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Influence of Daily Cow Population on Daily Cow Milk Production in Indonesia Period 2009-2019 and Government Policy to Realize White Revolution in Indonesia

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The purpose of this study was to determine the effect of the population of dairy cows on milk production of dairy cows in Indonesia for the period 2009-2019 and government policies to realize the white revolution in Indonesia. The research method used is a descriptive analysis approach regarding the development of the dairy cow population and its relationship to dairy cow's milk production in Indonesia. The type of data used is annual time series secondary data starting from 2009-2019. Based on the results of the regression, the coefficient value was 0.6677752, indicating that an increase in the population of dairy cows by 1 unit will increase the production of dairy cows in Indonesia by 0.6677752 units. The increase in dairy cow's milk production is relatively low due to the lack of understanding of local breeders regarding dairy cow rearing and feeding to provide adequate nutrition for cows. Government policies are to realize the white revolution by paying attention to the provision of fresh milk for poor children, counseling local farmers, increasing the economic value of cow waste, and making cooperatives as a place for dairy farmers.

Keywords: population, production, dairy cows, white revolution

Research Background

Public health is an important factor in the nation's development process to achieve prosperity. The more developed a country, the government's response to people's health will increase. One of its manifestations is by increasing the consumption pattern of dairy cow's milk (fresh milk), especially for children as the forerunner and next generation of the nation with healthy Indonesian Human Resources (HR).

The reality of dairy cow's milk consumption in Indonesia is lagging behind other Southeast Asian countries such as Vietnam, the Philippines, Malaysia, and Thailand. Indonesia's milk consumption level has only reached 7.7 liters per capita per year, while people have reached 8.5, 11, and 25 liters per capita per year. In fact, we are left behind by India, which consumes about 45 liters of milk per capita per year (Prabowo et al., 2013).

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The low level of consumption can be seen from two directions, namely the demand and supply sides. This research focuses more on the development of dairy cow's milk production in Indonesia. The main reason for the news that the low consumption of dairy cow's milk is followed by its production (https://lokaldata.id,article, consumption-susu-masih-low). Meanwhile, Indonesia, as a country with a large area, has the potential to increase dairy farming for various economic and social purposes.

Table 1 and Figure 1 are the development of milk and dairy cow population in Indonesia for the period 2009-2019.

Table 1

Cow Population and Milk Production

	Year	Cow population (per head)	Milk production (tons)
1	2009	474,701	827,249
2	2010	488,448	909,533
3	2011	597,213	974,694
4	2012	611,940	959,731
5	2013	444,266	786,849
6	2014	502,516	800,749
7	2015	518,649	835,125
8	2016	533,933	912,735
9	2017	540,441	928,108
10	2018	581,822	951,004
11	2019	565,001	944,537

Source: https://www.bps.go.id/indicator/24/470/1/populasi-sapi-perah-menurut-provinsi.html; https://www.bps.go.id/indicator/24/493/4/produksi-susu-segar-menurut-provinsi.html.

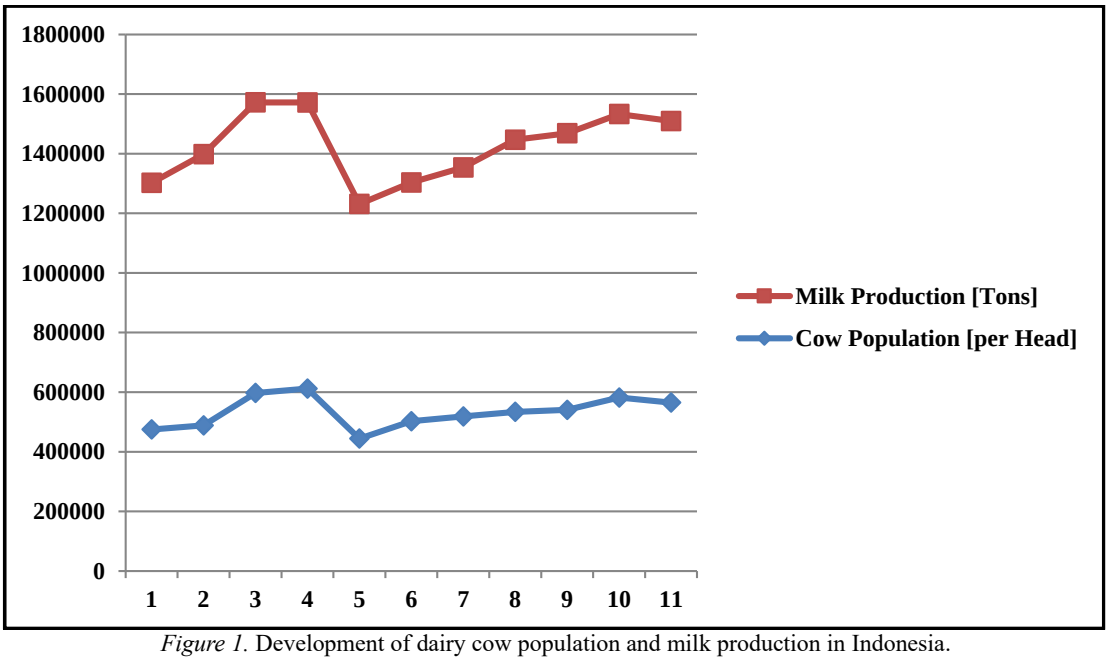

Figure 1. Development of dairy cow population and milk production in Indonesia.

Information: 1 = 2009; 2 = 2010; 3 = 2011; 4 = 2012; 5 = 2013; 6 = 2014; 7 = 2015; 8 = 2016; 9 = 2017; 10 = 2018; 11 = 2019.

Source: https://bps.go.id/indikator/24470/1-7/populasi-sapi-perah-menurut-propinsi.html; https://fdokumen.com/document/27705sni-31411-2011-susu-segar-bag1-sapi.htm.

From Table 1, it can be seen that the population of dairy cow in Indonesia in 2009 was 474,701 heads and in 2019 it became 565,001 cows or an increase of 19.02%. The dairy cow population fluctuated, with the lowest being 444,266 in 2013 and the highest at 581,882 in 2018. Likewise, the milk production of dairy cows increased from 827,249 in 2009 to 944,537 tons in 2019. The lowest production of dairy cows was 786,849 tons in 2013 and the highest was 974,649 tons in 2011. Although the development of the two variables looks in the same direction, from 2011 to 2012 when the population of dairy cows increased from 597,213 to 611,940, the milk production of dairy cows actually decreased from 974,694 tons to 959,731 tons.

Based on this description, it is very important to examine the influence of the dairy cow population on dairy cow milk production in Indonesia and government policies in realizing the white revolution (Prabowo, 2013).

The white revolution, namely the national development process requires effective government development policies so that development goals, and targets can be achieved more efficiently. The policy is divided into three interrelated parts, namely:

1. The policy of major incentives for quality sources of economic growth;

2. Resource optimization policies: policies needed to optimize the utilization of national resources to support quality growth;

3. Policies to suppress leakage: policies to suppress inefficiencies and leakages that occur in the national economy (Prabowo, 2013).

Formulation of the Problem

Based on the description of the background of the problem, the formulation of the problem proposed is:

1. What is the effect of the dairy cow population on dairy milk production in Indonesia?

2. What policies can the government take to bring about the white revolution?

Research Purposes

The aim of this research is:

1. To determine the effect of the population of dairy cows on dairy milk in Indonesia.

2. To find out the policies that can be done by the government to realize the white revolution.

Theoretical Review

Production Theory

Production theory emphasizes the relationship between output and input. Inputs or factors of production are everything needed in the production process to increase the utility of an item. Factors of production are divided into four, namely: 1. Land (natural resources) = R; 2. Labor (labor) = L; 3. Capital (capital) = K; 4. Skill (expertise/entrepreneurial) = S.

The relationship between the factors of production used and the output achieved is called the production function. When associated with the four factors of production, the complete production function can be written:

$$Q = f (R, L, K, S)$$

Based on this equation, it shows that the amount of output is strongly influenced by the size of the factors of production. The analysis that discusses the relationship between output and input is what gave birth to the concept of Production Theory (Lia, 2012).

In its application, the production function can be general, characterized by the freedom to enter the factors of production as expected, whether one or more. The production function is widely practiced in the agricultural sector.

Mathematically it can be written:

$$Q = f(X_1, X_2, ... X_n)$$

Explanation:

Q = output

$X_1, X_2, ... X_n$ = input

While the specific production function is limited to only two variables, namely capital and labor. Therefore, it can be formulated:

$$Q = f(L, K)$$

Explanation:

Q = output

L = labor

K = capital

From the elaboration of the two formulas, it will be seen that the elasticity value has different meanings. In the general production function, if the elasticity is elastic ($e > 1$), then an increase in factors of production will give a greater increase in output and vice versa if it is inelastic ($e < 1$). As for the specific production function, the elasticity value obtained aims to describe the choice of technology desired by the company. If the elasticity of labor is greater than capital ($eL > eK$) then it is called labor intensive and vice versa ($eL < eK$) (Case & Fair, 2007).

Framework

The progress of a country's Human Resources (HR) is strongly supported by people's consumption patterns, both nutritious food and drinks (Sulistyo, 2021). Dairy cow's milk is a fresh milk drink that contains protein and other nutrients that can help brain growth so as to increase the nation's intelligence. The importance of consuming dairy cow's milk has not been reached by poor children in Indonesia, so handling is needed from the production side. Especially with regard to Indonesia, a country that has a fairly large and fertile area, of course, has the potential to raise dairy cows which can increase dairy cow's milk production.

In addition to relying on cow production factors owned by farmers, increasing dairy cow's milk production must be supported by appropriate government policies. Thus, raising dairy cows will provide benefits for rural communities to produce dairy cow's milk that can meet their nutritional needs and welfare. It will further assist government programs in eradicating poverty in villages and have a high multiplier effect on other related fields such as health, education, and so on.

The influence of the dairy cow population on the milk production of dairy cows in Indonesia for the 2009-2019 period can be described as follows:

Figure 2. The influence of the dairy cow population on the dairy milk production.

Research Hypothesis

The increase in the population of dairy cows will encourage an increase in milk production of dairy cows in Indonesia. This statement is in accordance with the production theory which states that the production of a commodity is influenced by the production factors used. Dairy cows as an element of natural resources are the main input for farmers to be able to produce dairy cow's milk. The increasing population of dairy cattle owned by local farmers will encourage an increase in milk production of dairy cows in Indonesia. The impact of an increase in the population of dairy cows will have a positive impact on milk production of dairy cows in Indonesia.

Research related to commodity production in Indonesia has been carried out by the researcher himself using the independent variables, namely land area and the dependent variable of corn. By using the data limit from 1990 to 2006 it is obtained that there is a positive and significant relationship (Sugiartiningsih, 2012). Related to the case of dairy cow milk production, the main factors are land area and natural conditions as capital for farmers to develop dairy cows.

Based on this statement, the proposed hypothesis is:

Ha: The population of dairy cows will have a positive effect on milk production of dairy cows in Indonesia.

Research Methods

This study uses a microeconomic approach, namely the theory of production. The research method uses a quantitative descriptive approach, namely the relationship between the population of dairy cows and milk production of dairy cows in Indonesia. The data used in this study are classified as secondary annual time series data where the population of dairy cattle in Indonesia is sourced from the Central Statistics Agency (https://bps.go.id/indikator/24470/1-7/population-sapi-perah-according to-province.html).

Meanwhile, the production of dairy cows in Indonesia is sourced from the Director General of Livestock & Animal Health of the Ministry (https://www.bps.go.id).

The research period is limited from 2009 to 2019. The selection of data is 2009 because it has passed from the world economic crisis that hit Europe and America. The 2019 limit is due to the peak of Indonesia's economic cycle before being hit by the COVID-19 pandemic, so that more concrete analysis results will be obtained on sustainable development in Indonesia.

The model that analyzes the effect of the dairy cow population on dairy cow milk production in Indonesia for the 2009-2019 period uses the following general production function:

$$QS = aPS^{b} \quad (1)$$

Explanation:

QS = milk production of dairy cows in Indonesia

PS = dairy cow population in Indonesia

a, b = parameters

Considering that the general production function is still in the form of a non-linear equation, so to regress it must transform it into log form like Equation 2 below:

$$\text{Log } QS = \log a + b \text{ Log } PS \quad (2)$$

From the regression results, the anti-log value is sought to estimate the amount of milk production for dairy

cows if the dairy cow population has not been operationalized. The estimation of parameter b is the elasticity of milk production of dairy cows to the population of dairy cows in Indonesia (Domoinick, 2002).

Hypothesis Testing Design

In this study, the *t, F* and R^2 tests will be used. The three tests can be described as follows:

Regression Equation Partial Test

Equation of the Effect of Dairy Cow Population on Dairy Cow Milk Production in Indonesia for the 2009-2019 Period

The population of dairy cows has a positive effect on milk production of dairy cows in Indonesia for the period 2009-2019.

Ho: r < 0 population of dairy cows has a negative effect on milk production of dairy cows in Indonesia for the period 2009-2019.

Ho: r > 0 population of dairy cows has a positive effect on milk production of dairy cows in Indonesia for the period 2009-2019.

Ho is rejected when r > 0.

Simultaneous Test of Regression Equation

Equation of the Effect of Dairy Cow Population on Dairy Cow Milk Production in Indonesia for the 2009-2019 Period

The population of dairy cows has an effect on the milk production of dairy cows in Indonesia for the 2009-2019 period.

Ho: r = 0 The population of dairy cows simultaneously has no effect on milk production of dairy cows in Indonesia for the period 2009-2019.

Ho: $r^1 \neq 0$ The population of dairy cows simultaneously affects the milk production of dairy cows in Indonesia for the period 2009-2019.

Ho is rejected if $r^1 \neq 0$.

Results and Discussion

The results of data processing against the regression equation for the 2009-2019 period obtained the following results:

Table 2

Data Processing Result

Caption	Coef.	Std. err.	*t*	*p* > |*t*|	[95% Conf. Interval]	
Milk production/ton	0.6677752	0.1292812	5.17	0.001	0.3753209	0.9602295
Population of dairy cow/ head cons	2.127358	0.7400816	2.87	0.018	0.4531773	3.801539

From the regression results, QS is the variable of milk production of dairy cows in Indonesia and PS is the population of dairy cows in Indonesia. The calculation results show that the log a is 2.127358 then the anti-log is searched to be 134.0781. This shows the amount of dairy cow's milk production in Indonesia before there was a dairy cow population of 134.0781 tons. Estimated 0.6678 is the value of elasticity of production to the population

of dairy cattle in Indonesia during the study period. This means that an increase in the population of dairy cows by 1% will increase the production of dairy cows in Indonesia by 0.6677752%.

Statistical Test

Statistical testing of the coefficients of the regression equation in this study used the *t*, *F* and R^2 tests.

Regression Equation Partial Test

Ha: The population of dairy cows in Indonesia has a positive effect on milk production of dairy cows in Indonesia for the period 2009-2019.

From the results of the *t*-statistical test, the dairy cattle population variable in Indonesia has a *t*-count value of 5.17. The *t*-value proved to be greater than the *t*-table at a significance level of 1% (*t*-table = 3.250) (Salvatore, 2002).

Simultaneous Test of Regression Equation

Ha: The population of dairy cows in Indonesia has a positive effect on milk production of dairy cows in Indonesia for the period 2009-2019.

From the results of the *F*-statistics test, it looks like the following table:

Table 3

F-Statistics Test

Source	SS	df	MS	Number of obs = 11 F(1, 9) = 26.68 Prob > F = 0.0006 R-squared = 0.7478 Adj R-squared = 0.7197 Root MSE = 0.01788
Model residual	0.008528034	1	0.008528034	
	0.002876745	9	0.000319638	
Total	0.011404779	10	0.001140478	

This *F*-statistic value of 26.68 looks bigger than the *F*-table at a significance level of 1% (*F*-table = 4.96) (Salvatore, 2002).

R^2 Test

The contribution of the dairy cow population variable in Indonesia to dairy cow milk production in Indonesia for the 2009-2019 period can be seen in the table above, which is 0.7478. Thus, the contribution of the dairy cow population in Indonesia to the milk production of dairy cows in Indonesia is 0.7478 or 74.78%. The remaining 25.22% excluded the independent variables used. The contribution of the dairy cow's milk population is quite large in accordance with the characteristics of pure milk products which are highly dependent on the productivity of dairy cows.

Discussion

Based on the design hypothesis, it has been previously found:

Ha: The population of dairy cows has a positive effect on milk production of dairy cows in Indonesia for the period 2009-2019.

The population variable of dairy cows has a positive effect on milk production of dairy cows in Indonesia. This statement is in accordance with the microeconomics premise that the dairy cow population is the main factor for farmers to be able to produce dairy cow milk. If the population of dairy cows kept by farmers increases, the milk production of dairy cows will also be abundant.

Judging from its capacity, a dairy cow can produce 12 liters per day so that in a year it can produce 4,320 liters. If the specific gravity of dairy cow's milk is 1.027 g/mL, the milk production of dairy cows per head is 4,320 liters/year or 4,437 tons/year (https://fkode.com/document/27705sni-31411-2011-susu-segar-bag1-sapi.htm). This target can be achieved if the quality of dairy cattle is maintained in terms of food, cages, land, and all the necessary capital goods. A good dairy cow food is king grass type grass added with concentrate to meet the cow's nutrition. While the productive period of dairy cows is 10 years and the peak of the best milk production is in the fourth to fifth year. This attention was carried out at the Baturraden Center for Superior Cattle Breeding and Forage (BPPTU-HPT) so that dairy cows' milk production could reach 15 to 20 liters per day (https://amp-kontan-co-id.cdn.amproject.org/v/s/amp.kontan.co.id/news/capacity-production-milk-peternak-lokal-limited?amp...).

Although the results of data processing show a positive relationship, it is still inelastic during the period under study. Thus the increase in milk production of dairy cows in Indonesia is relatively low. This is different from the prediction above that the increase in milk production of dairy cows per head can reach a high number (4,437 tons/year).

The small increase in dairy cow's milk production is inseparable from the condition of local farmers. Many Indonesian farmers do not know how to raise good dairy cows. The main factor is the limited knowledge of local farmers regarding the maintenance of dairy cows and the provision of feed that is still not sufficient for cow nutrition. Besides being caused by a lack of understanding, the low feed for dairy cows is also triggered by the limited area of land for feed (https://amp-kontan-co-id.cdn.amproject.org/v/s/amp.kontan.co.id/news/kapasitas-hasil-susu-peternak-lokal-limited?amp...).

The impact is that the production of dairy cows in Indonesia has not been optimal and has not been able to provide welfare for both farmers and the general public.

Then to increase the high environmental economic value of fresh cow's milk production, cow waste is used, especially manure to be used as biogas. Talking about biofuel biotechnology, we already know four generations, namely bioethanol, biohydrogen, algae fuel, and electro fuel & solar fuel. So biogas is the first generation by utilizing animal waste, garbage, and compost (Theresia, 2021). In Indonesia, the use of biogas as fuel in the kitchen has been introduced since the New Order by the government. This action not only reduces environmental pollution but also reduces the cost of living for farmers and the user community. Thus, the government is still obliged to preserve this biogas as well as to use it for higher levels such as transportation.

Finally, to balance the interests of various related parties who need dairy cow's milk for direct consumption and industrial raw materials, the government is obliged to appoint cooperatives as a forum for farmers to be much fairer. Cooperatives must be able to serve the needs of the people with high volumes and low prices. On the other hand, cooperatives can meet the needs of industrialists with appropriate stock and prices. Thus, the cooperative can treat dairy cow's milk as a public good that is abundant and affordable for the poor. For the backward side, the cooperative must be able to serve the needs of cattle farmers, starting from cow food, medicine, all needs for dairy cows and providing fresh funds for farmers to survive in order to be protected from moneylenders.

Conclusions and Suggestions

Conclusion

1. The population of dairy cows has a positive effect on milk production of dairy cows in Indonesia for the period 2009-2019.

2. Government policy to increase milk production for dairy cows is to realize a white revolution in Indonesia, by (1) paying attention to land provision, (2) superior dairy cattle seeds, (3) counseling (4) management of cow waste and, (5) the role of cooperatives especially dairy cooperatives.

Suggestion

1. In future research, it is necessary to add other production factors that influence the milk production of dairy cows in Indonesia.

2. The government's role is needed through clear policies and legal regulations to educate the nation through policies on dairy cow milk production in Indonesia.

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