FACTORS INFLUENCING DOMESTIC FRESH MILK PRODUCTION (SSDN)

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ABSTRACT
Currently the supply of domestic fresh milk (SSDN) is still unable to fulfill the need of domestic fresh milk. The limited supply as well as limited production of fresh milk in
the country is caused by forage finding difficulty, relatively expensive concentrate prices, limited farmers’ capital, fluctuating milk prices, and farmers’ inability to increase dairy cow population by cattle breeding; they depend on natural birth alone. The aim of this research is to identify the general description of dairy cattle business and analyze the influential factors of domestic fresh milk (SSDN) production. Quantitative approach is used in the research method. The data used are primary data and secondary data related to the research. The research located in Boyolali District, Central Java Province. Multiple Linear Regression method using the Cobb Douglas model is used to analyze the data. The results indicate that the number of dairy cattle, forage feed, concentrates and land area have a significant effect on the amount of milk production for dairy cattle. While partially, only the number of dairy cattle have a significant effect on the amount of domestic fresh milk production (SSDN).

**Keywords**: Domestic Fresh Milk, Multiple Linear Regression, Cobb-Douglas

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**1. INTRODUCTION**

Food and nutrition security is one of the visions of the Working Cabinet Governance to realize community food and nutrition need fulfilment. Government Regulation Number 17 of 2015 concerning Food and Nutrition Security explains food security and nutrition as a condition for fulfilling the needs of food and nutrition for the country to individuals, which is reflected in the availability of adequate food—both in quantity and quality-safe, diverse, and fulfill nutritional adequacy, equitable and affordable and does not conflict with the religion, beliefs, and culture of society to realize good nutritional status in order to live a healthy, active, and productive life in a sustainable manner. To realize food security, the government develops livestock sub-sector. This sector produces several products such as meat, eggs and milk. National meat and egg production during 2010-2014 recorded an increase of 5.98 per cent and 7.08 per cent annually. While milk production is recorded to decline to 2.73 per cent annually. The decline in production worsened the Government efforts to fulfill domestic fresh milk need.

At present, the need for domestic fresh milk (SSDN) for processed milk reaches 3.3 million tons per year. 79 percent (2.61 million tons) of processed milk raw material need is still have to be imported from several countries such as Australia, New Zealand, the United States and the European Union. Imported raw materials for processed milk are in the form of skim milk powder, anhydrous milk fat, and butter milk powder. While 21 per cent or 690,000 tons of the needs is supplied by domestic fresh milk (Ministry of Industry, 2017). The Indonesian Minister of Agriculture Regulation Number 26 of 2017 concerning Milk Supply and Distribution states the fulfillment of domestic milk needs through domestic production conducted by farmers, cooperatives and business actors.
Factors Influencing Domestic Fresh Milk Production (SSDN)

The growth of national dairy cow / SSDN production in 2011 to 2018 is shown in Figure 1. Milk production growth fluctuated until 2018. In 2013, the growth declined to 18.01 percent. The decline in domestic fresh milk production (SSDN) was caused by the 27.40 percent population decrease of dairy cows. East Java, West Java, and Central Java Provinces as the three biggest provinces of dairy cattle population face similar problems dealing with dairy farmers who tend to sell dairy cows and threat of dairy farmers switching to beef cattle breeders which is caused by the stagnant price of milk. The Indonesian Association of Dairy Cooperatives (GKSI) of East Java Province explained the decline in cow milk production in 2013 as a result of the high price of beef that made dairy farmers decided to sell cattle when the price of milk has no significant change (Emil, 2013). The Indonesian Association of Dairy Cooperatives (GKSI) of West Java Province also explained that similar conditions occurred in dairy farmers in West Java and Central Java Provinces who decided to sell dairy cows and switch to beef cattle breeders (153, 2013; Ratri, 2013). Domestic fresh milk production (SSDN) was increasing again until the end of 2017 as the dairy cattle population increased.

Figure 1. Production Growth of Domestic Fresh Milk (SSDN) in 2011-2017.
Source: Processed Agricultural Statistics Database Ministry of Agriculture, 2018

The current dairy cattle business is still dominated by farmers cattle business with traditional management and is an uneconomic business scale based on the ownership of livestock and its productivity. The ownership of livestock is around 1-4 heads, with a low level of milk production, which is an average of 10 liters per day per head (Nurtini & UM, 2014). While based on dairy cattle business by dairy cattle companies in Indonesia, National Bureau
of Statistics shows that milk production by dairy companies in Indonesia reaches 126.5 million liters. Total dairy company in Indonesia is 35 companies. The companies consist of breeding establishment company, dairy establishment company, and collecting milk of dairy cattle company. Based on company classification according to legal entities, the number of dairy companies consists of foundations, individuals, cooperatives, state-owned enterprises, and PT / CV / Firms. The composition of the dairy company currently consists of 21 PT / CV / Firm, 10 cooperatives, and 4 other foundations. Dairy companies have decreased in number over the past five years. Recorded from 2013 to 2017 there was a decline in the company by 47.76%, which was 67% in 2013 to 35% in 2017. If the decline in the number of companies continues to occur, it will have an impact on the level of domestic fresh milk production (SSDN).

Chairman of the Indonesian Cattle Breeders Association (APSPI) said that domestic milk production is still difficult to develop due to many obstacles faced by farmers. Besides, the national dairy cattle population also decreased from 611,940 cows in 2012 to 525,171 cows in 2016. The decline reached 16.5 per cent (Julianto, 2016). These obstacles include difficulty of finding forage for dairy cattle, especially during dry season, dairy farmers are reluctant to increase the number of dairy cattle they have because of the difficulty of getting forage and breeders who mostly rely on natural birth also cause the difficulty of increasing dairy cattle population. The difficulty to increase dairy cattle population has an impact on the emergence of conditions of lack of domestic fresh milk supply (SSDN) (HKTI Center, 2018). The purpose of this research is to analyze affecting factors namely the number of dairy cattle, forage feed, concentrate and land area- influencing domestic fresh milk production (SSDN).

2. RESEARCH METHODS

The research was developed from a framework based on domestic fresh milk (SSDN). The lack of supply of domestic fresh milk (SSDN) has an impact on the amount of imported milk, especially raw materials for processed milk such as milk powder (skim milk powder), milk fat and milk butter powder. According to Ministry of Agriculture Regulation No.26 of 2017, it is explained that the provision of milk through domestic production can be done by increasing productivity. Increased productivity can be done by means of improving the quality of breeds, providing feed, improving the quality of feed and feeding, and improving maintenance and animal health management. Productivity is analyzed through the production function. The production function shows the maximum number of outputs / outputs that can be generated from the use of a combination of capital and labor input factors (Nicholson & Snyder, 2008). The production function in the agricultural sector is applied by applying the Cobb-Douglas production function.

The scope of the study covers the analysis of factors that affect domestic fresh milk production (SSDN) in Boyolali District, Central Java Province. The factors of production are limited to the factors of dairy cow production, the number of dairy cows, forage feed and concentrates given to dairy cows, and the extent of dairy farms. Site selection is based on the size of the dairy cow population. The research was conducted in June, October 2018.

The approach used in this research is a quantitative approach. The quantitative approach uses the post-positivism paradigm that develops knowledge (such as: causal thinking, reduction of certain variables, hypotheses and questions; the use of size and observation; and theory testing) that uses research strategies such as conducting experiments and surveys, collecting data instruments determined in research that produce statistical data (Creswell, 2003).

The research data uses secondary and primary data. Secondary data were taken from the publication of the report from the Central Java Regional Livestock and Animal Health Service Office, Boyolali Regency Livestock and Animal Health Service Office and Central Java
Provincial Bureau of Statistics. While the primary data were obtained by interviewing concerning parties related to existing problems. Cobb Douglas production function model is used in the method analysis. Mathematical equation of the Cobb Douglas function is shown by the following equation (Gujarati, 2006):

\[ Y = b_0 X b_1, Xb_2, Xb_3, \ldots, Xb_i \]  

Transformations in linear form using natural logarithms (ln) are performed in estimating parameters Cobb-Douglas function equation written as follows (Gujarati, 2006):

\[ \ln Y = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \varepsilon \]  

Where: \( Y = \) dairy cattle production (liters / day); \( X_1 = \) number of dairy cattle; \( X_2 = \) forage feed; \( X_3 = \) concentrate; \( X_4 = \) land area; \( \beta_0 = \) constants; \( \beta_1, \beta_2, \beta_3, \beta_4 = \) coefficient of estimated parameters with \( \beta_1, \beta_2, \beta_3, \beta_4 > 0 \)

The explanation of the coefficient of production factors is as follows: 1) \( \beta_1 > 0 \) means that if the number of dairy cattle increases by one per cent, it will increase milk production from dairy cattle by one per cent; 2) \( \beta_2 > 0 \) means that if the amount of forage feed increases by one per cent, it will increase milk production by one per cent; 3) \( \beta_3 > 0 \) means that if the amount of concentrate is added by one per cent it will increase the production of dairy cattle by one per cent; and 4) \( \beta_4 > 0 \) means that if the total area of land is added by one per cent, it will increase the production of dairy cattle by one per cent.

It is necessary to perform hypotheses test to see the properness of the model used in the research (Gujarati, 1978) such as: 1) OLS (Ordinary Least Square) assumption test; 2) model parameter test (F test); and 3) variable parameter test (t test). OLS assumption test must fulfill several main assumptions in classical linear regression model using OLS method including: 1) linear regression model in parameter; 2) \( X \) is assumed to be non-stochastic (fixed in repeated and non-random samples); 3) average error value is zero; 4) homoscedasticity; and 5) no autocorrelation between errors (Kuncoro, 2001). F-test is used to test model parameter. The F test is described as follows:

\[ F_{-calculate} = R2 / (k-1) (1-R2) / (n-k) \]  

Where: \( R2 = \) Coefficient of determination \( K = \) Number of independent variables \( N = \) Number of respondents

Test criteria are explained that: 1) If \( F_{-calculate} > F_{-table} \) (k-1, n-k), at the real level \( \alpha \) then reject \( H_0 \); and 2) If \( F_{-calculate} < F_{-table} \) (k-1, n-k), at the real level \( \alpha \) then accept \( H_0 \). T-test is used to test variable parameters and is described as follows:

\[ t_{-calculate} = \beta_i - 0 \ \text{S}\beta_i \]  

Where: \( \beta_i = \) i-regression coefficient which is assumed to be \( \text{S}\beta_i = \) standard deviation of \( \beta_i \)

Test Criteria are explained that: 1) \( T_{-calculate} > T_{-table} \) (\( \alpha / 2; n-k \)), then \( H_0 \) is rejected, meaning that there is an influence of the free variables to the dependent variables; and 2) \( T_{-calculate} < T_{-table} \) (\( \alpha / 2; n-k \)), then \( H_0 \) is accepted, meaning that there is no influence of the independent variables to the dependent variables (\( n: \) number of respondents and \( k: \) number of variables)

3. RESULTS AND DISCUSSION

Boyolali Regency, Central Java Province is one of the locations with the highest population of dairy cattle. The dairy farming business in Central Java Province consists of local community dairy farming businesses with traditional management and dairy farming businesses in the form of companies (Limited Liability Company (PT) / Commanditer Company (CV) / Firms, cooperatives and foundations). The total population of dairy cattle in Central Java Province reached 138,560 with 66.84% of the dairy cattle population coming from Boyolali Regency.
The population of dairy cattle in Boyolali Regency reached 92,619 in 2018. The population of dairy cattle is spread in several sub-districts in Boyolali Regency, Selo District (8,233 heads), Ampel District (16,073 heads), Cepogo District (19,509 heads), Musuk District (27,166 heads), Boyolali District (6,273 heads), Mojopuro District (15,223 heads), Teras District (128 heads), Simo District (10 heads), and Wonosegoro District (4 heads) (BPS, 2018). The size of the dairy cattle population in Boyolali Regency has made Boyolali District a location for the master plan for the development of the Central Java Province dairy farming area.

![Figure 3. Domestic Fresh Milk (SSDN) Production Growth in Boyolali Regency, 2008-2017](image)

Source: processed data, 2019

Figure 3 shows the growth of Boyolali Regency domestic fresh milk production (SSDN) during the period of 2008 - 2017. Domestic fresh milk production decreased to 5.71% in 2014 and 1.57% in 2017. Decreased production of domestic fresh milk (SSDN) in 2014 was one of the direct impacts of the eruption of Mount Kelud in East Java Province. The eruption of Mount Kelud has limited the availability of healthy food derived from green grass. The decline in production reached around 10% of the total daily production of 150-160 tons of milk. The condition improved again with increasing green grass on the land of dairy farmers in Boyolali District (Setiadi, 2014). While the decline in domestic fresh milk production (SSDN) in 2017 is not as big as the decline in 2015 can also be influenced by the increase in the dairy cattle population in Boyolali Regency. The population of dairy cows in Boyolali Regency increased by 28.41% in 2017 when compared to the dairy cattle population in 2015. Hadjosubroto in Tawaf and Rusanti (2017) explained that the amount of milk production in dairy cows can also be influenced by a combination of genetic factors and environmental factors.
The main purpose of producers in carrying out an economic activity or business is to make a profit. One of the efforts to gain profit in dairy farming is by increasing dairy cattle production of the cattle they breed. This shows that an understanding of the factors that influence farmer dairy cattle production in Boyolali Regency is needed as the basis for efforts to increase dairy cattle production they breed. Analysis of these factors uses the Cobb-Douglas function model which shows the mathematical relationship between milk production and the production factors used. Production factors considered to be influential in dairy cattle business in Boyolali Regency include the number of dairy cattle (X1), forage feed (X2), concentrate (X3), and land area (X4). These four factors are then analyzed to see their influence on dairy cattle production. Parameter estimation in the function of Cobb Douglas equation is done by changing the data in the form of double natural logarithm (ln). Based on the results of data processing using Eviews 10 software, the following production function model is obtained:

\[ \ln Y = 2.279900 + 0.969\ln X1 - 0.120\ln X2 - 0.005\ln X3 + 0.047\ln X4 + e \]  

The model estimation results using the Cobb-Douglas function model showed that the coefficient of determination (R2) was 74.58 per cent with the value of corrected determination (R2 adjusted) of 72.16 per cent. The value of determination (R2) shows that at 72.16 per cent
of the variation in production could be simultaneously explained by the factors of number of dairy cattle, forage, concentrates, and land area. While 27.84 per cent was explained by other factors outside the model. Other factors outside the model that were estimated to influence fresh milk production were age, environment, climate and weather influences, administration of drugs and vitamins, livestock environment and disease attacks. The coefficient value in the Cobb-Douglas function model is the production elasticity value of the production variables. The results of the F-calculate on the production function estimator model reached 30.808 and the probability value was 0.000 where the probability value was less than the real level value (0.05). This condition explains that all production factors used in dairy cattle business activities together have a significant influence in dairy cattle milk production.

Based on the results of the t-test it is recognized that the independent variable that has a significant effect on milk production is the number of dairy cattle, whereas for forage inputs, the concentrates and land area do not have a real effect on milk production.

Analyzed production function estimation model showed the existence of feasibility level based on OLS (Ordinary Least Square) assumptions. The intended OLS assumptions are model; there is no multicollinearity between independent variables, homogeneous variety (homoscedasticity) and no autocorrelation. Multicollinearity testing is done so that independent variables used do not influence each other. Based on the test using VIF (Variance Inflation Factors), it can be identified that problem-free model is multicollinearity; this is based on the results of the VIF test which showed all variables had a value of less than 10, namely 1.900454; 1.521631; 1.811734; 1.099674. Autocorrelation test using Breusch-Godfrey Serial Correlation LM Test with a Chi-Square (2) probability value of 0.2243 and it was greater than the real level (0.05). So, it can be concluded that the problem-free model is autocorrelation. Heteroscedasticity test carried out using Breusch Pagan-Godfrey test where the value of p value was indicated by the value of chi square (2) probability in Obs * R-Squared was equal to 0.5359. Because the p value of 0.05359 is greater than the real level of 5% (0.05), H₀ is accepted. Regression model is homoscedasticity or problem-free heteroscedasticity. For the normality test, Jarque Bera test is used. The Jarque-Bera probability value from the estimation results in this research was 0.065475, where the value was greater than the real level of 0.05. So, it was concluded that the estimation results passed the normality test. Based on the results of statistical calculations, the analysis of the estimator of production function model in farmers in Boyolali Regency has met the OLS (Ordinary Least Square) assumption.

These OLS assumptions fulfilled requirements indicate that the production function model can be used in estimating the relationship between the independent variables (production inputs) used for production result (output) in dairy cattle business activities. The input of production includes the number of dairy cattle, forage, concentrates and forage land.

3.1. Number of Dairy Cattle (X1)

Based on the results of parameter estimation of production factors, it showed that the variable number of dairy cattle (X1) had a P-value of 0.0000. If the real level is 5 per cent (0.05), the variable number of dairy cattle has a significant influence on cow's milk production, so that if there is a decrease or an increase in the number of dairy cattle it will significantly influence the productivity of dairy cattle. Based on the factor parameter coefficient, the number of dairy cattle had a positive value of 0.968976. This value indicates that if the number of dairy cattle increases by one per cent, it will increase dairy cattle production by 0.968976 per cent by assuming that all other things remaining equal (ceteris paribus).

The result of the research by Vijaykumar et al (2017) explains a significant relationship between the amount of milk production in dairy cattle and the number of Korean Holstein
lactating cattle \( (p < 0.001) \) with milk production reaching the maximum of cattle in the third lactating cow. The research noted that milk production was the highest in the longer period of time than in the previous stage (55 to 90 days) at 4 times daily milking frequency and the lowest milk production in dairy cattle at the end of the lactation period \( (> 201 \text{ days}) \). Besides, the frequency of milking also had a significant impact on milk production \( (p < 0.001) \) in Korean Holstein cattle using an automatic Milking System (AMS) (Vijaykumar, et al., 2017). The Food and Agriculture Organization of the United Nations (FAO) explains that cow milk production in developing countries has decreased in line with the number of dairy operation and the number of dairy cattle, but productivity has increased. Meanwhile, milk production for dairy cattle has increased along with the increasing number of lactation cattle in developing countries (FAO, 2018). Production analysis carried out by the Ministry of Agriculture in 2016 showed that milk production was significantly affected by the size of the dairy cattle population within the current year (Ministry of Agriculture, 2016).

The Indonesian Minister of Agriculture Regulation Number 26 of 2017 concerning Milk Supply and Distribution stipulates that efforts to increase dairy cattle population can be done through: 1) increase in birth rates; 2) prevention of slaughtering of productive female dairy cattle; 3) entry of productive female dairy cattle; and 4) calf enlargement activities (rearing). Increasing birth rates is conducted by handling reproductive disorders and increasing reproductive efficiency.

3.2. Forage \( (X_2) \)

Based on the results of parameter estimation of production factors, it showed that forage variable \( (X_2) \) had a \( P \)-value of 0.2047. If the real level is 5 per cent \( (0.05) \), the forage variable has no significant effect on milk production. So, if there is a decrease or an increase in the amount of forage there is no significant effect on dairy cattle productivity. Even so, it does not mean that forage has no effect, because simultaneously all variables significantly influence the productivity of dairy cattle milk. Based on the parameter coefficient value, the number of forage had a negative value of \(-0.120452\). This value shows that if forage increases by one per cent it will reduce dairy cattle production by 0.120452 per cent by assuming all other things remaining equal (ceteris paribus).

The negative effect of forage on dairy cattle production level of indicates that the forage nutrient content given to dairy cattle in Boyolali Regency has not met the nutritional needs needed by dairy cattle. Maemunah (2017) research also shows that forage has no significant effect on the production of Etawa Peranakan (PE) goat milk with a negative coefficient value so that the amount of PE goat milk production can be increased by reducing forage. This shows that the forage provided is lower in nutrition than the nutritional needs needed by PE goats.

Forage sourced from Boyolali Regency can also be affected by the eruption of Mount Merapi. The eruption of Mount Merapi has an effect on the content and quantity of forage originating from Boyolali Regency. Research by Ilham and Priyanti (2011) states that the Merapi catastrophe occurred in 2010 caused livestock deaths and decreased milk production. Livestock deaths was caused by hot clouds and land and consumption of green feed contaminated with ash. Cattle that were left displaced were not given food and drink for four days which resulted in the highest reduction in milk production.

3.3. Concentrate \( (X_3) \)

Based on the results of parameter estimation of production factors, it showed that the Concentrate variable \( (X_3) \) had a \( P \)-value of 0.9421. If the real level is 5 per cent \( (0.05) \), the concentrate variable has no significant effect on cow milk production. So, if there is a decrease or increase in the amount of concentrate does not significantly affect the productivity of dairy
cattle milk. Even so, it does not mean that the concentrate does not have an effect, because simultaneously all variables significantly influence the productivity of milk for dairy cattle. Based on the factor coefficient of concentrate, the coefficient had a negative value of -0.005409. This value indicates that if the concentrate increases by one per cent, it will reduce dairy cow production by 0.005409 per cent by assuming all other things remaining equal (cateris paribus).

Comparison of the use of concentrate with forage has an effect on the amount of milk production in dairy cattle. The experimental forage research in crossbred descent by Sanh et al. (2002) shows that the ratio of use of concentrate and forage with a ratio of 70%: 30% resulted in milk production of dairy cattle with a greater protein content compared to the use of green concentrate and forage with a ratio of 30%: 70%. The amount of fat content in dairy cattle milk production is inversely proportional to the large ratio of concentrates mixed in animal feed. The higher the ratio of concentrates mixed in animal feed will have an impact on the lower fat content in milk for dairy cattle (Sanh, Wiktorsson, & Ly., 2002).

3.4. Land area (X4)
Based on the results of parameter estimation of production factors, it showed that land area variable (X4) had a P-value of 0.2687. If the real level is 5 per cent (0.05), land area variable has no significant effect on cow’s milk production. So, if there is a decrease or increase in land area it does not significantly influence the productivity of dairy cattle milk. Even so, it does not mean that the land area has no effect, because simultaneously all variables significantly influence the productivity of dairy cattle. Based on the coefficient parameter value, land area factor had a positive value of 0.047814. This value indicates that if the land area increases by one per cent, it will increase the production of dairy cattle by 0.047814 per cent by assuming that all other things remaining equal (cateris paribus).

Mugambi, et al. regarding the assessment of the performance of smallholder farms in Kenya with an econometric approach shows that land size variable has a positive but not significant effect on total milk production in the East Embu area. While the land size variable has a negative and not significant effect on total milk production in the South Igembe area. Land area variable has a positive but not significant effect on total milk production if the research was conducted in two locations (East Embu and South Igembe) (Mugambi, Kimenchu, Mwangi, Wambugu, Kairu, & M.M, 2015).

4. CONCLUSION AND POLICY IMPLEMENTATION
The increase in domestic fresh milk production through the addition of dairy cattle population is one of the efforts to strengthen the position of domestic fresh milk (SSDN) as raw material in the dairy industry. Based on the results of multiple regression variables the number of dairy cattle, forage, concentrates, and land area significantly influence the level of milk production. While partially, only the number of dairy cattle that variable has a significant effect on milk production volume. Forage and concentrate variables have negative and not significant effects on the amount of domestic fresh milk production (SSDN). While the variable area of land has a positive but not significant effect on the amount of domestic fresh milk production (SSDN). The negative effect of forage and concentrate on domestic fresh milk production (SSDN) can also be caused by environmental conditions around the farm or feed source environment, considering that the research location is one of the locations affected by the distribution of volcanic ash from the eruption of Mount Merapi.

Increasing domestic fresh milk production (SSDN) can be done through optimizing input variables in the management of dairy farms such as increasing the number of dairy cattle, forage feed and concentrates on dairy cattle food, and land area. Increasing the population of dairy cattle, forage feed and concentrates on dairy cattle food and land area is carried out by taking...
into account the quality of the improvement efforts such as applying the good dairy farming practices (GDFP) method on dairy farming. The method is applied with the aim of ensuring that the dairy products produced are safe, as needed and sustainable.

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