

The Effect of Using Milking Mechanization on Production at the Rembangan Livestock Breeding and Forage Farms

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Abstract: The livestock sub-sector has a strategic role in the development of the agricultural sector, especially in efforts to strengthen food security to meet animal protein needs, strengthen the economic influence of society and accelerate regional development. This research aims to: (1) determine the difference in production before and after milking mechanization, (2) determine the difference in profit levels before and after milking mechanization, (3) determine the break-even point of the dairy business before and after milking mechanization. Determining the research location was carried out purposively (purposive method), namely in Arjasa District, Jember Regency. The method used in this research is descriptive and quantitative methods. for sampling using the total sampling method with a total of 4 respondents. The analyzes used in the research are: (1) production analysis, (2) profit analysis, (3) BEP analysis. The research results show that (1) milk production before mechanization was 3,180 liters/month while milk production after mechanization was 3,394 liters/month, (2) losses before mechanization were IDR. 3,483,101/month, profit after mechanization is IDR. 2,157,605/month, (3) the break-even point (Break Event Point) before mechanization is 3,496 liters and Rp. 38,458,701/month and after mechanization it was 3,214 liters and Rp. 38,569,195/month with an increase of 8.07% and 0.29%.

Keywords: Mechanization; Milk production; Dairy cows

INTRODUCTION

The livestock sub-sector is part of the agricultural sector that can support development, especially in the world economy. Several important roles of the livestock subsector include the production of meat, eggs and milk to meet human needs for sources of animal protein with high nutritional value and as industrial raw materials (Hakim, 2012) . The livestock sub-sector has a strategic role in the development of the agricultural sector, especially in efforts to strengthen food security to meet animal protein needs, strengthen the economic influence of society and accelerate regional development (Daryanto, 2011) .

Based on the 2020 Census of the Jember Regency Livestock, Fisheries and Maritime Affairs Service, the base area for dairy cattle agribusiness, the results showed that the total production of dairy cattle in Jember Regency was around 2,958,807 kg. The largest dairy cattle production is in Sumberbaru District at 597,665 kg, Arjasa District has the 2nd largest production in Jember Regency recorded at 476,598 kg. One way to develop and increase the productivity of domestic dairy cows. The success of increasing livestock production is not only determined by genetic factors, but also by environmental factors, including technical livestock skills, namely breeding, feeding, daily care and other maintenance of the breeder. Managers or breeders must allocate production equipment as efficiently as possible. Technology is also needed that can increase livestock productivity and production scale.

Hamid, (2017) , concluded that milk production from machine milking was higher than milk production from milking farmers who had not used machines, respectively, namely 3694 L/lactation and 3549 L/lactation, but the difference between the two was not significant ($p>0.05$). The milk quality tests carried out consisted of specific gravity, acidity, pH, 70% alcohol, methylene blue reduction test (MBRT) and milk fat

tests. The test results were then compared with SNI 3241.: 2011, the research results showed that there was no difference in the quality of milk from machine and manual milking in terms of specific gravity (BJ), acidity, pH. Both alcohol tests were negative, and the MBRT test for both samples showed that the milk quality was at a fairly good level with an estimated bacterial count of 4 to 20 million. The fat content of milk produced by machine milking tends to be higher than milk produced by farmers who do not use machines, namely 3.2% and 2.8%, respectively. The difference in milk fat percentage makes the average price of fresh milk for machine farmers Rp. 4,762.00/liter and manual breeders Rp. 4,469.00/liter. The results of the partial budget analysis show that there was an increase in income of Rp. 1,430,347.00/year or equivalent to Rp. 119,195/month. The use of milking machines in general can increase farmers' income and actually increase efficiency in terms of labor utilization and milking time.

Muhammad Ernawan, (2016) , concluded that the profit from the lactation dairy cattle farming business in Minggirsari Village, Kanigoro District, Blitar Regency was IDR. 3,135,100/year. In strata I, the profit from the livestock business is IDR. 1,757,500/year, strata II Rp. 4,165,800/year, and strata III Rp. 10,718,600/year. The BEP value of the livestock business is based on the price of milk, namely Rp. 3,809/liter and based on milk production, namely 16,129 liters/year. In strata I, the BEP price value is Rp. 3,804/liter and production BEP is 11,310 liters/year, strata II price BEP value is Rp. 3,851/liter and BEP production is 18,601 liters/year, and strata III BEP price value is Rp. 3,759/liter and BEP production is 44,919 liters/year. The R/C value in the dairy farming business is 1.054 and the B/C value is 0.054. In strata I the R/C value for the livestock business is 1.047 and the B/C value is 0.047, in strata II the R/C value is 1.063 and the B/C value is 0.063, and in strata III the R/C value is 1.080 and the B/C value is 0.080.

Londa et al., (2017) , concluded that milk production was 5.8 liters/cow/day by rearing 27 cows, while only 6 cows were produced. The production costs incurred consist of fixed costs of Rp. 7,291,750 and variable costs of Rp. 19,221,000. The revenue obtained was IDR. 15,900,000 from the sale of 1060 liters of milk at a price of Rp. 15,000 per liter. Break Even Point (BEP) analysis obtained revenue (Rp) is Rp. 26,512,750 and the unit's Break Even Point (BEP) is 1,767.52. The Break Even Point (BEP) for the "MSC order" dairy farming business can be achieved by receiving milk sales of IDR. 26,512,750 with a milk production volume of 1,767.52 liters or when the number of lactating cows was 10.16.

This research focuses on milking mechanization. Milking mechanization itself is a change in milking technology from hand to machine. Milking mechanization has become widespread on dairy farms, but has not been widely adopted in Indonesia. The introduction of this technology is expected to provide added value to the livestock sector through efficiency, productivity and quality of milk produced in accordance with national and international standards.

Rembangan Livestock Breeding and Forage UPT is one of the dairy farming companies that has recently implemented milking mechanization in order to increase fresh milk production in Indonesia. However, until now there are still many dairy farmers who have not adopted mechanized milking. This research aims to determine the difference in the amount of milk production before and after mechanized milking, to calculate the difference in the level of profit in the dairy business before and after the mechanization of milking, and to determine the break-even point for the dairy business before and after the mechanization of milking.

METHOD

Research design

The method used in this research is quantitative with a descriptive approach. The descriptive method is a research method that aims to describe events systematically, factually and accurately regarding the facts, characteristics and relationships between phenomena that occur in the present. Meanwhile, quantitative research methods are a type of research whose specifications are systematic, planned and clearly structured from the start until the creation of the research design (Sugiyono, 2012) .

Population, Sample, Sampling

The sampling technique was carried out using the *total sampling method*. The number of dairy farmers taken was 4 breeders with a total of nine (9) dairy cows at the Rembangan Livestock Breeding and Forage UPT.

Intervention Procedures.

Determining the research location was carried out deliberately (*purposive* sampling). The location of this research was carried out at the Rembangan Livestock Breeding and Forage UPT which is located in Jember Regency, East Java with the consideration that the company is located in Arjasa District which is one

of the 2nd largest producers of dairy milk in Jember Regency. The research was conducted in June 2022 before mechanization and January 2023 after mechanization.

Instrument

1. To answer the first research objective, namely to determine the milk production produced before and after milking mechanization, production theory analysis according to (Algifari, 2002) was used . Mathematically it can be written as follows :

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

Information :

Q = Output/Amount of Production

f = Production Factors

K = Capital

L = Labor

To test the first hypothesis regarding differences in milking production before and after mechanization, a mean difference t test was carried out using secondary data in the field with the formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} - 2r \left(\frac{S_1}{\sqrt{n_1}} \right) \left(\frac{S_2}{\sqrt{n_2}} \right)}}$$

Information :

\bar{X}_1 = Average Milking Sample Before Mechanization

\bar{X}_2 = Average Milking Sample After Mechanization

S_1 = Standard Deviation of Milking Samples Before Mechanization

S_2 = Standard Deviation of Milking Samples After Mechanics

S_1^2 = Milking Sample Variance Before Mechanization

S_2^2 = Milking Sample Variance After Mechanization

r = Correlation Between Two Samples

To determine the hypothesis, use the following criteria:

H_0 : There is no difference in the amount of cow's milk produced before and after mechanized milking.

H_a : there is a difference in the amount of cow's milk produced before and after mechanized milking.

If H_0 is true then the decision making criteria are:

If the probability is >0.05 then H_0 is accepted

If the probability ≤ 0.05 then H_0 is rejected

1. To answer the second research objective, namely to calculate the level of profit in the dairy milk business between milking before and after mechanization at the Rembangan Animal Breeding and Forage UPT. According to (Yuspitasari, 2020) , mathematically, profit can be formulated as follows:

$$\pi = TR - TC$$

$$\pi = P \times Q - (TFC + TVC)$$

Profit:

π : Profit

TR : Total Revenue (Total Revenue)

TC : Total Cost (Total Cost)

P : Price (Production Price)

Q : Quantity (Production Amount)

TFC : Total Fixed Cost (Total Fixed Cost)

TVC : Total Variable Cost (Total Variable Cost)

To answer the third research objective, namely measuring the break-even point of dairy cattle businesses before and after milking mechanization, break-even analysis was used. The break-even point is the

point where total revenue equals total costs (Widiati & Kusumastuti, 2013) . Mathematically it can be written as follows :

$$\text{BEP yield or product} = \frac{\text{Biaya total}}{\text{Harga produk}}$$

$$\text{BEP price} = \frac{\text{Biaya total}}{\text{Produk total yang diharapkan}}$$

To test the second hypothesis that the dairy farming business has broken even if total revenue is equal to total costs. Differences in BEP values for milking dairy cows before and after mechanization .

RESULTS AND DISCUSSION

In the dairy farming business, it produces products in the form of milk, where the production process is carried out during the lactation period of cows. The cow's lactation period or starts producing at the age of 2.5 – 3 years after giving birth to a calf. Milk production results are a measure of success in a dairy farming business, the more production produced makes the livestock business profitable. The adoption of mechanized milking was implemented by the Livestock Breeding and Forage UPT in August 2022, the farm carried out two milking processes in the morning and afternoon. Production per day during June 2022 before mechanization and November 2022 after it is presented in Table 1.

Table 1 Milk Production Per Month Before and After Mechanization at the Rembangan Animal Breeding and Forage UPT in 2023

No	Cattle	ID. Cattle	Before Mechanization (liter)	After Mechanization (liter)
1	Santi	S.001	521	571
2	Bella	S.002	340	487
3	Lola	S.003	189	253
4	Serly	S.004	231	260
5	Bonita	S.005	828	851
6	Karla	S.006	283	344
7	Rahma	S.007	155	51
8	Farah	S.008	453	476
9	Azmi	S.009	181	103
Total			3,180	3,394

Source: Processed Primary Data (2023).

Table 1 shows the results of milk production for a month with a total of 9 lactating cows before mechanization, which was lower than the production after mechanization, namely 3,190 liters, where the cow named Bonita was the lactating cow with the highest milk production of 828 liters and the cow named Rahma was the cow with the highest production. lowest of 155 liters for a month. Milk production after mechanization was 3,394 liters with the highest production being 851 liters produced by a cow named Bonita while the lowest production was produced by a cow named Rahma at 51 liters in a month. The average level of total milk production per cow after mechanization is higher than the total milk production before mechanization, this is because the milking machine used after mechanization can milk cows optimally compared to manual milking which was done before the implementation of mechanization. There are 2 cows whose milk production after mechanization is lower than before mechanization because the 2 cows named Rahma and Azmi are experiencing a dry period. This is the same according to research (Jurnalita, 2007) , performance test results show that milking machines are able to milk more dairy cows than manual milkers.

Table 2 Results of T-Test Analysis of Average Differences (Paired Sample T-test) of Milk Production Before and After Mechanization at the Rembangan Livestock Breeding and Forage UPT in 2023

Paired Samples Test										
Paired Differences										
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		Q	df	Sig. (2-tailed)	
					Lower	Upper				
Pair 1	Before									
	Mechanizatio									
	n - After	-23.81111	75.65625	25.21875	-81.96566	34.34343	-.944	8	.373	
	Mechanizatio									
	n									

Source: Processed Primary Data (2023).

The results of *the paired t-test* in table 2 above can be explained as follows. The significance level of this test is 5%. The basis for making decisions regarding the proposed hypothesis is if the sig value. (2-tailed) < 0.05 then Ho is rejected and Ha is accepted and vice versa. It can be seen from the table, the sig value. (2-tailed) is 0.373, where this value is greater than 0.05, so Ho is accepted and Ha is rejected. So it can be concluded that there is no significant difference in the amount of cow's milk production produced before and after mechanized milking at the Rembangan Animal Breeding and Forage UPT . Dairy cow milk production is not significant because the difference between production before mechanized milking and after mechanization is relatively small. The results of this analysis are not in accordance with the first hypothesis because there is no difference in the amount of milk produced by dairy cows between milking before and after mechanization at the Rembangan Animal Breeding and Forage UPT.

Production costs are the value of the use of production facilities and other facilities charged to the product. Production costs are divided into fixed costs and variable costs. Fixed costs consist of building rental costs and depreciation costs. Meanwhile, variable costs consist of feed costs, health costs, maintenance costs, electricity and water costs, labor costs and other costs. Below are presented the costs of producing milk for dairy cows before mechanization and after mechanization at the Rembangan Livestock Breeding and Forage UPT in January 2023 Table 1.3.

Table 3 Dairy Cow Milk Production Costs at the Rembangan Livestock Breeding and Forage UPT in 2023.

No	Cost component	Unit	Amount	Unit price		Cost		(%)
				(Rp/Day)	(Rp/Month)	(Rp/Day)	(Rp/Month)	
Before Mechanization								
Fixed cost								
1	Pen	Rp/m2	1	16,667	500,000	16,667	500,000	1.30%
2	Outlets	Rp/m2	1	2,778	83,333	2,778	83,333	0.22%
3	Tool Depreciation	Units	1	3,496	104,868	3,496	104,868	0.27%
Sub Total 1						22,940	688.201	1.79%
Variable Costs								
1	Animal feed	Units	1	958,000	28,740,000	958,000	28,740,000	74.73%
2	Health	Units	1	1,050	31,500	1,050	31,500	0.08%
3	Maintenance	Units	1	933	28,000	933	28,000	0.07%
4	Electricity and Water	Units	1	11,633	349,000	11,633	349,000	0.91%

5	Miscellaneous expense	Units	1	87,400	2,622,000	87,400	2,622,000	6.82%
6	Labor	Person	4	50,000	1,500,000	200,000	6,000,000	15.60%
Sub Total 2						1,259,017	37,770,500	98.21%
Total Cost						1,281,957	38,458,701	100.00%
After Mechanization								
Fixed cost								
1	Pen	Rp/m2	1	16,667	500,000	16,667	500,000	1.30%
2	Outlets	Rp/m2	1	2,778	83,333	2,778	83,333	0.22%
3	Tool Depreciation	Units	1	7,179	215,361	7,179	215,361	0.56%
Sub Total 1						26,623	798,695	2.07%
Variable Costs								
1	Animal feed	Units	1	958,000	28,740,000	958,000	28,740,000	74.52%
2	Health	Units	1	1,050	31,500	1,050	31,500	0.08%
3	Maintenance	Units	1	933	28,000	933	28,000	0.07%
4	Electricity and Water	Units	1	11,633	349,000	11,633	349,000	0.90%
5	Miscellaneous expense	Units	1	87,400	2,622,000	87,400	2,622,000	6.80%
6	Labor	Person	4	87,400	1,500,000	200,000	6,000,000	15.56%
Sub Total 2						1,259,017	37,770,500	97.93%
Total Cost						1,285,640	38,569,195	100.00%

Source: Processed Primary Data (2023).

From Table 3 it is known that the total cost of milk production for dairy cows at the Rembangan Live-stock Breeding and Forage UPT in November 2022 after using mechanization tools is higher than before using mechanization tools. Total production costs before mechanization were Rp. 38,458,701 / month, while after mechanization it was Rp. 38,569,195 /mo. The increase in total production costs was due to an increase in fixed costs, especially equipment depreciation costs.

Table 4 Monthly Revenue and Profit from Dairy Cattle Farming Business Before and After Mechanization at the Rembangan Livestock Breeding and Forage UPT in 2023

Before Mechanization							
No	Cattle	ID. Cattle	Total Production (Liter/Month)	Total Cost Per Cow/Month	Price/Liter	Receipt/Month	Profit/Month
1	Santi	S.001	521	4,273,189	11,000	5,731,000	1,457,811
2	Bella	S.002	340	4,273,189	11,000	3,740,000	- 533,189
3	Lola	S.003	189	4,273,189	11,000	2,079,000	- 2,194,189
4	Serly	S.004	231	4,273,189	11,000	2,535,500	- 1,737,689
5	Bonita	S.005	828	4,273,189	11,000	9,108,000	4,834,811
6	Karla	S.006	283	4,273,189	11,000	3,113,000	- 1,160,189
7	Rahma	S.007	155	4,273,189	11,000	1,699,500	- 2,573,689
8	Farah	S.008	453	4,273,189	11,000	4,978,600	705.411
9	Azmi	S.009	181	4,273,189	11,000	1,991,000	- 2,282,189

Total			3,180	38,458,701		34,975,600	- 3,483,101
After Mechanization							
No	Cattle	ID. Cattle	Total Production (Liter/Month)	Total Cost Per Cow/Month	Price/Liter	Receipt/Month	Profit/Month
1	Santi	S.001	571	4,285,466	12000	6,852,000	2,566,534
2	Bella	S.002	487	4,285,466	12000	5,848,800	1,563,334
3	Lola	S.003	253	4,285,466	12000	3,036,000	- 1,249,466
4	Serly	S.004	260	4,285,466	12000	3,114,000	- 1,171,466
5	Bonita	S.005	851	4,285,466	12000	10,206,000	5,920,534
6	Carla	S.006	344	4,285,466	12000	4,128,000	- 157,466
7	Mercy	S.007	51	4,285,466	12000	606,000	- 3,679,466
8	Farrah	S.008	476	4,285,466	12000	5,706,000	1,420,534
9	Azmi	S.009	103	4,285,466	12000	1,230,000	- 3,055,466
Total			3,394	38,569,195		40,726,800	2,157,605

Source: Processed Primary Data (2023).

Table 4 shows that the profit of the dairy farming business before mechanization can be said to be a loss with a loss of Rp. 3,483,101 / month with total production of 3,180 liters, while after mechanization the profit was Rp. 2,157,605 / month with total production of 3,394 liters. The level of milk production after mechanization was greater than milk production before mechanization, which caused production before mechanization to experience losses. The use of milking machines as a form of transition from manual milking to mechanical milking is one of the factors that causes production to increase by 6.74%, this is because the use of milking machines makes the milking process more optimal so that more milk is produced. The results of this analysis are in accordance with the second hypothesis, namely that there is a difference in the level of profit in the dairy business between milking before and after mechanization at the Rembangan Animal Breeding and Forage UPT.

The break-even point is a condition where the company's sales level makes no profit and no loss. The break-even point is used to see the minimum limit of products that must be produced so that a business can make a profit. A business is said to be at the break-even point, if total revenue is equal to total costs (TR - TC). If the total revenue obtained is above the break-even point, then the business is profitable and vice versa, if the total revenue is below the break-even point, then the business is at a loss. The lower the break-even point value, the faster the company will make a profit, conversely, the higher the break-even point value, the longer it will take the company to make a profit. The break-even point value obtained by the dairy milk business at the Rembangan Livestock and Forage Breeding UPT can be seen in Table 5 below:

Table 5 Breakeven Point (*Break Event Point*) Per Month for Dairy Cattle Business Before and After Mechanization at UPT Livestock Breeding and Forage Rembangan 2023

No	Description	Unit	Information		
			Before Mechanization	After Mechanization	Change (%)
1	Total Cost	1 (Rp)	38,458,701	38,569,195	0.29%
2	Production	2 (Liter)	3,180	3,394	6.73%
3	Selling price	3 (Rp/Liter)	11,000	12,000	9.09%
4	Reception	4 (Rp)	34,975,600	40,726,800	16.44%
5	BEP Units	5 (1/3) (Liter)	3,496	3,214	8.07%
6	BEP Rupiah	6 (5*3) (Rp)	38,458,701	38,569,195	0.29%

Source: Processed Primary Data (2023).

Table 1.5 shows that the break-even point based on the prevailing price of dairy farming from before mechanization to after mechanization has increased. The break-even point (*Break Event Point*) before mechanization was 3,496 liters and Rp. 38,458,701 / month and after mechanization it was 3,214 liters and Rp. 38,569,195 / month with changes of 8.07 % and 0.29 %. The level of the break-even point is influenced by the revenue and costs incurred. The higher the revenue and food costs, the higher the breakeven point (*Break Event Point*) and vice versa, the smaller the revenue and costs, the lower the breakeven point (*Break Event Point*). Based on the value of the results of the break-even point calculation, it can be said that the dairy cow milk farming business before mechanization was below the break-even point, whereas after mechanization it can be said that the dairy cow milk farming business was in a profitable condition. The results of this analysis are in accordance with the third hypothesis, namely that there is a difference in the BEP value in the dairy business between milking before and after mechanization at the Rembangan Animal Breeding and Forage UPT.

CONCLUSION

Based on the problem formulation, research objectives, hypotheses and research results and discussion, it can be concluded that there is no significant difference between the amount of milk production produced before and after mechanization at the Rembangan Animal Breeding and Forage UPT. Milk production before mechanization was 3,180 liters/month while milk production after mechanization was 3,394 liters/month. Profits before mechanization can be said to be losses with a large loss of Rp. 3,483,101/month with total production of 3,180 liters, while after mechanization the profit was Rp. 2,157,605/month with total production of 3,394 liters. The break-even point (*Break Event Point*) before mechanization was 3,496 liters with a value of Rp. 38,458,701/month and after mechanization it was 3,214 liters with a value of Rp. 38,569,195/month with an increase of 8.07% and 0.29%. Thus, if the farm wants to increase the profits it earns, the farm must increase sales above the break-even point (*Break Event Point*). For future researchers, it is hoped that they will conduct research on acceptance, profits and BEP at the Rembangan Livestock Breeding and Forage UPT in the form of flavored milk variants.

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