Profitability Analysis of Urban Dairy Cattle Farming in Farmer Groups in Jakarta Metropolitan Area

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ABSTRACT

Dairy cattle farming contributes significantly to global food security, yet research on urban dairy operations remains limited, particularly in metropolitan areas of developing countries where land scarcity and high operational costs present unique challenges. This study quantifies the profitability of smallholder dairy operations in Jakarta by examining production costs, revenue streams, return-cost ratios, and net profit margins under urban resource constraints. A survey conducted from October to November 2024 involving 56 active farmers used structured questionnaires and field observations. A Cobb-Douglas production framework analyzed through ordinary least squares regression identified determinants of milk output, complemented by descriptive examination of producer demographics, resource utilization, and economic indicators. Farmers averaged 49 years old with 13 years of formal education and 24 years of farming experience. Input allocation was found to be unbalanced, with forage and concentrates below recommended levels while tofu pulp and labor were excessive. Regression analysis indicated that lactating cow numbers and concentrate use significantly influenced milk production, while other inputs showed no significant effect. Feed, particularly tofu pulp, dominated the cost structure, with average annual production cost of IDR 280.2 million. Total annual revenue reached IDR 384.6 million, yielding net income of IDR 104.4 million. Urban dairy farming in Jakarta proved economically feasible with an R/C ratio of 1.37 and profitability of 37.27%. Metropolitan dairy production remains economically viable for small-scale operators through optimized feeding protocols, proactive animal healthcare, strategic policy support including input price stabilization and urban agricultural zoning, alongside revenue diversification for enhanced operational resilience.

Keywords: farm sustainability, feed management, net income, production inputs, R/C ratio

BACKGROUND

Dairy cattle production serves as a fundamental pillar in meeting global demand for animal protein. The sector has undergone substantial transformation, shifting from household-level traditional practices toward more intensive commercial systems. This evolution reflects rising consumer demand coupled with the integration of modern technologies in animal genetics, nutritional management, and farm operations (Brito et al., 2021). Indonesia presents a distinct scenario, where nearly 98 percent of dairy operations remain small-scale enterprises managed primarily through family labor (Susilorini et al., 2022). While these farms contribute to national milk output, domestic production fulfills less than 25 percent of total consumption, leaving Indonesia heavily reliant on imports to meet approximately 75-80 percent of national requirements (United States Department of Agriculture, 2024). In metropolitan regions such as Jakarta, urban dairy farming is not a recent phenomenon but rather traces its roots to the Dutch colonial period and has persisted to the present day. Farmers operating in these urban contexts must navigate distinctive conditions, adapting to increasingly constrained land availability and limited resources. This urban setting introduces specific challenges, including scarce land for housing and forage cultivation, environmental regulatory pressures, and notably higher operational costs compared to rural counterparts.

In the past decade, urban dairy farming has faced increasing pressures from economic, environmental, and social dimensions. This phenomenon occurs not only in developing countries but also in developed nations, along with urbanization and land-use changes that shift productive areas toward non-agricultural functions. Pressures on urban dairy systems include limited space, land-use conflicts, and high production costs, which threaten the sustainability of smallholder farms (Vellinga et al., 2011; Kiambi et al., 2018; Schlecht, 2021)..

In facing these challenges, the economic aspect becomes a primary concern, particularly related to the ability of smallholder dairy farms to survive and grow under urban environmental pressures. One key indicator that reflects the sustainability of this business is the level of profitability. Small-scale farms, which are commonly found in urban areas, often experience difficulties in reaching adequate profit levels. This is due to limitations in spreading fixed costs, low production volumes, and restricted access to productive inputs. International studies show that scale and operational efficiency are key factors in improving profitability, as seen in cases from Switzerland and the Czech Republic (Syrůček et al., 2022; Schmid, 2022; Zakova Kroupova, 2016).

Urban dairy farming, including in Jakarta, still plays an important role in food security and household economies, although these businesses are generally small-scale and rely on traditional methods. These farms are usually managed by families and are limited by land constraints as well as simple technologies, resulting in low milk productivity (Wynn et al., 2019). This condition requires management innovations and the development of appropriate technologies so that the business can remain sustainable and competitive in the modern era.

Previous studies revealed that the profitability of dairy farming is strongly influenced by input costs such as feed and labor. High uncertainty in financial record-keeping and low financial literacy among farmers make it difficult to assess economic performance accurately. As a result, farmers struggle to determine optimal business strategies and to plan for sustainability (Emawati, 2017;

Haloho et al., 2013). International studies also show that non-technical factors, such as farmer characteristics and decision-making styles, also affect business profitability (O'Leary et al., 2018).

In the global context, various studies emphasize the importance of comparative analysis to identify best practices and formulate effective policies for improving the performance of urban dairy farming. Risk analysis and cost control approaches are effective strategies for increasing income stability, especially in environments filled with uncertainty and price fluctuations (Wolf et al., 2020); (Kumar et al., 2021; Godfrey et al., 2022; Li et al., 2020). These findings are an important basis for conducting a comprehensive local study regarding the profitability and sustainability of dairy farming businesses in Jakarta.

Research on dairy cattle farming in Indonesia has predominantly been conducted in rural or highland areas, as evidenced by studies in East Java, Central Java, and West Java (Haloho et al., 2013; R.L.Dolewikou, 2016; Emawati, 2017). Meanwhile, empirical investigations focusing on the profitability of dairy farming within urban contexts—particularly in metropolitan regions such as Jakarta—remain relatively scarce. This is noteworthy given that urban environments present distinct challenges absent in rural settings, including acute land scarcity, different operational cost structures, limited access to quality feed, and more stringent environmental regulations. The paucity of empirical evidence concerning the economic dimensions of urban dairy operations creates a knowledge gap that warrants attention, particularly in understanding whether such enterprises remain financially viable and what strategies might sustain them amid ongoing urbanization pressures. This study addresses this gap through comprehensive profitability analysis in Jakarta's metropolitan context.

Based on these factors, this study aims to assess the profitability of dairy farming businesses in DKI Jakarta by examining net returns against production costs. The results of this study are expected to serve as a foundation for developing more efficient and sustainable urban dairy farm management strategies and to provide targeted policy recommendations to support local farmers in facing future challenges.

RESEARCH METHODS

This study was conducted in the Special Capital Region of Jakarta (DKI Jakarta), Indonesia. The research was carried out from October to November 2024 using a census method. The research location was determined based on the concentration of active dairy farmers in the urban area of Jakarta.

The census method was chosen as it provides complete data on the entire population without sampling error, making it highly appropriate for describing comprehensive population coverage (Jensen dan Hogan, 2017). Field verification conducted with the Food Security, Marine, and Agriculture Service of DKI Jakarta identified 59 actively operating dairy farmers from the agency's registry, as some registered farms had ceased operations due to livestock sales, farmer mortality, or business closure. All 59 active farmers were approached for data collection, achieving a 100% response rate.

Three observations were excluded from the final analysis due to outlier values that caused multicollinearity issues in the regression model. This resulted in 56 valid respondents consisting of 32 farmers in East Jakarta, 23 in South Jakarta, and 1 in Central Jakarta, representing 94.9% of the active dairy farming population in Jakarta.

Primary and secondary data were used in the study. Primary data were obtained through direct interviews with farmers using structured questionnaires and field observations. The questionnaire was designed to gather information on milk production, input costs, revenue, farm characteristics, and management practices. Secondary data were collected from related institutions such as the DKI Jakarta Livestock and Animal Health Service and farmers' cooperative records.

The data collected were analyzed using descriptive and quantitative methods. Quantitative analysis included the calculation of income, return cost ratio (R/C), and profitability to assess the economic performance of urban dairy cattle farming in the study area.

Multiple Linear Regression

To identify the variables influencing dairy cow productivity, a multiple linear regression analysis was applied. A Cobb-Douglas production function with logarithmic transformation was used in this study. This approach is commonly used in agricultural research to analyze how different inputs affect milk production (Dewi et al., 2023). By taking the logarithm of the data, it is possible to measure production elasticity-in other words, how much milk production increases when each input increase by 1 percent. This makes the results easier to understand and compare with other studies. This method also works well with farm data that often has uneven variation, helping to avoid statictical problems (Wang et al. 2021). The general form of the equation used in this study is:

$$lnY = a + \beta_1\, lnX_1 + \beta_2\, lnX_2 + \beta_3\, lnX_3 + \beta_4\, lnX_4 + \beta_5\, lnX_5 + \beta_6\, lnX_6 + e$$

Where:
Y   = Total milk production (liters/year)
α   = Intercept or constant term in the regression equation
x_1 = Amount of forage (kg/year)
x_2 = Amount of concentrate (kg/year)
x_3 = Amount of pulp feed (kg/year)
x_4 = Labor input used (workdays/year)
x_5 = Number of lactating cows (head/year)
x_6 = Amount of medicine and vitamins used (ml/year)
b_1–b_6 = Coefficients that represent the effect of each independent variable on milk production
e   = Error term accounting for unexplained variation in the model

To evaluate the effect of multiple independent variables on milk production, multiple linear regression analysis was employed. The model's validity was examined through both simultaneous and partial significance testing. Simultaneous testing using the F-test aimed to determine whether all independent variables jointly had a significant influence on milk production, while partial testing with

the t-test assessed the contribution of each independent variable (X_1 to X_6) in explaining variations in milk output when other variables were held constant. To ensure the reliability and robustness of the regression results, several classical assumption tests were conducted. First, the normality test of residuals was performed using the Shapiro-Wilk test to verify whether the error terms followed a normal distribution, as this assumption is crucial for the validity of hypothesis testing in OLS regression. Second, the multicollinearity test was applied using Variance Inflation Factor (VIF) analysis to detect high intercorrelations among independent variables that could bias the estimates; VIF values below 10 indicate acceptable levels of multicollinearity. Third, the heteroskedasticity test was carried out using the Breusch-Pagan test to examine whether the residual variance remained constant across observations, ensuring homoscedasticity in the model.

Income Analysis

Income and cost structures in the urban dairy farming business were calculated as applied by the total revenue (TR) was obtained by multiplying the unit price of milk (Py) by the total volume of milk produced (Y). The analysis dairy farm performance applies an extended version of the profitability decomposition method developed by Soekartawi (2002), as shown in the equation :

$$TR = P_y \cdot Y$$
$$TC = P_x \cdot X$$
$$\pi = TR - TC$$
$$\frac{R}{C} ratio = TR/TC$$

Where:

π = income (IDR/year)

TR = total revenue (IDR/year)

TC = total cost (IDR/year)

Y = milk production (liters/year)

Py = milk price (IDR/liter)

PXi = price of inputs (concentrate feed, forage feed, labor, medicines and vitamins, depreciation value, land tax, transportation, electricity, waste) (IDR/unit)

Xi = Xproduction inputs (concentrate feed, forage feed, labor, medicines and vitamins, depreciation value, land tax, transportation, electricity, waste) (unit/year

Profitability

Profitability shows how much profit a business earns compared to its total costs. It is measured by comparing total income to total expense (Riyanto, 1995), as shown in the following equation:

Profitability = (Net Income ÷ Total Cost) × 100%

In agricultural economic analysis, profitability is commonly assessed against benchmark opportunity costs such as bank interest rates to evaluate whether farming generates competitive returns (Soekartawi, 2002; Wolf et al., 2020). Given the operational risks and resource constraints specific to urban dairy farming including price volatility, disease exposure, land scarcity, and regulatory

compliance costs profitability levels substantially higher than bank rates indicate stronger business resilience and sustainability (Godfrey et al., 2022).

RESULT AND DISCUSSION

Characteristics of Dairy Farmers in DKI Jakarta

Based on the analysis presented in Table 1, the average age of dairy farmers in DKI Jakarta was 49 years, ranging from 27 to 80 years, with a standard deviation of 12.49. This distribution indicates that most farmers are within the productive to pre-elderly age group, generally possessing sufficient physical capacity and experience to manage their farming activities. In terms of formal education, the average length of schooling was 13 years, equivalent to senior high school to early tertiary level, with a range of 6 to 17 years. This level of education suggests a relatively adequate literacy capacity, which potentially facilitates the understanding and adoption of technology and innovations in dairy farming.

Table 1. Respondent Characteristics of Dairy Farmers in DKI Jakarta

No.	Variables	Mean	Std Deviation	Minimum	Maximum
1	Age	49	12.49	27	80
2	Education	13	3.07	6	17
3	Farming experience	24	16.76	2	70

Source: Primary data processed, 2025

Farming experience averaged 24 years with a standard deviation of 16.76, ranging from 2 to 70 years. This wide variation reflects the presence of both novice farmers and those who have managed dairy operations for several decades. The relatively long average experience serves as an important asset in technical and managerial decision-making, although continuous knowledge updates remain necessary to align with technological developments and sustainability demands. Compared to rural Indonesian dairy regions where elementary-level education predominates—63.77% in Central Java with average experience of 8.11 years (Prasetyo et al., 2020), and 59.76% in Bogor (Dewi et al., 2023)-Jakarta farmers exhibit notably higher educational attainment (average 13 years) and longer farming experience (24 years). Educational level serves as an important indicator of farmers' capacity in farm management and productivity enhancement, influencing both technical decision-making and adoption of improved practices. This urban-rural disparity likely reflects differential access to educational infrastructure and the persistence of multi-generational dairy enterprises in Jakarta's metropolitan context (Emawati, 2017; Susilorini et al., 2022).

Characteristics of Dairy Farming Enterprises in DKI Jakarta

Table 2 presents the production and input allocation patterns of dairy farms in Jakarta. Annual milk production averaged 27,180 liters per farm, though substantial heterogeneity existed across operations (range: 4,270–152,500 liters; SD = 23,897.99). This variation reflects differences in herd size (average 10.34 lactating cows; range 2–50 head), management capacity, and resource access. Productivity per cow in Jakarta appears comparable to other Indonesian dairy regions. Dewi et al.

(2023) reported average productivity of 13.66 liters per cow per day in Cisarua, Bogor, while the national average stands at approximately 11–12 liters per cow per day (Susilorini et al., 2022).

Feed inputs showed wide variability: forage (mean 65,200 kg/year), concentrate (5,765 kg/year), and tofu pulp (75,736 kg/year). The high reliance on tofu pulp—an agro-industrial by-product—is characteristic of urban dairy systems where land scarcity limits forage production (Widodo et al., 2023). This substitution pattern mirrors findings from other urban dairy contexts in developing countries, where farmers increasingly depend on purchased feed and by-products due to limited grazing land (Kiambi et al., 2018; Reichenbach et al., 2021). Labor requirements averaged 482 workdays annually, ranging from 122 to 2,016 days, reflecting variations in farm scale and mechanization levels. The relatively high labor intensity likely reflects constraints typical of urban dairy systems, where limited space necessitates more intensive manual operations for feeding, waste management, and daily animal care.

Table 2. Production and Input Allocation of Dairy Farm

No.	Variables	Mean	Std. Deviation	Minimum	Maximum
1	Milk Production (ltr/year)	27.18	23,897.99	4,270.00	152,496.97
2	Forage (kg/year)	65,202.27	77,918.54	8,522.88	488,698.00
3	Concentrate (kg/year)	5,764.99	7,034.36	0.00	30,659.57
4	Tofu Pulp (kg/year)	75,735.84	81,109.38	11,426.04	549,794.58
5	Labor (HOK/year)	482.27	350.02	121.67	2,015.90
6	Lactating cows (head/year)	10.34	8.52	2.00	50.00
7	Medicine and Vitamin (ml/year)	318.93	320.37	0.00	1,590.91

Source: Primary data processed, 2025

The use of medicines and vitamins also varied widely, with an average of 318.93 ml per year, ranging from 0 ml to 1,590.91 ml. This indicates differences in farmers' livestock health management strategies, both in frequency and intensity of application. Overall, these findings demonstrate a high degree of heterogeneity in farm size, input allocation, and production outcomes among dairy farms in DKI Jakarta. The extreme variation in certain inputs—particularly concentrate feed with minimum values of zero-reflects economic constraints rather than management choice. Field observations confirmed that financially constrained farmers completely substitute concentrate with tofu pulp (okara), which contains approximately 15-20% dry matter with 24-28% crude protein on a dry matter basis (Rahman et al., 2021). While tofu pulp provides an economically accessible protein source, its lower dry matter content compared to commercial concentrates may limit optimal nutritional balance for high-producing dairy cows (Widodo et al., 2023). The wide standard deviations observed in this study across all input categories (Table 2) indicate substantial differences in resource access and management practices among farms.

Comparative analysis reveals that Jakarta's average herd size of 10.34 lactating cows substantially exceeds typical smallholder operations in Semarang Regency, where farms average 2-3 cows with predominantly elementary-level education among farmers (Prasetyo et al., 2020; Asmara et al., 2016; Fifin et al., 2024) and Bogor with 3.5 cows (Dewi et al., 2023), reflecting the capital-

intensive nature and economies of scale required in urban settings. However, productivity per cow in Jakarta (7.2 liters/day) is notably lower than Bogor (13.66 liters/day) and Semarang Regency (9.92 liters/day), indicating that urban constraints compromise per-animal productivity despite larger herd sizes. This gap reflects suboptimal nutrition from concentrate substitution, limited forage access, and environmental stressors. Jakarta's lowland location (7 masl) exposes cattle to higher temperatures and humidity than highland regions like Bogor (900-1,200 masl) and Semarang (700-1,500 masl), inducing heat stress that reduces milk production (Asmarasari et al., 2023; Alrhmoun et al., 2024). The FMD outbreak that occurred during data collection also contributed to productivity declines in the study area.

Factors Affecting Dairy Milk Production

The analysis shows that milk production in DKI Jakarta is significantly influenced by the number of lactating cows and the use of concentrate feed. The elasticity of lactating cows was 0.0775 (t-ratio 7.69; $p < 0.05$), indicating that a 1% increase in the number of lactating cow results in a 0.775% increase in milk production, with other factors held constant. This confirms that the capacity of productive animals is the main determinant of milk output (Badr et al., 2024), consistent with Santoso et al. (2022). Concentrate feed also showed a statistically significant effect with an elasticity of 0.018 (t-ratio 2.60; $p < 0.05$). This means that a 1% increase in concentrate use results in a 0.018% increase in milk production. Although the elasticity value is smaller compared to lactating cows (0.775), concentrate feed remains an important factor in improving milk production. The relatively lower elasticity suggests that while concentrate feed influences production, the capacity of productive animals (lactating cows) is the more dominant factor. Consistent provision of quality concentrate feed helps improve both the quantity and quality of milk (Rossiyanti et al., 2024). The model demonstrated strong explanatory power (adjusted $R^2=0.928$) with all VIF values below 10, confirming acceptable multicollinearity levels despite moderately elevated values for forage (4.42) and tofu pulp (4.61), which reflect their natural correlation as complementary feed components. The high adjusted R^2 primarily stems from the biological dominance of lactating cow numbers rather than statistical overfitting.

In contrast, other inputs such as forage, tofu pulp, labor, and veterinary inputs (medicines and vitamins) were not statistically significant, although they remain practically essential for farm operations. The limited use of forage reflects land scarcity in urban areas, while the high use of tofu pulp illustrates a substitution strategy with cheaper agro-industrial by-products of varying quality (Widodo et al., 2023; Thakur et al., 2015). Field observations revealed clear spatial variation in feeding practices across Jakarta. In South and Central Jakarta, high transport costs led some farmers to exclude concentrates and rely only on limited forage and tofu waste. Conversely, farmers in the relocated East Jakarta complex consistently used concentrates due to lower delivery costs. This spatial and economic variation resulted in inconsistent ration formulation and nutritional quality across farms, which may explain why forage and tofu pulp were not statistically significant despite their biological relevance (Cremilleux et al., 2022).

The use of medicines and vitamins was recorded at 97% below the recommended level, even though farmers reported high expenditures during the FMD outbreak. This indicates that livestock health expenditures are still incidental and reactive to disease outbreaks rather than preventive and continuous, as recommended in modern livestock management practices (Susilorini et al., 2022). Field observations revealed that six farmers did not use any medicines or vitamins because their animals were not infected. They considered their herds safe and therefore did not use the veterinary supplements provided by the local livestock office. This behavior reflects a risk-avoidance strategy, where farmers prefer to minimize disease transmission risks by avoiding unnecessary interventions rather than maintaining routine preventive practices.

Overall, the findings confirm that the productivity of urban dairy farms is largely determined by the optimization of lactating cow numbers and the adequacy of concentrate feed. However, achieving sustainability also requires improvements in forage provision, efficient use of alternative feed resources, and more consistent preventive health management.

The comparison of production inputs in Table 3 reveals an imbalance in resource utilization among dairy farms in DKI Jakarta. The use of forage and concentrate feed was lower than recommended, by 42% and 24% respectively, while tofu pulp and labor were excessively used, by 67% and 87%. The shortage of forage is closely related to the limited availability of land in urban areas (Asminaya et al., 2022), Whereas the high use of tofu pulp reflects a substitution strategy with low-cost agro-industrial by-products, although with variable nutritional quality (Widodo et al., 2023). The utilization of soybean pulp as a substitute for soybean meal up to 30% can maintain the production performance and health of dairy cows, thereby potentially reducing feed costs without lowering farm outputs (Thakur et al., 2015). Although forage and tofu pulp are important components, regression results indicated that both were not statistically significant, likely due to differences in quality and inconsistencies in ration formulation (Cremilleux et al., 2022).

Table 3. Analysis Results of Multiple Linear Regression

Model		Coefficients[a]	t-ratio	VIF
1	Intersep			
X1	Forage	0.419	0.68	4.42
X2	Concentrate	0.018**	2.60	1.32
X3	Tofu Pulp	0.120	1.60	4.61
X4	Labor	0.033	0.51	2.13
X5	Amount of lactating cow	0.775**	7.69	6.95
X6	Medicine and vitamin	0.006	0.59	1.20
Adj-R^2		0.928		
F-Sig		0.000		
Breusch-Pagan		0.175		
Shapiro-Wilk		0.083		

a. Dependent Variabel: Milk Production
b. t-table (df=49, α=10%) = ±1.677
   t-table (df=49, α=5%) = ±2.010
c. Significance: * = 10%, ** = 5%, *** = 1%

Source: Primary data processed, 2025

Conversely, the number of lactating cows and concentrate feed were statistically significant, as they directly determine milk production capacity (Rahmadiati et al., 2023; Badr et al., 2024). Interestingly, the use of medicines and vitamins was recorded 97% below the recommended level, despite farmers reporting high expenditures during the FMD outbreak. This finding suggests that veterinary input use tends to be incidental and reactive to disease events, rather than preventive and continuous, as recommended in modern livestock management practices (Susilorini et al., 2022). Therefore, enhancing productivity requires a stronger focus on optimizing the number of lactating cows and concentrate feed, while simultaneously improving access to forage, regulating the use of alternative feed resources, and adopting more consistent preventive health management practices.

Dairy Farming Production Costs

Production costs are one of the key factors determining the sustainability of dairy farming enterprises. Cost components can be classified into cash and non-cash expenditures. Cash costs include all actual expenses paid by farmers, such as forage, concentrates, tofu pulp, hired labor, medicines and vitamins, and transportation. In contrast, non-cash costs represent expenditures that are not directly paid in cash, such as family labor, electricity and gas, barn rent, waste management, and depreciation of lactating cows and equipment.

The findings of this study indicate that the average total production cost of dairy farming in DKI Jakarta amounted to IDR 280,206,742 per year. Of this amount, the majority consisted of cash costs at IDR 190,984,650 (68.16%), while non-cash costs contributed IDR 89,222,092 (31.84%).

Within cash costs, feed-related expenses dominated the cost structure, with tofu pulp purchases averaging at IDR 49,844,207 (17.79%), forage at IDR 47,514,160 (16.96%), and concentrates accounted for IDR 22,659,528 (8.09%), collectively accounting for approximately 43% of total production cost. Hired labor represented the single largest individual cost component at IDR 59,943,526 (21.39%). .of total costs. Within the non-cash category, the largest components were family labor at IDR 37,889,286 (13.52%) and barn rent at IDR 23,221,591 (8.29%), followed by depreciation of lactating cows at IDR 19,921,012 (7.11%).

Table 4. Average Costs, Revenues, Net Income, and R/C Ratio of Dairy Farming in DKI Jakarta

	Description	Average IDR/year	Percentage (%)
1	Costs		
	A. Cash Costs		
	Forage	47,514,160	16.96
	Concentrate	22,659,528	8.09
	Tofu pulp	49,844,207	17.79
	Hired Labor	59,943,526	21.39
	Veterinary medicines and vitamins	526,928	0.19
	Transportation	10,496,300	3.75
	Total Cash Costs	190,984,650	68.16

Description	Average IDR/year	Percentage (%)
B. Non-Cash Costs		
Family Labor	37,889,286	13.52
Electricity and gas	5,011,017	1.79
Barn rental	23,221,591	8.29
Waste management costs	1,619,500	0.58
Depreciation of lactating cows	19,921,012	7.11
Depreciation of equipment	1,559,686	0.56
Total Non-Cash Costs	89,222,092	31.84
Total Production Costs (A+B)	280, 206,742	100.00
2. Revenue		
C. Cash Revenue		
Milk sales	271,997,780	70.72
Cattle sales	91,297,411	23.74
Processed dairy products	7,499,571	1.95
Total Cash Revenue	370,794,763	
D. Non-Cash Revenue		
Calf Consumption	6,964,286	1.81
Manure sales	6,875,621	1.79
Total Non-Cash Revenue	13,839,907	
Total Revenue (C+D)	384,634,670	100.00
3. Income	104,427,928	
4. R/C Ratio	1.37	

Source: Primary data processed, 2025

These results confirm that feed remains the dominant cost component, absorbing the largest share of farmer expenditures, whether in the form of forage, concentrates, or tofu pulp. This finding is consistent with previous studies showing that feed costs always dominate the cost structure of dairy farming (Haloho et al., 2013; Emawati, 2017; Kumar et al., 2021). Some studies even emphasized that the proportion of feed costs can reach more than 70% of total production costs (Zakova Kroupova, 2016; Syrůček et al., 2022).

Beyond feed, non-cash costs such as barn depreciation and lactating cow depreciation were also found to be substantial. These costs are often overlooked by farmers, yet they affect long-term farm profitability (Wolf et al., 2020; Schmid, 2022). In Jakarta's dispersed and land-limited urban setting, cooperative barn ownership is impractical. However, cost-sharing can still be achieved through functional cooperation, such as collective equipment maintenance, joint procurement of building materials, or shared logistics for milk delivery. These approaches help extend asset lifespan and reduce individual depreciation costs without requiring centralized facilities. Therefore, improving

feed cost efficiency and asset management is crucial to enhance the competitiveness and sustainability of dairy farming, particularly in urban areas with limited land and relatively high operating costs (Godfrey et al., 2022; O'Leary et al., 2018).

Dairy Farm Revenues

Revenues from dairy farming are derived from the sum of all income sources generated by farmers, both primary and supplementary. These components include sales of fresh milk, sales of cattle, by-products such as processed dairy products, and manure. Based on the findings, the average annual revenue of dairy farmers in DKI Jakarta reached IDR 370,807,620.

The largest source of revenue came from fresh milk sales, averaging IDR 271,997,780 or about 70.72% of total revenue. This underscores that milk remains the core product sustaining the viability of dairy farming. Income from cattle sales was also considerable, contributing IDR 91,297,411 or 23.74%. In contrast, processed dairy products generated only IDR 7,499,571 (1.95%). Manure contributed IDR 6,875,621 (1.79%) as non-cash revenue; however, most farmers do not economically utilize this by-product. Common practices include disposing of manure into rivers, stockpiling without use, giving it away for free to local residents, or using minimal amounts for home garden plants. In East Jakarta, farmers have access to a livestock waste disposal facility managed by the local government agency, but they must pay a disposal fee of IDR 7,000 per head to the farmer group operating the facility to cover operational costs such as labor and maintenance. Only a few farmers sell manure directly, and for most, manure disposal represents an additional production cost rather than a revenue source, indicating significant untapped economic potential in manure management.

These results indicate that dairy farmers in Jakarta remain highly dependent on fresh milk sales, consistent with earlier studies that emphasized milk as the primary income source in dairy farming across regions (Emawati, 2017; Kumar et al., 2021). Nonetheless, cattle sales provide an important supplementary cash flow that supports farm liquidity (Zakova Kroupova, 2016; Schmid, 2022).

When compared with the total production cost of IDR 280, 206,742, dairy farms in urban Jakarta generated an average net income of IDR 104,427,928. This is reflected in an R/C ratio of 1.37, meaning that each rupiah spent on production yields 1.37 rupiah in revenue. An R/C ratio greater than one confirms that dairy farming in Jakarta is economically viable (Wolf et al., 2020; Syrůček et al., 2022).

Overall, despite the challenges of limited land and relatively high production costs in urban settings, the study demonstrates that dairy farming in Jakarta remains highly profitable. Enhancing the utilization of by-products such as processed milk and manure offers opportunities to diversify income streams and strengthen the long-term economic sustainability of urban dairy farming (Godfrey et al., 2022; O'Leary et al., 2018).

Dairy Farm Income

Farm income in dairy enterprises is calculated as the difference between total revenues and total production costs. The results indicate that the average net income of dairy farmers in DKI Jakarta amounted to IDR 104,427,928 per year, derived from total revenues of IDR 384,634,670 and total

costs of IDR 280,206,742. This analysis produced an R/C ratio of 1.37, meaning that every rupiah spent on production generated 1.37 rupiah in revenue. Accordingly, dairy farming in the urban areas of Jakarta can be considered economically viable. Nevertheless, the heavy dependence on fresh milk sales exposes farmers to potential price fluctuations in urban markets where consumer demand tends to be price-sensitive. This indicates that profitability may fluctuate under changing market conditions, underscoring the importance of income diversification or value-added processing to strengthen economic resilience.

The income structure shows that the largest contribution came from fresh milk sales, accounting for more than 70% of total revenue, while cattle sales and by-products contributed only marginally. On the cost side, production was dominated by feed expenses, particularly tofu pulp, forage, and concentrates, making feed management efficiency a decisive factor in determining farmers' net income. This finding is consistent with Hafeez dan Rahman (2014), who emphasized that smallholder dairy farms in urban areas face a major challenge from high feed costs, even though they continue to offer meaningful economic opportunities for households.

Furthermore, Rathva et al. (2021) highlighted that dairy farming in urban and peri-urban areas still holds promising profitability, provided that cost efficiency and access to fresh milk markets are secured. This is highly relevant to the context of dairy farmers in Jakarta, who rely heavily on milk sales as their main source of income. In addition, Dalimunthe et al. (2023) stressed that the development of agriculture and livestock in urban settings, including dairy farming, not only provides economic benefits but also contributes to more sustainable urban food systems. Field interviews revealed that farmer groups in Jakarta have expressed interest in milk processing equipment to support value-added production, while biogas utilization from manure has begun in East Jakarta and partially in South Jakarta, mainly to address waste complaints from nearby residents. Although space limitations constrain wider adoption, such initiatives reflect the necessity for urban dairy farms to pursue economic, social, and environmental sustainability simultaneously. Thus, the income generated by dairy farmers in Jakarta is significant not only for household welfare but also for strengthening food security in the metropolitan area. Thus, the income generated by dairy farmers in Jakarta is significant not only for household welfare but also for strengthening food security in the metropolitan area.

Return Cost (R/C) Ratio

The analysis presented in Table 2 shows that small-scale dairy farms in DKI Jakarta achieved an R/C ratio of 1.37. This figure implies that every IDR 1.00 spent on production generated IDR 1.37 in revenue, resulting in an additional net return of IDR 0.37 for each rupiah invested. Accordingly, dairy farming in the urban areas of Jakarta can be considered economically viable and efficient under current cost and price structures.

Across individual farms, the R/C ratio ranged from 0.92 to 2.04, with a median of 1.32 and an interquartile range of 1.15–1.48. This indicates that while most farmers benefited economically,

profitability was not evenly distributed; approximately 82% of respondents achieved R/C ratios above 1.0, whereas a small subset operated close to or below the break-even point due to high feed expenses or lower milk productivity.

The R/C ratio obtained in Jakarta is relatively comparable to similar studies, though slightly lower than values reported by Haloho et al. (2013) in Semarang (1.80), Hafeez dan Rahman (2014) in Bangladesh (1.40 to 1.68), and Emawati (2017) in Sleman (1.60). These differences likely reflect Jakarta's higher input prices and limited forage availability. Given that feed accounts for about 43% of total production costs, a 10% rise in feed prices would reduce the average R/C ratio from 1.37 to approximately 1.30, potentially pushing low-performing farms below profitability thresholds. Therefore, stabilizing feed prices and improving feed efficiency are critical strategies to maintain the economic resilience of urban dairy farming.

Profitability

In terms of profitability, the total revenue of dairy farmers in DKI Jakarta reached IDR 384.6 million per year, with total costs amounting to IDR 280.2 million, resulting in an average net income of IDR 104.4 million. The profit-to-cost ratio stood at 37.27%, confirming that dairy farming remains economically feasible in the metropolitan context. When compared with the average commercial bank interest rate used as the profitability benchmark, this figure suggests that urban dairy farming still provides a higher return than conventional financial investments. However, profitability varied considerably among farmers, mainly due to differences in herd size (standard deviation = 8.52), feed costs, and access to forage. Several farmers even recorded negative net income during the foot-and-mouth disease (FMD) outbreak, when milk production declined and depreciation costs were included. In general, farmers perceived their business as still profitable because they usually exclude non-cash expenses such as barn or livestock depreciation in their own accounting.

At the national level, Jakarta's profitability of around 37% can be considered moderate yet competitive compared to smallholder dairy farms in Semarang (43.46%) and Sleman (54%) (Haloho et al., 2013; Emawati, 2017). These differences reflect Jakarta's higher operational challenges, including expensive concentrate and green feed, high transportation costs for forage collection, and difficulty in finding skilled labor. Waste disposal also adds to expenses, particularly in East Jakarta where it is charged per head of cattle, while practices in South Jakarta vary between annual fees and direct discharge into waterways. Despite these constraints, most farmers continue their dairy operations as part of family inheritance and livelihood continuity rather than active business expansion. The combination of moderate profitability and high cost exposure highlights the need for policy support to improve feed access, waste management, and urban livestock zoning. These findings align with Wolf et al. (2020) and Godfrey et al. (2022), who emphasize that efficient input management and stable milk markets are key factors in ensuring the long-term sustainability of dairy enterprises.

CONCLUSION AND SUGGESTION

This study examined the profitability of smallholder dairy farming in urban Jakarta, addressing the limited evidence on urban livestock systems in Indonesia. The results confirm that urban dairy farming remain economically viable with an R/C ratio of 1.37 and a profitability level of 37.27%. These findings reflect the economic resilience of urban dairy farmers who continue their family-based enterprises across generations, often relying on experience rather than formal management systems. Profitability, however, varied widely due to herd size, feed expenses, and the temporary impact of the foot-and-mouth disease outbreak during data collection. Beyond confirming economic feasibility, the study highlights that sustainability in Jakarta's urban dairy sector is largely adaptive: economically through collective feed procurement, environmentally through gradual adoption of manure-to-biogas practices, and socially through informal farmer learning and mutual support. Given these realities, immediate efforts should focus on stabilizing feed prices and improving forage access, while medium-term policies should strengthen waste management and facilitate small-scale milk processing to enhance value addition. The study's cross-sectional design and lack of biological herd data limit the assessment of long-term productivity trends, but the results provide valuable insights into how smallholder dairying can sustain livelihoods and local food supply under complex urban pressures

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