Effect of milking methods on cost efficiency and profits of Sapera dairy goat farming business

Pengaruh metode pemerahan terhadap efisiensi biaya dan keuntungan usaha peternakan kambing perah Sapera

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Keywords: Business profits Cost efficiency Milking methods Sapera dairy goats Trajumas livestock group This study aims to determine the amount of milk production, milking duration, cost efficiency, and profit of Sapera dairy goat farming business with manual and automatic milking methods in the Trajumas Livestock Group. The materials used in this study were 7 Sapera goats that were lactating and 20 months old. This research method has 2 treatments, namely T0 = milking without a milking machine and T1 = milking with a milking machine. The variables observed were milk production, milking duration, cost efficiency, and business profit. Milk production at T0 = 1.61 ± 0.58 and T1 = 1.62 ± 0.61 ; and milking duration at T0 = $0.83\pm0.06^*$ and T1 = 0.48 ± 0.01 . Cost efficiency is obtained from the use of automatic milking methods and produces potential profits with milking cost savings of Rp 1,354,230.30 per year, and an investment payback period of 385 days. The study concludes that automatic milking methods on a small or community scale is more efficient in terms of milking time and labor cost savings, but does not increase milk production and does not provide significant business benefits.

A B S T R A K

Kata kunci: Keuntungan usaha Efisiensi biaya Metode pemerahan Kambing perah sapera Kelompok ternak trajumas Penelitian ini bertujuan untuk mengetahui jumlah produksi susu, durasi pemerahan, efisiensi biaya dan keuntungan usaha ternak kambing perah Sapera dengan metode pemerahan secara manual dan otomatis di Kelompok Ternak Trajumas. Bahan yang digunakan dalam penelitian ini adalah 7 ekor kambing Sapera yang sedang laktasi dan berusia 20 bulan. Metode penelitian ini dengan 2 perlakuan, yaitu P0 = pemerahan susu tanpa mesin perah dan P1 = pemerahan susu dengan mesin perah. Variabel yang diamati adalah produksi susu, durasi pemerahan, efisiensi biaya dan keuntungan usaha. Produksi susu pada P0 = 1,61±0,58 dan P1 = 1,62±0,61; serta durasi pemerahan pada P0 = 0,83±0,06* dan P1 = 0,48±0,01. Efisiensi biaya diperoleh dari penggunaan metode pemerahan secara otomatis dan menghasilkan potensi keuntungan dengan penghematan biaya pemerahan sebesar Rp 1.354.230,30 per tahun, serta periode pengembalian investasi selama 385 hari. Kesimpulan dari penelitian ini yaitu penggunaan metode pemerahan secara otomatis pada skala usaha kecil atau rakyat lebih efisien dari segi waktu pemerahan dan penghematan biaya tenaga kerja, tetapi tidak meningkatkan produksi susu dan tidak memberikan keuntungan usaha yang signifikan.

INTRODUCTION

The dairy goat farming industry is an important sector that provides a source of high-

quality animal protein, especially through goat milk production. Goat's milk has nutritional advantages over cow's milk, such more easily digested fat and higher protein and mineral



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content (Arief et al., 2018). One type of dairy goat that excels in milk production is the Sapera goat, resulting from a cross between Saanen and Peranakan Etawa (PE) goats. Sapera goats are popular among breeders because of their high milk productivity and ability to adapt to tropical climates (Winaya & Sujono, 2016). However, various technical aspects in livestock management, such as milking methods, are very important. Using the right milking method affects the quality and quantity of milk produced, and the efficiency of operational costs in the livestock business (Satiti et al., 2022).

Milking is removing milk from the udders of dairy cattle that are in the lactation period calmly, naturally, and without causing pain to the livestock (Hartanto et al., 2021). Farmers use various milking methods, namely manually and automatically with milking machines. Each method has a different impact on operational costs, labor requirements, and time required. The manual milking method tends to be cheaper regarding equipment investment, but requires more labor and a longer milking duration. On the other hand, the automatic milking method is faster and more consistent even though it requires a relatively large investment in equipment (Sari et al., 2021). A practical method of milking dairy goats can help farmers reduce operational costs such as labor costs. Therefore, farmers can increase milk productivity without spending more money, so business profitability can be increased. Currently, most farmers still use manual milking methods compared to automatic milking using milking machines. The use of milking machines not only increases the efficiency of time and energy, but also maintains the cleanliness and quality of the milk produced. Therefore, it can later increase the selling value of goat milk. However, modern technology in milking methods among small and medium farmers is still limited due to the relatively high investment costs.

Based on community service activities carried out by Sari et al., (2023) that the use of milking machines on cows can increase milk production and quality, more efficient milking times, and increase the economic income of farmers. However, applying automatic milking requires a relatively large investment cost for equipment, so farmers still find it difficult to accept. Using of electric milking machines for farmers is one of the uses of current technological advances. The milk harvest results are more optimal and hygienic which is proof that technological advances can be utilized for the welfare of the community, especially in increasing the income of farmers.

Based on the description above, it is necessary to study the influence of various milking methods, both manually and automatically, on the cost efficiency and profit of Sapera dairy goat farming business by considering the parameters of milk production and milking duration. The results of this study are expected to make a real contribution to efforts increasing the cost efficiency and profit of Sapera dairy goat farming business. In addition, they can encourage the adoption of more modern milking technology among farmers.

MATERIALS AND METHODS

Equipments and Materials

The materials used in this study were 7 lactating Sapera goats with 20 months aged in the Trajumas Livestock Group, Kalirejo Village, Salaman District, Magelang, Central Java. The tools used in this study were Jiecare brand milking equipment with a capacity of 5 liters and a power of 100 watts, measuring cups, stopwatches, cellphone cameras, milk cans, rags, and stationery.

Methods

This study uses data collection methods that include: The interview method by asking questions directly to Trajumas Livestock Group farmers, Observation by directly observing activities carried out by farmers related to operational implementation to obtain information directly to support research data, and literature study by searching for supporting data using library data sourced from books, journals, and scientific magazines. This research design uses 2 treatments, namely:

T0: milking without a milking machine

T1: milking with a milking machine

The parameters measured are milk production, milking duration, and cost efficiency and business profit analysis.

Research Procedure

Milking stage

- 1. Pre-milking (Hartanto et al., 2021)
 - 1) Sanitation of the pen is carried out.
 - Milking equipment such as rags, buckets, and milk cans are prepared clean and dry. Jiecare brand milking equipment is prepared automatically.
 - Milkers wash their hands with soap, wear clean clothes, and their nails are not long
- 2. Milking process
 - a) Machine (Hartanto et al., 2021)
 - 1) Each goat's udder is washed using warm water and wiped to clean and dry.
 - 2) The teats are manually milked three times to release milk flow (stripping) and the condition of the milk is checked.
 - 3) Then, a teat cup (nipple funnel) is attached to each goat's teat.
 - 4) The machine will automatically pump milk from the goat's udder. Milking by machine usually takes about 2-3 minutes, depending on the milk produced.
 - 5) If the teat cup comes off, reattach it immediately.
 - 6) When the milk is finished being milked, the teat cup is removed slowly so as not to injure the teats
 - b) Manual (Arief & Ramaiyulis, 2016)
 - 1) Each goat's udder is washed using warm water and wiped to clean and dry.
 - 2) The teats are manually milked three times to release milk flow (stripping) and the condition of the milk is checked.
 - 3) Then, a teat cup (nipple funnel) is attached to each goat's teat.
 - 4) The machine will automatically pump milk from the goat's udder. Milking by machine usually takes about 2-3 minutes, depending on the milk produced.
 - 5) If the teat cup comes off, reattach it immediately.
 - 6) When the milk is finished being milked, the teat cup is removed slowly so as not to injure the teats
- 3. Post-milking
 - 1) Rinse the nipples with water and wipe them with a cloth until dry.
 - 2) Wash the milking equipment until clean

Measurement of milk production

Goat milking is done manually or automatically. Then, all the milk produced is collected in a milk can. The milk is poured into a measuring cup. The volume of milk produced is recorded in liters (Rosartio et al., 2015).

Measurement of milking duration

The stopwatch is turned on when milking starts either manually or automatically when the machine starts working. Then the stopwatch is turned off after milking is complete. The time achieved is recorded in minutes (Florya et al., 2023).

Cost efficiency

Cost efficiency is obtained from savings in operational costs, especially labor by replacing it with a milking machine. With the use of a milking machine, the milking duration can be shortened so that the need for labor is reduced and wage costs can be reduced. Cost efficiency is calculated by comparing the cost of manual milking and the cost of automatic milking. Milking costs are obtained using the following formula (da Borso et al., 2022):

• Electricity cost of milking equipment per day

$$C_{LA} = \frac{(p.T) \cdot X_0}{7}$$

Description:

- CLA= Electricity cost of milking equipment per day (Rp)
- P = Electricity power of milking equipment (kWh)
- T = Electricity rate (Rp/kWh)
- XO = Total duration of automatic milking (hours)
- Manual milking costs per day

$$\mathbf{MC}_{M} = \mathbf{X}_{M} \cdot \mathbf{C}_{TK}$$

Description:

MCM = Manual milking cost per day (Rp)

XM = Average duration of manual milking per day (hours)

CTK = Labor cost (Rp/hour)

• Automatic milking costs per day

$$\mathbf{MC}_{0} = (\mathbf{X}_{0} \cdot \mathbf{C}_{\mathrm{TK}}) + \mathbf{C}_{\mathrm{LA}}$$

Description:

- MCO = Automatic milking cost per day (Rp)
- X0 = Average duration of automatic milking per day (hours)
- CTK = Labor cost (Rp/hour)
- CLA = Electricity cost of milking equipment per day (Rp)

Business profit

Business profits increase along with cost efficiency obtained from milking machines. Business profits are determined by several steps as follows (da Borso et al., 2022):

- 1) Calculating the average milking duration per day both manually and automatically.
 - Average manual milking duration per day

$$\overline{\mathbf{X}}_{\mathbf{M}} = \frac{\sum_{k=1}^{7} \sum_{h=1}^{7} \left(\mathbf{x}_{\mathbf{M}_{k,h}}^{morning} + \mathbf{x}_{\mathbf{M}_{k,h}}^{evening} \right)}{h}$$

Description:

\overline{X}_{M}	= Average duration of manual milking per day (hours)
$\mathbf{X}_{\mathbf{M}_{k,h}}^{morning}$	= Duration of manual morning milking of the k-th goat on
$X_{M_{k,h}}^{evening}$	 the h-th day (seconds) = Duration of manual afternoon milking of the k-th goat on the h-th day (seconds)
k h	= Goat index (k = 1, 2, 3,, 7) = Milking days (h = 1, 2, 3,, 7)

•Average duration of automatic milking per day

$$\overline{X}_{O} = \frac{\sum_{k=1}^{7} \sum_{h=1}^{7} \left(x_{O_{k,h}}^{morning} + x_{O_{k,h}}^{evening} \right)}{h}$$

Description:

Χo	= Average duration of manual milking per day (hours)
X _{O_{k,h}^{morning}}	= Duration of manual morning milking of the k-th goat on the h-th day (seconds)
X _{0 k.h}	 Duration of manual afternoon milking of the k-th goat on the h-th day (seconds)
k h	= Goat index (k = 1, 2, 3,, 7) = Milking days (h = 1, 2, 3,, 7)

2) Calculate the total difference in milking costs per day.

$$\Delta T = MC_{M} - MC_{O}$$

Description:

- ΔT = Total difference in milking costs per day (Rp)
- MCM = Manual milking costs per day (Rp)
- MC0 = Automatic milking costs per day (Rp)
- Calculating the potential savings in milking costs per year as a potential business profit obtained.

$$PP = \Delta T \cdot WD \cdot 12$$

Description:

PP = Potential profit (Rp)

 ΔT = Total difference in milking duration per day (hours)

WD = Number of working days per month (days)

Payback Period (PBP)

Payback period (PBP) is the period of time to return the initial investment costs calculated using the following formula (Andrean & Kurniawan, 2024):

 $Payback Period = \frac{Initial investment}{Cash flow} \times 1 \ year$

Data Analysis

The data obtained were analyzed qualitatively and quantitatively. Qualitative data analysis explains descriptively related to cost efficiency and business profits processed with the help of Microsoft Office Excel application and presented in tabular form. Quantitative data analysis in this study with Dependent Sample T-Test (Paired Sample T-Test) to determine the differences in milk production and milking duration in different milking methods (Upton et al., 2023). This analysis uses a significance level of 5% with the help of IBM SPSS software (version 22) and then the data is explained descriptively.

RESULTS AND DISCUSSION

Based on the research results, there is a difference in the duration of milking Sapera goats using the manual milking method with hands and automatically milking method with a milking tool, but there is no difference in the milk production produced. The average milk production and milking duration for manual and automatic milking are presented in Table 1.

The store out	Parameter		
	Milking duration (Hour)	Milk productions (Liter)	
Manual milking	$0.83 \pm 0.06^{ m b}$	1.61 <u>±</u> 0.58	
Automatic milking	$0.48 \pm 0.01^{\circ}$	1.62 <u>±</u> 0.61	

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Table 1 Average regults of miller	a duration and mille	production in manual	and automatic milling mothods
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Note: ^{ab} means in the same column indicate a significant difference (P<0,05) ; ns means in the same column indicate no significant difference (P>0,05)

Milk Production

Based on the results of the study, there was no difference (P>0.05) in the production of Sapera goat milk with manual milking using hands and automatic milking based on a bucket system. The results of this study are supported by research conducted by Gökdai et al. (2020) which stated that the automatic milking method does not affect the production of Saanen goat milk on a small business scale. In this study, milk production was more influenced by external factors such as cage facilities. The insignificance of these results can be caused by several factors, including udder capacity, feed quality, and physiological conditions of goats such as genetics and goat health, as well as uniform feeding patterns in the study. Therefore, it can be assumed that internal factors more influence goat milk productivity than the milking method used. Although in terms of quantity, milk production does not show a significant difference, the milking method used will impact the efficiency of time and labor. This has been proven in the study of Anjani & Ansori (2023) that automatic milking helps reduce dependence on human labor in the milking process. Manual milking requires farmers to spend a lot of time and energy, but automatic milking technology can work without direct human intervention. According to Laya et al., (2018) that milk production is influenced by various factors such as genetic quality, age of the mother, udder dimensions, body weight, lactation duration, maintenance management (cage system, climate conditions, and livestock health), milking activities, and livestock adaptability. One of the milking activities that affects milk production is the milking frequency according to the livestock's ability to produce milk. The body weight of PE goats affects the milk production produced. Dairy goats with a larger body weight

tend to produce more milk than goats with a smaller body weight (Sudrajat et al., 2022).

Milking Duration

Based on the analysis results, there is a significant difference in the duration of milking Sapera goats between manual and automatic milking methods (P<0.05). The average milking duration in the automatic method is shorter than in the manual method. This shows that the automatic milking method is more time efficient because the milking machine works consistently compared to the manual milking method which tends to depend on the milker's expertise, resulting in unstable milking speed. Therefore, automatic milking can milk more livestock at one time. Although the duration of automatic milking is faster, it does not affect the milk quality produced (Satiti et al., 2022). In addition, the automatic milking method can improve the hygiene of the milk produced because of the minimal touch or exposure to outside air, thus minimizing the risk of contamination by microbes. This is proven in the study of Susilaningrum et al., (2022) that exposure to Salmonella sp. is more common in cow's milk that is milked manually. Also supported by the study of Sari et al., (2021) the use of milking machines has been proven to reduce the level of Escherichia coli bacterial contamination by 26,92%.

The significant difference in milking duration between manual and automatic milking methods shows that the use of the automatic milking method can increase the efficiency of operational costs of Sapera goat farms. These operational costs are lower labor costs due to reduced milking time requirements and do not depend on the skills of the milker. This is proven in the research of Mishra et al., (2020) that the automatic milking method using a machine is more profitable and saves time during milking, so it can make a significant contribution to achieving business profits.

Details of the costs incurred and the business profits obtained from using the milking

Table 2. Details of costs and profits of milking business

method are presented in Table 2.

The results of the payback period analysis of the use of milking equipment in the Trajumas Livestock Group are presented in Table 3.

Description	Goat population of 7 heads		
Description	Manual	Automatic	
UMR per hour ^{1,2}	Rp 12,730.16	Rp 12,730.16	
Total duration per day (hour)	0.83	0.48	
Labor cost per day	Rp 10,534.72	Rp 6,122.10	
Additional cost	Rp 0.00	Rp 72.14	
Total cost	Rp 10,534.72	Rp 6,914.23	
Labor cost per month	Rp 273,902.63	Rp 161,050.11	
Labor cost per year	Rp 3,286,831.57	Rp 1,932,601.27	
Efficiency per year	Rp 0.00	Rp 1,354,230.30	

Note: ¹ Badan Pusat Statistik (BPS) Kabupaten Magelang. (2024). Upah Minimum Kabupaten Magelang dan Sekitarnya, 2024; ² Employment Regulations based on Law No. 13 of 2003

Table 3. Payback period (PBP) for automatic milking

Description	Unit	Value
Initial investment costs	Rp	1,450,000.00
Cash flow	Rp	1,354,230.30
Payback period	Days	385

Cost Efficiency and Business Profits

Based on the analysis description, there is no significant difference in milk production between manual and automatic milking methods. Thus, business profits are more influenced by operational costs in the form of labor. Based on the details of the milking method costs and efficiency obtained in Table 2, the minimum wage for labor used according to (BPS (Central Bureau of Statistics) in Magelang, Indonesia, 2024) is Rp 2,316,890.00. In manual milking, the duration of milking required is more extended than in automatic milking. This causes a higher need for labor, directly contributing to increased labor costs. Conversely, automatic milking can reduce dependence on manual labor, there by reducing labor costs incurred. In addition to saving labor, automatic milking shows additional costs in its operations in the form of electricity costs for milking equipment. Although it requires additional costs, monthly and annual labor costs are still lower than manual milking. In addition

to the operational cost aspect, this analysis includes the impact on annual profit. The annual efficiency obtained shows increased profit due to reduced labor costs. The profit obtained from automatic milking is calculated based on the difference between manual and automatic milking labor costs.

According to Andrean & Kurniawan (2024), the payback period (PBP) is the period of time to return the initial cost calculated based on the comparison between the initial investment in purchasing milking equipment and the cash obtained each year. Based on Table 3, the payback period for using the milking machine is 385 days. Using milking machines on a small scale such as the Trajumas Livestock Group obtains annual efficiency that can return the initial investment cost by purchasing milking equipment. Therefore, the efficiency obtained from reducing labor costs will be optimal if applied to a larger business scale. This is supported by the opinion of Hartanto et al., (2021) that the automatic milking method using a milking machine is more efficient to apply to medium and large-scale farms than the manual milking method using hands. This is also supported by the opinion of Sari et al., (2021) that each milking method has a different impact on operational costs, labor requirements, and time required. In addition, the use of the right milking method can affect the success of a livestock business in achieving economic efficiency. A livestock business is said to have achieved economic efficiency if it can achieve technical and cost efficiency (Pakage et al., 2015).

Based on this study, implementing of the automatic milking method can be a more profitable choice in the long term, especially for farms with a larger business scale. Farmers who will switch from manual to automatic milking methods need to make several careful considerations, such as the availability of initial capital, potential long-term cost efficiency, and the impact on daily productivity.

CONCLUSIONS

Based on the results of the study, it can be concluded that the use of automatic milking methods in small-scale businesses is more efficient in terms of milking time and labor cost savings, but does not increase milk production and does not provide significant business benefits. The efficiency of milking methods is influenced by the scale of the business being run. Automatic milking can increase the profit obtained even though it has additional costs in the form of electricity costs. Therefore, selecting of the right milking method must be adjusted to the financial capabilities of farmers and their needs.

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