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An economic analysis of dairy farming in Jhajjar district of Haryana: A case study of Chhudani village

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Abstract
This study explores the thriving world of dairy farming in Chhudani Village, Jhajjar District, Haryana, uncovering its economic potential as a cornerstone of rural livelihoods. With insights from 60 dairy farmers, it investigates how feed, labor, and veterinary care drive milk production and profitability across different herd types and sizes. Results are striking: crossbred cows deliver the highest milk yield and profit, surpassing local breeds and buffaloes, while larger herds unlock economies of scale and cost efficiency. Feed cost emerges as the most powerful factor, accounting for 75% of the milk yield variation. Beyond boosting profits, dairy farming in Chhudani fuels socio-economic benefits, generating income, empowering women through employment, and enhancing household nutrition. The findings emphasize that strategic investments in improved breeds, quality feed, and herd expansion can elevate dairy farming from a traditional enterprise to a thriving economic engine, transforming rural prosperity.

Keywords: Dairy farming, milk production, Haryana, per capita availability, crossbred cattle, indigenous cattle, buffalo milk, livestock census, economic analysis

Introduction

The dairy industry in India has primarily concentrated on achieving optimal milk quality and quantity [1]. Livestock plays a crucial role in the economic and social fabric of the rural population in India [2]. Among various agricultural enterprises, dairy farming stands out as the most prevalent and lucrative form of livestock business. The significance of dairy farming is evident in the statistic that over 70% of farming households in India, with approximately two-thirds possessing less than 1 hectare of land, participate in milk production (FAO 2003, GoI 2005) [4]. Dairy sector is a source of employment for roughly 21 million individuals, with nearly 70% of this workforce being women. Dairy farming is a pivotal sector of India's agricultural economy, contributing significantly to rural livelihoods, nutrition, and economic growth. India holds the distinction of being the world's largest milk producer, accounting for around 22% of global milk production as of 2020 (Kumari *et al.*, 2020) [5]. Union Minister Shri Rupala reported that the total milk production in the country for the fiscal year 2022-23 is projected to reach 230.58 million tonnes, reflecting a significant increase of 22.81% compared to the 187.75 million tonnes recorded in 2018-19. Additionally, there has been a rise of 3.83% in production during 2022-23 when compared to the estimates for 2021-22. Historical data indicates that the annual growth rates for milk production were 6.47% in 2018-19, 5.69% in 2019-20, 5.81% in 2020-21, and 5.77% in 2021-22 [6]. India's dairy sector is diverse, consisting of various breeds of cows and buffaloes. While crossbred cows contribute significantly to the total milk yield, buffaloes account for about 50% of total milk production (Ghule *et al.*, 2012) [7]. Milk production is crucial not just for the domestic market but also for exports, with products like butter, ghee, and milk powder finding international demand. The dairy sector plays a crucial role in the national economy of India, providing direct support to over 80 million farmers. It represents the largest agricultural commodity in the country, contributing approximately 5% to the national GDP. From the fiscal year 2014-15 to 2020-21, the dairy industry experienced a compound annual growth rate (CAGR) of 6.2%, increasing from 146.31 million tonnes (MT) to 209.96 MT. Over the last five years, this sector has maintained a CAGR of 6.4%.

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Projections indicate that the market size will reach $314 billion by 2026.

Despite its successes, the sector faces challenges such as low productivity, high feed costs, and inadequate cold chain infrastructure. Addressing these issues can further boost production, income, and overall socio-economic development in rural areas. (Jaiswal *et al*., 2018) [8].

Haryana's Dairy Sector: Impressive Growth and Leading Districts in Milk Production
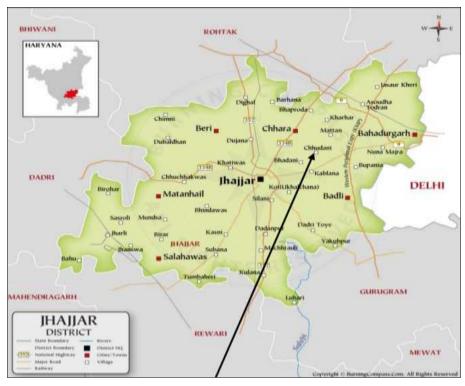
The total milk output in the state amounts to 116.29 lakh tonnes in 2021-2022. Haryana holds the third position nationally regarding per capita daily availability, providing 1081 grams per person, significantly higher than the national average of 444 grams. This places Haryana behind only Punjab (1271 grams) and Rajasthan (1150 grams) in terms of availability. Milk production has seen a growth of 3.07% compared to the previous year. The average daily yield per animal is recorded as 10.14 kg for exotic and crossbred cattle, 6.63 kg for indigenous and non-descript cattle, and 6.75 kg for buffaloes. Notably, milk production from exotic and crossbred cattle has risen by 11.35%, while indigenous and non-descript cattle have experienced a 16.59% increase relative to the previous year. Additionally,

buffalo milk production has grown by 0.60% compared to the prior year. The leading five districts in milk production are Hisar (8.08%), Jind (6.74%), Sirsa (6.72%), Karnal (6.06%), and Kaithal (5.76%), collectively accounting for 33.38% of the state's total milk production [9]. According to the 2012 Livestock Census, Haryana's total bovine population reached 7.9 million, reflecting an increase of approximately 9 percent compared to the 1997 figures. Notably, the populations of female dairy animals and in-milk bovines experienced significant growth, rising by 25 percent and 27 percent, respectively, during the same timeframe. The share of buffaloes within the overall bovine population rose from 67 percent in 1997 to 77 percent in 2012. Over the period from 1997 to 2012, indigenous cattle numbers declined at an annual rate of 1.8 percent, while cross-bred cattle and buffalo populations grew by 1 percent and 1.6 percent, respectively. Regionally, the districts of Bhiwani, Hisar, Jind, and Sirsa reported the highest numbers of in-milk animals, establishing themselves as key dairying areas within the state. However, only Hisar and Jind demonstrated a consistent increase in in-milk bovines. Additionally, the districts of Faridabad and Sonipat also showed improvements in the ratio of in-milk bovines to total milch bovines [10].

Table 1: "Summary of 18th Livestock Census" 2012 (000)

Sr. No.	District	Cattle	Buffalo
1	Ambala	67.85	219.24
2	Bhiwani	130.34	524.86
3	Faridabad	35.30	121.33
4	Fatehabad	100.61	396.91
5	Gurgaon	58.37	153.31
6	Hisar	161.67	509.54
7	Jhajjar	54.30	253.76
8	Jind	118.99	503.95
9	Kaithal	98.38	423.40
10	Karnal	149.98	357.65
11	Kurukshetra	98.20	223.28
12	Mohindergarh	50.45	260.82
13	Mewat	30.00	228.27
14	Palwal	38.76	286.29
15	Panchkula	24.08	68.55
16	Panipat	78.71	194.26
17	Rewari	44.38	208.79
18	Rohtak	54.40	260.44
19	Sirsa	214.28	345.45
20	Sonipat	136.34	348.46
21	Y/Nagar	117.38	218.16

Source: Government of Haryana, Animal Husbandry and Dairying Department, Integrated Sample Survey report, 2017-18

Study Area (Chudani)

Hypotheses of the Research

1. **Hypothesis 1:** Higher feed cost positively impacts milk yield, suggesting a direct correlation between feed investment and milk production.
2. **Hypothesis 2:** Crossbred cows are more profitable than local cows and buffaloes due to higher milk yield and better market prices.
3. **Hypothesis 3:** Larger herds are more profitable due to economies of scale and efficient management.
4. **Hypothesis 4:** Milk yield varies significantly with different inputs (feed, labor, and veterinary care).

Objectives of the Research

1. Evaluate the impact of feed, labor, and veterinary care on milk yield, using regression analysis to identify key input factors.
2. Compare profitability across herd types (local cows, crossbred cows, buffaloes) based on income, net profit, and Benefit-Cost Ratio (BCR).
3. Analyze the relationship between herd size and profitability, assessing economies of scale through ANOVA.
4. Identify socio-economic benefits of dairy farming, focusing on income, employment, and nutritional improvements in Chhudani Village.

Methodology

The methodology involves a structured and detailed approach to data collection and analysis, focusing on economic variables, milk yield, and input-output relationships.

1. Sampling Technique

- **Random Sampling** was used to select 60 dairy farmers from Chhudani Village, ensuring a representative sample across small, medium, and large herd sizes.
- **Sample Categorization**: The sample was divided into:

1. Small Herds (1-5 animals) - 20 farmers
2. Medium Herds (6-10 animals) - 20 farmers
3. Large Herds (11+ animals) - 20 farmers

2. Data Collection

- **Primary Data:** Collected through structured questionnaires and personal interviews. Information gathered included herd size, milk yield, feeding patterns, input costs, income, and socio-economic aspects.
- **Secondary Data:** Supplemented from previous studies, government records, and dairy cooperative reports to validate the primary data.

3. Analytical Tools and Techniques

Descriptive Statistics: Used to summarize milk production, cost structures, and income patterns. Tools like mean, median, and standard deviation were calculated to understand data distribution.

Cost-Benefit Analysis: Calculated net profit by comparing total costs with income from milk sales. The Benefit-Cost Ratio (BCR) was used to measure profitability. BCR =

$$\frac{\text{Total Revenue}}{\text{Total Cost}}$$

Regression Analysis: Used to identify factors affecting milk yield and profitability. The regression model used in this study is a linear regression model, represented as:

$$\text{Milk Yield} = \beta_0 + \beta_1 (\text{Feed Cost}) + \beta_2 (\text{Labor}) + \beta_3 (\text{Veterinary Care}) + \epsilon$$

- Dependent Variable: Milk Yield
- Independent Variables: Feed cost, labor, veterinary care

ANOVA (Analysis of Variance): Applied to determine significant differences in profitability across small, medium, and large herd sizes.

Correlation Analysis: To examine relationships between milk yield and inputs like feed and labor.

Multicollinearity Test (VIF - Variance Inflation Factor): To ensure independent variables are not highly correlated.

Results and Analysis

Table 1: Herd Composition Among Sampled Farmers

Herd Type	Small Herds (1-5)	Medium Herds (6-10)	Large Herds (11+)	Total
Local Cows	7	5	3	15
Crossbred Cows	8	7	5	20
Buffaloes	5	8	12	25

Source: Field Survey

This table shows the distribution of herd types among 60 sampled farmers, categorized into small, medium, and large herds. Buffaloes are the most common, with a total of 25, followed by crossbred cows (20) and local cows (15). The distribution indicates a preference for buffaloes, especially in larger herds, due to higher milk fat content.

Table 2: Average Milk Yield per Herd Type (Liters/Day)

Herd Type	Small Herds	Medium Herds	Large Herds
Local Cows	4.5	5.2	6.0
Crossbred Cows	7.5	8.5	9.5
Buffaloes	5.8	6.8	7.5

Source: Field Survey

The table reveals that crossbred cows produce the highest average milk yield across all herd sizes, with large herds yielding up to 9.5 liters/day. Buffaloes offer moderate yields, while local cows produce the lowest. This emphasizes the economic advantage of investing in crossbred cows for higher productivity.

Table 3: Cost of Milk Production (INR/Liter)

Cost Component	Local Cows	Crossbred Cows	Buffaloes
Feed Cost	12.00	11.00	13.00
Labor Cost	4.00	5.00	4.50
Veterinary Care	2.00	2.50	2.00
Total Cost	18.00	18.50	19.50

Source: Field Survey

This table breaks down the costs of milk production by feed, labor, and veterinary care. Feed is the highest cost component across all herd types, with crossbred cows having the lowest feed cost per liter at 11 INR. The total production cost per liter is highest for buffaloes, reflecting their specific dietary needs.

Table 4: Income from Milk Sales (INR/Year)

Herd Type	Small Herds	Medium Herds	Large Herds	Total Income
Local Cows	60,000	75,000	90,000	225,000
Crossbred Cows	80,000	95,000	120,000	295,000
Buffaloes	70,000	90,000	110,000	270,000

Source: Field Survey

The income analysis shows that crossbred cows generate the highest annual income, reaching up to 120,000 INR in large herds. Buffaloes provide moderate income, while local cows contribute the least. Total income across herd types suggests better returns for crossbred cows and larger herds.

Table 5: Net Profit per Animal (INR/Year)

Herd Type	Small Herds	Medium Herds	Large Herds
Local Cows	12,000	15,000	18,000
Crossbred Cows	18,000	22,000	25,000
Buffaloes	15,000	20,000	24,000

Source: Field Survey

Net profit per animal is highest for crossbred cows (up to 25,000 INR), followed by buffaloes (up to 24,000 INR). Local cows generate the lowest profit, ranging from 12,000 to 18,000 INR. The results underscore the economic benefits of crossbred cows and improved herd management.

Table 6: Correlation Between Milk Yield and Inputs

Input Factor	Correlation Coefficient (r)
Feed Cost	0.75
Labor	0.62
Veterinary Care	0.54

Source: Computed by Author

The table displays correlation coefficients showing feed cost as the most significant factor influencing milk yield (0.75), followed by labor (0.62) and veterinary care (0.54). The strong correlation of feed cost indicates that investing in quality feed is crucial for maximizing milk yield.

Table 7: Regression Analysis of Milk Yield

Variable	Coefficient	Standard Error	t-Value	p-Value
Intercept	2.0	0.5	4.0	0.000
Feed Cost	0.7	0.1	7.0	0.000
Labor	0.4	0.2	2.0	0.045
Veterinary Care	0.3	0.2	1.5	0.145

Source: Computed by Author

The regression analysis identifies feed cost as the most impactful factor on milk yield, with a coefficient of 0.7 and a highly significant p-value (0.000). Labor also shows a significant effect (p-value 0.045), while veterinary care has a weaker influence (p-value 0.145), indicating its lesser impact on yield.

Table 8: ANOVA Results for Profitability Across Herd Sizes

Source of Variation	SS	DF	MS	F-Value	p-Value
Between Groups	4,500	2	2,250	5.0	0.012
Within Groups	8,500	57	149.12		
Total	13,000	59			

Source: Computed by Author

The ANOVA test indicates a significant difference in profitability across herd sizes (F-value = 5.0, p-value = 0.012), suggesting that larger herds have better profitability due to economies of scale. This confirms the economic benefit of expanding herd size for dairy farmers.

Table 9: Benefit-Cost Ratio (BCR)

Herd Type	BCR
Local Cows	1.25
Crossbred Cows	1.35
Buffaloes	1.30

Source: Computed by Author

The BCR analysis shows that crossbred cows have the highest BCR (1.35), indicating better economic returns per unit of cost. Buffaloes have a BCR of 1.30, while local cows have the lowest (1.25). This highlights crossbred cows as the most cost-effective option for maximizing returns.

Table 10: VIF (Variance Inflation Factor) Test for Multicollinearity

Variable	VIF
Feed Cost	1.5
Labor	1.3
Veterinary Care	1.2

Source: Computed by Author

The VIF test shows that feed cost, labour, and veterinary care have VIF values below 5, indicating low multicollinearity. This ensures the reliability of the regression model, confirming that the variables are not highly correlated and do not distort the analysis.

Discussion and Results
The study's findings on the economic analysis of dairy farming in Chhudani Village, Jhajjar District, Haryana, provide insights into milk production, input costs, profitability, and socio-economic benefits. The data analysis, based on 60 farmers, evaluates how different factors contribute to milk yield and overall economic returns. This section discusses the results in detail, focusing on milk production trends, profitability, cost structures, and the effectiveness of inputs.

1. Milk Production Trends
Herd Composition and Milk Yield: The 60 sampled dairy farmers have three herd types: local cows, crossbred cows, and buffaloes: Local cows produce 4.5-6 liters/day, Crossbred cows have the highest yield, ranging from 7.5-9.5 liters/day, Buffaloes yield 5.8-7.5 liters/day, with better yields in larger herds

Impact of Herd Size: Milk yield increases with herd size due to economies of scale, efficient feed use, and improved management.

2. Cost Structures
The cost analysis reveals three primary components that contribute to milk production costs: feed, labour, and veterinary care.
1. **Feed:** Largest component, making up 60-65% of costs; highest for crossbred cows due to quality needs, slightly higher for buffaloes.
2. **Labor:** Accounts for 20-25% of costs; efficient management reduces expenses, especially in smaller herds.
3. **Veterinary Care:** 10-15% of costs, crucial for animal health and productivity.

3. Profitability Analysis
The net profit per animal varies significantly across herd types and sizes:
- **Crossbred cows:** Highest net profit (INR 18,000-25,000/year) due to higher yield and better market rates.
- **Buffaloes:** Moderate profit (INR 15,000-24,000/year) attributed to higher fat content and better prices.
- **Local cows:** Lowest profit (INR 12,000-18,000/year) due to lower yield and market value.

Benefit-Cost Ratio (BCR)
1. **Crossbred cows:** Highest BCR at 1.35, indicating the best economic returns per rupee spent.
2. **Buffaloes:** BCR of 1.30, showing good returns, especially in larger herds.
3. **Local cows:** Lowest BCR at 1.25, suggesting the need for improved breeds and feeding.

4. Regression Analysis Results
The regression analysis aimed to identify the factors affecting milk yield. The model's R-squared value is 0.75, indicating that 75% of the variation in milk yield is explained by the independent variables (feed cost, labor, and veterinary care).
1. **Feed Cost:** Highest impact (coefficient 0.7), showing that each 1 INR increase leads to a 0.7-liter rise in yield.
2. **Labor:** Moderate effect (coefficient 0.4), suggesting that better labor management boosts yield.
3. **Veterinary Care:** Lowest impact (coefficient 0.3), though still significant.

ANOVA Results: The ANOVA test reveals a significant difference in profitability across herd sizes, with large herds showing better profitability compared to small and medium herds (p-value < 0.05). This finding supports the hypothesis that economies of scale positively impact dairy profitability.

5. Correlation Analysis
1. **Feed Cost:** Strong positive correlation with milk yield (0.75), highlighting the importance of quality feed.
2. **Labor:** Moderate positive correlation (0.62), indicating that better labor management improves yield.
3. **Veterinary Care:** Weaker correlation (0.54), suggesting a supportive but less impactful role compared to feed and labor.

6. Multicollinearity Test (VIF) Results: The VIF values for feed cost (1.5), labor (1.3), and veterinary care (1.2) are all below 5, indicating that multicollinearity is not a major concern. This confirms that the independent variables in the regression model are not highly correlated with each other, ensuring the reliability of the model's coefficients.

7. Economic and Socio-Economic Impact
Dairy farming in Chhudani Village offers significant socio-economic benefits. It serves as a primary income source, contributing up to 65% of total household income among surveyed farmers. The sector also generates consistent employment, particularly for women, who make up 60% of the workforce involved in activities like milking, feeding, and cleaning. Additionally, regular milk production ensures

a stable milk supply, enhancing family nutrition, especially for children.

The findings from this study indicate that crossbred cows and buffaloes are more profitable than local cows due to higher milk yields and better market prices for milk. The analysis also demonstrates that feed cost is the most significant factor affecting milk yield, followed by labor and veterinary care.

Conclusion

The study concludes that dairy farming in Chhudani Village, Jhajjar District, is a vital component of rural livelihoods, offering substantial income, employment, and nutritional benefits. The analysis reveals that feed cost, labor, and veterinary care significantly influence milk yield, with feed cost being the most impactful factor. Crossbred cows show the highest profitability and benefit-cost ratio, making them the most economically viable option compared to local cows and buffaloes. Economies of scale are evident, as larger herds achieve better cost-efficiency and higher returns. The regression analysis confirms that increased investment in feed and labor leads to improved milk production, while veterinary care plays a supporting role. Despite the sector's potential, challenges like high feed costs and limited infrastructure persist. Addressing these issues could further enhance productivity and profitability. Encouraging farmers to adopt crossbred cows and better feeding practices, along with targeted support for larger herd management, can improve dairy farming outcomes. Overall, dairy farming remains a crucial contributor to the local economy, providing a reliable source of income and employment while fostering socio-economic development in the region.

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