that affect the milk productivity of cows, namely the cost of forage feed and the cost of concentrate feed. Forage feed cost variable has a significance value of 0.003 less than 0.05 which means it affects milk productivity. The concentrate feed cost variable has a significance value of 0.007 less than 0.05 which means the concentrate feed cost variable affects milk productivity. Other variables such as cow breed and frequency of vitamin administration have no effect on milk productivity because they have a significance value greater than 0.05.

Hypothesis testing has been conducted to determine whether the hypothesis that has been set is statistically accepted or rejected. The estimation results in the t test or individual test show that the factors that affect cow's milk productivity are forage feed costs and concentrate feed costs. The results of the t test analysis mean that the hypothesis decision obtained is H1 accepted and H0 rejected, namely the factors of forage feed cost and concentrate feed cost affect the milk productivity of cows in Boyolali Regency.

4. Multiple Linear Regression Analysis Equation

There are several factors that affect the milk productivity of dairy cows including cow breed, forage feed cost, concentrate feed cost and frequency of vitamin administration. The analytical tool used to determine the influence of these four variables is multiple linear regression analysis. The dependent variable or the dependent variable in this study is cow's milk productivity (Y) and the independent variable is cow breed (X1) for independent variables or independent variables are cow breed (X1), the cost of forage feed (X2), the cost of concentrate feed (X3) and the frequency of vitamin of vitamin administration (X4).

Table 2 Results of Regression Analysis of Cow Type, Feed Cost, Cost of Forage, Cost of Concentrate Feed and Frequency ofVitamin Administration

	Coefficients	Standart Error	t-Start	Sig
Intercept	9,827	5,408	1,817	0,073
Jenis sapi	5,686	3,358	1,693	0,095
Biaya Pakan Hijauan	2,436E - 5	0,000	3,074	0,003*
Biaya Pakan Konsentrat	3,046E - 5	0,000	2,789	0,007*
Frekuensi Pemberian Vitamin	2,322	1,434	1,619	0,110

*Significance < 0,05

Source: Primary Data Processed, 2024

$$Y = 9.827 + 5.686X1 + 2.436E\text{-}5X2 + 3.046E\text{-}5X3 + 2.322X4 + \varepsilon$$

The multiple linear regression equation shows that the intercept of this study is 9.827. This value shows the amount of cow's milk productivity will increase by 9.827 liters/day, when cow breed, forage feed cost, concentrate feed cost and frequency of vitamin administration are considered constant. Based on the regression coefficient value of the cow breed variable obtained of 5.686, the use of different cow breeds (Brownswiss = 0, Friesian Holstein = 1) using the equation Y = 9.827 + 5.686X1. If the Brownswiss cow breed is used, the cow's milk productivity remains at 9.827 liters while if the Friesian Holstein cow breed is used, the cow's milk productivity will increase by 15.513 liters. The use of individual cow breeds has no effect on milk productivity because factors such as feed, health management, and the environment determine milk production. Forage feed cost has a coefficient value of 2.436E-5. An increase in forage feed costs of Rp 1 will reduce productivity by 0.00002436 liters or 2.436 10-5 liters. Concentrate feed costs have a regression coefficient value of 3.046E-5, if there is an increase in concentrate feed costs of Rp 1 will reduce productivity by 3.046 10-5 or 0.00003046 liters.

The types of cattle kept by cattle farmers in Boyolali Regency are Friesian Holstein and Brownswiss. Friesian Holstein is the most widely farmed cow breed because of its high milk production ability compared to other dairy cows because Friesian Holstein cows are not temperament so favored by farmers, besides Friesian Holstein farmers in Boyolali Regency also keep several other types of dairy cows that are able to produce more milk, such as Brown Swiss cows. Although the Friesian Holstein cattle breed has the advantage of being able to produce more milk than the Brown Swiss cattle breed, individually the cattle breed in this study has no influence on cow's milk productivity. According to (Santoso, et al, 2020) additional costs in forage feed are generally used to improve feed quality, which can improve rumen health and digestive efficiency. This study shows that improving forage feed quality has a positive impact on milk production, but the higher cost must be considered in the context of the farm's operational budget. Amam and Harsita, (2019) study, meanwhile, highlighted that while high-quality forage can improve lactation performance of dairy cows, the costs associated with acquiring and managing high-quality forage are often subject to fluctuations influenced by factors such as weather and feed availability. Overall, improving forage quality can increase milk production by up to 0.5 liters per day per cow, but must be balanced with good managerial strategies to manage costs to stay within reasonable limits and support farm sustainability. (Albarrán-Portillo,et al., (2019) research highlights that although more expensive concentrate feeds can increase milk productivity, the higher costs should be considered in farm budget planning. The cost-effectiveness of concentrate feed should be assessed comprehensively, considering not only the cost but also the resulting increase in milk yield.

5. Coefficient of Determination (R2)

The coefficient of determination is a regression test that functions to find out how close the relationship is between the independent variable and the dependent variable.

Table 3 Coefficient of Determination Based on Analysis Multiple Linear Regression

Regression Statistics	
Multiple R	0,458
R Square	**0,210**
Adjusted R Square	0,167
Standart Error	9,540
Observations	79

Source: Primary Data Processed, 2024

Based on Table 3, it is known that the R Square value is 0.210, which means it shows that productivity is influenced by cow breed, forage feed cost, concentrate feed cost and frequency of vitamin administration by 21%. The remaining 79% is influenced by other factors not explained in this study. Other factors such as the level of education of farmers, climate, type of feed, technology, feeding and others in accordance with the research topic (Akbar, 2022).

6. Classical Assumption Test

The multiple linear regression model is also called a good model if the model meets the BLUE (Best Linear Unbiased Estimator) criteria. BLUE decisions can be made by fulfilling three basic assumptions or classical assumption (Sudariana and Yoedani, 2022). If one of the three basic assumptions is violated, the regression equation obtained is no longer BLUE (Best Linear Unbiased Estimator), the regression model tested will give a biased meaning and is difficult to interpret.

a. Multicollinearity Test

Based on the results of statistical tests, it is known that the VIF value of each variable is <5. This shows that there is no multicollinearity in the model presented in this study. If the VIF value < 5, the variables used do not have multicollinearity symptoms. This means that the regression coefficient resulting from the model is relatively stable and does not change significantly if one of the independent variables is removed from the model. Symptoms of multicollinearity are when variables that have a tolerance of more than 0.1 and a VIF value greater than 5.

b. Heteroscedasticity Test

Based on the analysis of heteroscedasticity data, it is known that the points in the scatterplot spread and do not form a certain pattern. The dots are above and below the number 0 of the Y axis, so it can be interpreted that there is no heteroscedasticity in the regression model. Symptoms of heteroscedasticity refer to the inequality of variance of the residuals in the regression model. This condition causes a violation of one of the classical assumptions of linear regression, which can lead to bias in parameter estimation and inaccuracy in hypothesis testing.

CONCLUSION

This study identifies several factors that affect cow's milk productivity in Boyolali Regency, which is the largest milk production center in Central Java. Based on the results of the tests conducted, it is known that the factors that contribute to milk productivity include forage feed costs and concentrate feed costs. Research shows that these two factors have a significant influence on milk productivity. In addition, cow breed variables and frequency of vitamin administration have no effect on productivity because they have a significance value of more than 0.05.

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