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Value Chain Analysis of Milk in Kathmandu Valley-Nepal

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ABSTRACT

Background: This study investigates the socio-demographic characteristics of dairy farmers and evaluates the economic *via*bility, gender dynamics and marketing efficiency of milk production in the Kathmandu Valley, Nepal. Dairy farming is a critical livelihood source, yet it faces challenges like high production costs, inefficiencies in marketing and gender disparities. Previous studies have emphasized production trends but less attention has been paid to value distribution, a gap this study addresses.

Methods: Primary data were collected in 2023 from 150 dairy farming households in Kathmandu Valley through structured surveys and focus group discussions. The study applied cost analysis to estimate fixed and variable costs, gross and net returns and cost per liter of milk. Value chain performance was assessed using marketing cost, marketing margin, marketing efficiency and producer's share in consumer price. Garrett's ranking technique was employed to identify production and marketing constraints faced by farmers.

Result: The findings reveal that 60.67% of households are male-headed, with nuclear families (79.33%) averaging 5.44 members. The literacy rate (79.33%) surpasses the national average, with 68% of household income derived from agriculture. The average number of milking animals per household is 2.01, with Lalitpur recording the highest milk yield of 14.45 liters per cow per day. The cost of milk production averages NRs. 74.25 per liter, with Kathmandu having the highest cost (NRs. 76.78). Women predominantly handle production tasks, while men dominate marketing activities. Bhaktapur households reported the highest net revenue, though profitability is constrained by high feed and veterinary costs. Marketing efficiency is highest in direct sales channels (Channel I), where farmers capture a 99.32% share, while intermediary-dependent channels significantly reduce margins. The study concludes that while milk production is profitable, systemic inefficiencies and gender disparities limit sustainability. Policy interventions should focus on reducing input costs, strengthening cooperatives and ensuring fair value distribution across the chain.

Key words: Dairy farming, Gender dynamics, Marketing efficiency, Milk production, Socio-demographics, Value chain analysis.

INTRODUCTION

Nepal, a landlocked South Asian nation, is characterized by its diverse topography, spanning approximately 147,181 square kilometers, with the Himalayan ranges in the north and fertile plains in the south. The country, home to 29.16 million people (CBS, 2021), remains predominantly agricultural, where livestock significantly contributes to household income, nutrition, draft power and manure (Khanal *et al.,* 2022). The agricultural sector accounts for 23.95% of Nepal's GDP, with livestock contributing 6.23% and the dairy sector playing a pivotal role. Notably, cattle's raw milk contributes 4.63% to agricultural GDP, while buffalo's raw milk accounts for 7.85% (MoALD, 2022). Dairy agriculture's origins trace back to the domestication of cattle, goats and sheep (Zeuner, 1963; Reed, 1984). Technological advancements and globalization have reshaped dairy production, with countries like Brazil, China, Germany, India and the USA leading global output as shown in Fig 1 (FAOSTAT, 2021). In Nepal, agriculture underpins livelihoods for 3.8 million households, of which 95% engage in dairy farming; however, only 14% sell in markets, with most producing for self-consumption (CASA, 2020). Similar patterns appear in India's major milk-producing states-Punjab, Bihar and Uttar Pradesh-where smallholders dominate, marketing largely occurs through informal channels and socio-economic constraints limit technology adoption (Kumar and Parappurathu, 2014; Kaur and Toor, 2024).

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Annual milk production in Nepal stands at 2.48 million metric tons, with buffalo milk (57%) surpassing cow milk (43%) in contribution. Between 2011/12 and 2020/21, production increased by 52.82%, reflecting substantial sectoral growth as shown in Fig 2 and 3 (MoALD, 2021). Regional disparities in livestock populations and milk output emphasize the need for targeted value chain improvements, as seen in the dominance of buffalo milk and provincial variations in productivity. Similar findings on regional disparities and the economic role of dairy are reported in drought-prone areas of Maharashtra, India, where crossbred cow and buffalo systems also reveal

differences in productivity and costs (Sapkal *et al.,* 2025). Despite growing demand, Nepal's dairy sector faces challenges such as inefficiencies in production, processing and distribution, particularly in urban areas like Kathmandu valley. Fragmentation among small-scale producers, limited technical expertise, inadequate rural infrastructure and insufficient advanced processing facilities hinder sectoral growth (Mahato *et al.,* 2019; Shrestha *et al.,* 2017). Quality and safety concerns, including adulteration and contamination, persist due to inadequate knowledge and testing technologies (Dhakal *et al.,* 2019). Similar gaps in adoption of key practices such as mastitis screening and cattle insurance have been documented among Indian dairy farmers even after formal training interventions (Thakur *et al.,* 2022). In the context of Kathmandu Valley, these challenges are more pronounced due to high consumer demand, dependence on smallholder farmers with low bargaining power, weak cold chain facilities, seasonal fluctuations in supply and dominance of informal milk marketing channels. These systemic problems reduce efficiency and profitability along the value chain, ultimately affecting both producers and consumers.

Value chain analysis, as outlined by Roduner (2007) and Zamora (2016), identifies inefficiencies and opportunities within production, transportation and consumer delivery systems. However, existing studies on Nepal's dairy sector have largely focused on production trends and consumption patterns, with limited attention to how value is distributed among actors, where inefficiencies emerge and what constraints farmers and intermediaries face within an urbanized market system like Kathmandu Valley. This lack of comprehensive value chain analysis constitutes a significant research gap. This research evaluates the milk value chain in Kathmandu valley, focusing on farmers' socioeconomic profiles, production costs, marketing efficiency and sectoral constraints. The findings aim to inform evidence-based interventions, enhancing income generation, rural development and consumer access to safe and nutritious milk. By addressing the identified gap, this study contributes empirical evidence on the structure, dynamics and constraints of the milk value chain in Kathmandu Valley, thereby guiding policy and investment strategies for sustainable growth.

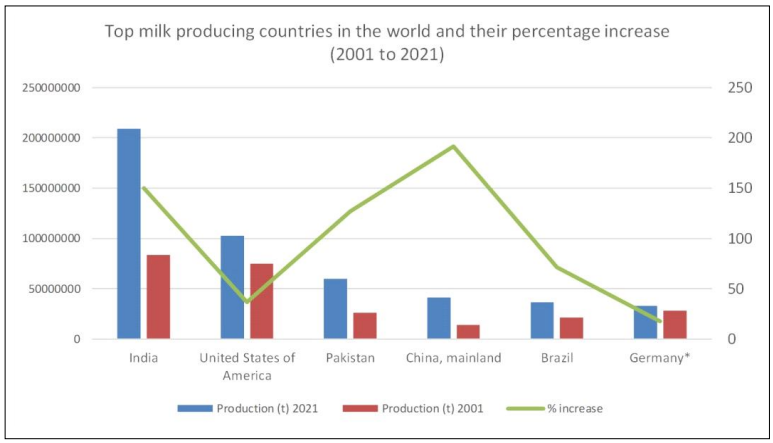
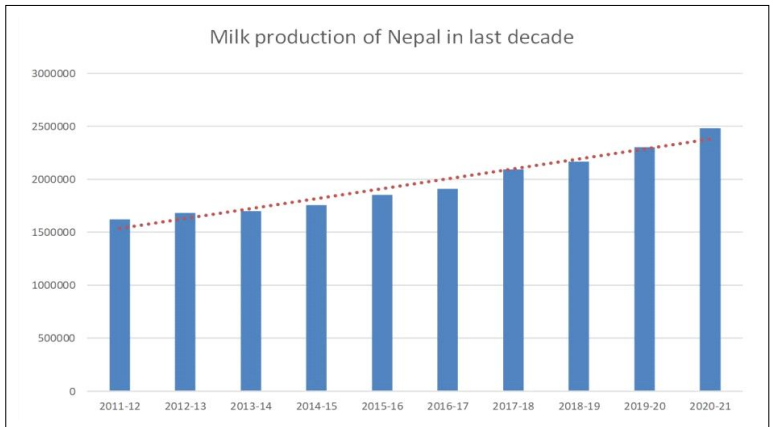


Fig 1: Top milk producing countries in the world.



(Source: MoALD, 2021).

Fig 2: Milk production of Nepal- last decade.

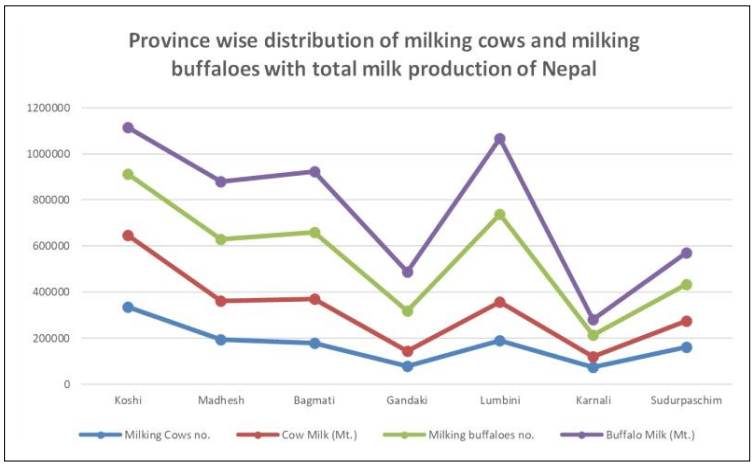


Fig 3: Province wise distribution of population and milk production of Nepal. Source: MoALD, 2021.

MATERIALS AND METHODS

Selection of site

Kathmandu Valley, comprising Kathmandu, Bhaktapur and Lalitpur districts, was purposively chosen due to its role as Nepal's economic, cultural and administrative hub. Its dense population, strong urban-rural connections and significant dairy industry make it an ideal setting to study the dairy value chain's adaptation to urbanized markets.

Population and sampling

The study utilized purposive sampling to select the Kathmandu Valley, which has a daily milk demand of 75,000 litres (NDDB, 2022) and ranks fifth in cattle population nationwide (MoALD, 2021). Municipalities-Shankharapur, Suryabinayak and Godawari were targeted, focusing on wards with dense farmer populations and high milk collection rates (DDC, 2023). A total of 150 households were randomly selected, with 50 households from each ward with a milk collection center.

Data collection

Primary data were collected between April and September 2023, at Kathmandu Valley, Nepal using pretested questionnaires and structured interviews. Field observations, key informant interviews (*e.g.*, with collection center managers and retailers) and focus group discussions with producers, collectors and consumers further enriched data. Secondary data were sourced from reports, journals and statistical records of organizations such as NDDB, NDA, DLS, MoALD and online materials.

Analytical concepts

The cost analysis encompassed fixed and variable costs. Fixed costs included depreciation of fixed assets, while variable costs covered feed, fodder, labor, veterinary expenses and miscellaneous expenditures. Feed and fodder costs accounted for green and dry fodder, concentrates and mineral mixtures, valued at market prices. Labor costs included hired labor, valued based on task-specific wages and family labor, estimated using prevailing rates. Veterinary expenses encompassed pharmaceuticals, vaccination fees, artificial insemination charges and veterinary fees. Miscellaneous costs included electricity, water services, repairs, insurance and related expenses. Depreciation was calculated using the straight-line method (Chaudhary, 2011), considering zero salvage value and useful lives of 12.5 years for animals and 30 years for farm buildings (Mohapatra *et al.,* 2021), with an 11% annual interest rate.

$$\text{Depreciation} = \frac{\text{Asset price - Salvage value}}{\text{Number of years of life}}$$

Cost concepts

i. Total cost (TC) =

Total fixed cost (TFC) + Total variable cost (TVC)

ii. Cost per liter of milk (Rs./liter) =

$$\frac{\text{Net cost per animal}}{\text{Average milk yield per day of animal}}$$

iii. Gross returns (GR): Calculated by multiplying milk yield with fat content and unit fat content price. In case of cooperative.

GR = (Milk produced / household / day * Fat content * Unit fat content price of milk) + value of dung (Rs)

Or, GR = (Milk produced / household / day * Price of milk / liter) + Value of dung (Rs)

iv. Net returns (NR) = Gross returns (GR) - Net cost (NC)

v. Flush and lean season: Flush Season (August-February): High milk production due to favorable conditions, abundant feed and increased yields. Lean season (March-July): Low milk production due to dry weather and limited pasture, leading to reduced yields and higher feeding costs (NDDB, 2020; CASA, 2020).

vi. Marketing cost: Total marketing expenses incurred by producers and intermediaries (Satashia and Pundir, 2021).

Total marketing cost =

Cost incurred by farmer + Cost incurred by middlemen

Marketing margin of the middlemen =

$$\frac{\text{Sale price per unit - (Purchase price per unit + Cost incurred on marketing)}}{\text{Sale price per unit}} \times 100$$

vii. Marketing efficiency (ME): Calculated by using Acharya method.

$$ME = \left[\frac{FP}{MC + MM}\right]$$

Where,
FP = Price received by the farmer.
MC = Net marketing cost.
MM = Net marketing margins.

vii. Producer's share in consumer's price =

$$\frac{\text{Price reveived by farmer}}{\text{Consumer price}} \times 100$$

Garrett's ranking technique

This was employed to assess production and marketing constraints. Respondents ranked challenges by significance, with scores derived from Garrett's Table. Average scores for each factor were calculated and ranked in descending order to identify the most influential factors (Garrett and Woodworth, 1969).

$$\text{Percentage score} = 100\left[\frac{R_{ij} - 0.5}{N_j}\right]$$

Where,
R_{ij} = Rank given for i^{th} variable by j^{th} respondents.
N_j = Number of variable ranked by j^{th} respondents.

RESULTS AND DISCUSSION

Socio-demographic characters of farmers

Table 1 shows that a majority of households (60.67%) were male-headed, with 39.33% female-headed, which is higher than the national average of 25% reported for livestock-based households (NDDB, 2018) and substantially higher than 6% in Bangladesh (Kabir *et al.,* 2018). Most households (79.33%) were nuclear families with an average size of 5.44, above the national average (4.37) (CBS, 2021), suggesting relatively larger household labor availability. The literacy rate (79.33%) exceeded the national rate (76.2%). Income sources included agriculture (68%), pensions, while 10% were fully dependent on livestock. Land ownership varied, with 7.33% holding 1-3 ropani and 52% owning 3-6 ropani. Average milking animals per household was 2.01, with Lalitpur highest at 2.32. These findings indicate that Kathmandu Valley farmers are relatively better educated and resource-endowed, which could facilitate adoption of improved practices. However, the higher proportion of female-headed households highlights increasing feminization of agriculture, likely due to male outmigration, aligning with broader South Asian trends (CASA, 2020). This feminization has policy implications, particularly in ensuring women's access to extension, finance and markets.

Involvement of women in production and marketing of milk

Table 2 shows over 60% of women engaged in production tasks such as forage cutting, shed cleaning and feeding, while men were more active in marketing and purchasing inputs. Similar trends were observed by CASA (2020), where women dominated on-farm labor but had limited decision-making roles in marketing. There was relatively equal involvement in milking. These results reinforce that women's contribution in dairy farming is substantial but undervalued. While they provide most production labor, their limited role in marketing perpetuates gender gaps in income control. Addressing these gaps could empower women and enhance household earnings.

Table 1: Socio demographic information of farmers.

Indicators	Bhaktapur	Kathmandu	Lalitpur	Percentage
Age				
20 to 30	0	1	0	0.67
30 to 40	1	2	1	2.67
40 to 50	5	5	14	16
50 to 60	31	23	30	56
60 to 70	12	17	4	22
70 and above	1	2	1	2.67
Gender				
Male	26	36	29	60.67
Female	24	14	21	39.33
Family type				
Nuclear	25	45	49	79.33
Joint	25	5	1	20.67
Qualification				
Illiterate	7	6	18	20.67
Literate	12	5	23	26.67
Primary	11	7	6	16.00
SLC	10	14	2	17.33
Inter	8	9	1	12.00
Bachelor	1	9	0	6.67
Master	1	0	0	0.67
Occupational structure				
Agriculture	36	48	18	68
Pension	7	0	12	12.67
Livestock	5	0	10	10
Service	2	2	9	8.67
Carpenter	0	0	1	0.67
Land holding				
1 to 3	2	0	9	7.33
3 to 6	27	21	30	52
6 to 9	18	17	9	29.33
9 and above	3	12	2	11.33
Cattle holding				
Average	2.3	1.42	2.32	2.01

Economic analysis of milk production

Table 3 presents costs and revenues while Table 4 explains about cost and production of milk in Kathmandu valley. Bhaktapur had total costs of NRs.337,418.75 with net revenue N Rs.96,280.57; Kathmandu costs N Rs.378,5 80.66 with net revenue NRs.69,653.53; Lalitpur costs N Rs.378,043.32 with net revenue N Rs.60,073.56. Feed emerged as the largest cost, followed by labor, corroborating (Satashia and Pundir 2021). Average yields were 12.72 liters (Bhaktapur), 12.96 (Kathmandu) and 14.45 (Lalitpur), mean 13.38 liters-slightly higher than Bhandari (2015), who reported 10-12 liters. Production costs averaged NRs.74.25/liter, higher than national range NRs.45-67 (NDDB, 2021). This confirms earlier observations by Timsina (2010) that household-level costs often exceed official estimates. Overall, while productivity in Kathmandu Valley is above average, elevated costs reduce competitiveness, especially for smallholders. Without interventions in feed efficiency, input cost reduction and cooperative marketing, farmers' margins will remain constrained.

Marketing channels, cost, margins, efficiency and producer share

The study area observed various marketing channels for transferring the milk produced on farms to consumers. The milk supply pattern varied across three different villages in the Kathmandu Valley. The main marketing channels identified in the study area were.

Table 5, 6 and 7 provide a comparative analysis of milk marketing across Bhaktapur, Kathmandu and Lalitpur districts, highlighting variations in cost structure, profit distribution and efficiency across different marketing channels. In Bhaktapur, two channels were observed. Channel-I, where farmers sell directly to consumers, yields the highest

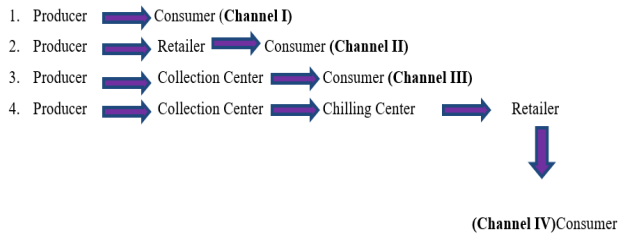


Table 2: Dynamics in production and marketing of milk.

Activities	Bhaktapur %		Kathmandu %		Lalitpur %		Total %	
	Male	Female	Male	Female	Male	Female	Male	Female
Forage and grass cutting	26.46	73.54	25.85	74.15	27.34	72.66	26.55	73.45
Shed cleaning	35.67	64.33	37.13	62.87	34.96	65.04	35.92	64.08
Water and feed feeding	33.8	66.2	35.42	64.58	32.56	67.44	33.93	66.07
Milking	47.31	52.69	45.78	54.22	43.78	56.22	45.62	54.38
Purchasing of inputs	63.92	36.08	64.39	35.61	66.43	33.57	64.91	35.09
Selling of milk	54.39	45.61	57.98	42.02	53.67	46.33	55.35	44.65

Table 3: Economic analysis of milk production in Kathmandu valley.

Cost	Bhaktapur	Kathmandu	Lalitpur	Average
Feed cost (mineral, bran, concentrate)	104088.65	95773.36	102171.05	100677.69
Rice straw cost	72336.97	83833.21	77714.17	77961.45
Green grass and forage cost	58811.77	80504.35	82809.63	74041.92
Labour cost	48529.85	53559.40	55320.98	52470.08
Miscellaneous expenses	10295.65	16065.51	13917.43	13426.20
Veterinary expenses	3573.06	4528.99	4363.30	4155.11
Total variable cost	297635.95	334264.81	336296.57	322732.44
Interest on fixed capital	12884.34	15395.22	13886.75	14055.44
Depreciation	13583.58	15605.75	14545.12	14578.15
Land tax	13314.88	13314.88	13314.88	13314.88
Total fixed cost	39782.80	44315.85	41746.75	41948.47
Total cost (TFC + TVC)	337418.75	378580.66	378043.32	364680.91
Revenue of milk in flush season	275444.99	284568.87	278674.44	279562.77
Revenue of milk in lean season	142933.62	147668.17	144609.44	145070.41
Total revenue from milk	418378.61	432237.04	423283.88	424633.18
Value of dung (per year)	15320.71	15997.15	14833	15383.62
Total revenue (Milk + dung)	433699.32	448234.19	438116.88	440016.80
Net revenue	96280.57	69653.53	60073.56	75335.89

(Values in Nepalese currency).

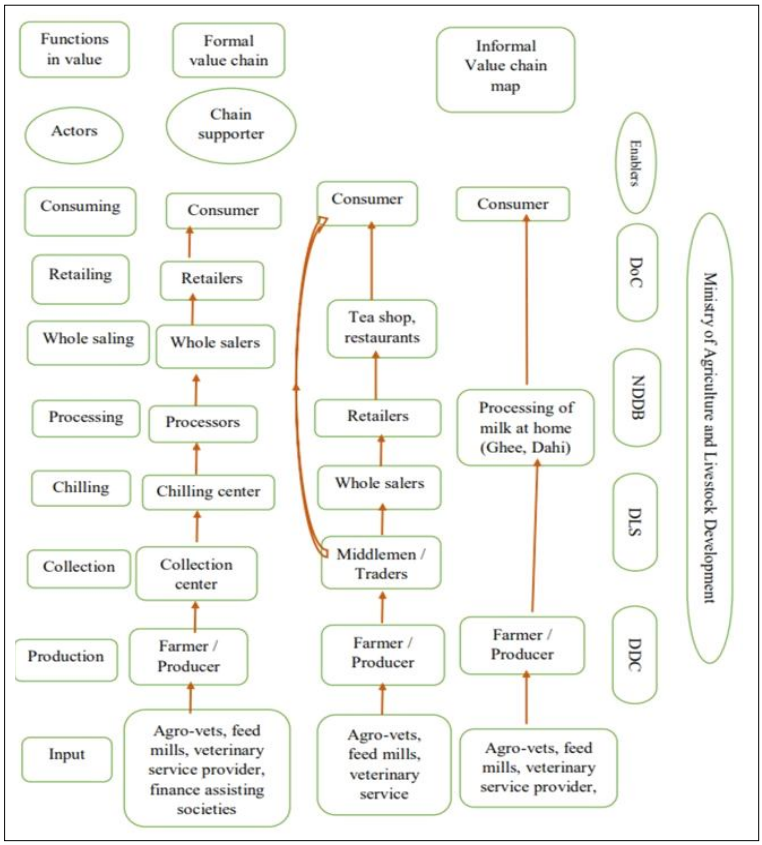


Fig 4: Value chain map of milk in Kathmandu valley.

Table 4: Cost and production of milk in Kathmandu valley.

Particulars	Milk production* (liter/day/cow)	Minimum (Rs/liter)	Maximum (Rs/liter)	Average (Rs/liter)
Bhaktapur	12.72	54.83	102.81	73.80
Kathmandu	12.96	51.61	104.09	76.78
Lalitpur	14.45	58.17	90.77	72.16
Average	13.38	54.87	99.22	74.25

Table 5: Marketing cost, marketing margin and marketing efficiency of Bhaktapur district (NRs/litre).

Particulars	Channel-I	Channel-II
Gross price received by the farmer	110	100
i) Marketing cost	0.75	0.3
ii) Net price realized	109.25	99.7
Retailer		
i) Price paid	-	100
ii) Marketing cost	-	1
iii) Marketing margin	-	17.8
iv) Price received	-	120
Consumer		
i) Price paid	100	120
Value added (MC+MM)	0.75	19.1
Marketing efficiency	145.66	4.911
Producer's share in consumer's rupees (%)	99.32	83.33

marketing efficiency (145.66) and producer's share (99.32%). In contrast, Channel-II, involving retailers, shows lower efficiency (4.911) and producer's share (83.33%). In Kathmandu, four channels were analyzed. Channel-I remains the most efficient, while Channels III and IV (with collection and chilling centers) further reduce efficiency and producer's share, with Channel-III showing the lowest efficiency (1.9). Similarly, in Lalitpur, Channel-I emerges as the most favorable for farmers, while Channels III and IV offer the lowest efficiency and producer share. These findings underscore that direct-to-consumer sales are the most beneficial for farmers, but such channels are limited in scale and reach. Reliance on intermediaries significantly reduces producer margins, echoing previous studies (Shrestha *et al.,* 2017). This points to structural inefficiencies in the milk value chain, highlighting the need for stronger cooperative structures and transparent pricing systems.

Table 6: Marketing cost, marketing margin and marketing efficiency of Kathmandu district (NRs/litre).

Particulars	Channel-I	Channel-II	Channel-III	Channel-IV
Gross price received by the farmer	110	100	75.57	75.57
i) Marketing cost	0.75	0.3	0.2	0.2
ii) Net price realized	109.25	99.7	75.37	75.37
Collection centre				
i) Price paid	-	-	75.57	75.37
ii) Marketing cost	-	-	1.3	0.4
iii) Marketing margin	-	-	38.13	4.6
iv) Price received	-	-	115	80.57
Chilling centre				
i) Price paid	-	-	-	80.57
ii) Marketing cost	-	-	-	5
iii) Marketing margin	-	-	-	12.43
iv) Price received	-	-	-	98
Retailer				
i) Price paid	-	100	-	100
ii) Marketing cost	-	1	-	0.3
iii) Marketing margin	-	17.8	-	1.7
iv) Price received	-	120	-	100
Consumer				
i) Price paid	100	120	115	100
Value added (MC+MM)	0.75	19.1	39.63	24.63
Marketing efficiency	145.66	4.911	1.9	3.05
Producer's share in consumer's rupees (%)	99.32	83.33	65.71	75.57

Table 7: Marketing cost, marketing margin and marketing efficiency of Lalitpur district (NRs/litre).

Particulars	Channel-I	Channel-II	Channel-III	Channel-IV
Gross price received by the farmer	110	100	75.41	75.41
i) Marketing cost	0.75	0.3	0.2	0.2
ii) Net price realized	109.25	99.7	75.21	75.21
Collection centre				
i) Price paid	-	-	75.41	75.41
ii) Marketing cost	-	-	1.3	0.4
iii) Marketing margin	-	-	38.29	4.6
iv) Price received	-	-	115	80.41
Chilling centre				
i) Price paid	-	-	-	80.41
ii) Marketing cost	-	-	-	5
iii) Marketing margin	-	-	-	12.59
iv) Price received	-	-	-	98
Retailer				
i) Price paid	-	100	-	98
ii) Marketing cost	-	1	-	0.3
iii) Marketing margin	-	17.8	-	1.7
iv) Price received	-	120	-	100
Consumer				
i) Price paid	110	120	115	100
Value added (MC+MM)	0.75	19.1	39.79	24.79
Marketing efficiency	145.66	4.911	1.89	3.03
Producer's share in consumer's rupees (%)	99.32	83.33	65.57	73.41

Table 8: Problem faced by milk producer.

Problems	Mean score	Rank
Cost of feed and fodder	63.78	1
Less availability of green grass and fodder	63.39	2
High cost for veterinary services	57.43	3
Disease outbreaks of milch animal	54.77	4
No proper price of milk obtained	48.33	5
Payment delay of milk sold	43.23	6
Poor genetic potential of milch animal	42.39	7
Irregular supply of milk	31.70	8

Value chain actors and their function

This section outlines the roles of key actors, including input suppliers, producers, collection centers, chilling centers, processors, wholesalers, retailers and consumers, along with supporting institutions such as DLS, DoC, NDDB and DDC as shown in Fig 4. The multiplicity of actors reflects both opportunities and inefficiencies. While institutions like DDC and NDDB provide critical support, weak coordination among actor's results in fragmented markets and inefficiencies, a finding consistent with Mahato *et al.* (2019). Strengthening linkages among value chain actors could enhance both productivity and farmer incomes.

Problems faced by farmer in Production and marketing of milk

Table 8 highlights challenges such as the high cost of feed and fodder, limited availability of green grass, rising veterinary service costs, disease outbreaks and lack of standardized milk pricing. Other issues include delayed payments, poor genetic potential of animals and irregular milk supply. These problems are consistent with Dhakal *et al.* (2019) and NDDB (2021), suggesting that systemic challenges persist in Nepal's dairy sector. The implications are that without policy support for feed resources, veterinary access and transparent milk pricing mechanisms, profitability and sustainability of smallholder dairy farming will remain at risk. Limitations of this study include its focus on Kathmandu Valley, meaning results may not fully generalize to rural or remote districts with differing agro-ecological contexts.

Suggestions

Most milk producers rear only one or two milch animals, reflecting the non-commercial nature of the sector. Enhancing herd size through targeted interventions, promoting year-round fodder cultivation and strengthening farmer-led cooperatives can improve efficiency. Government support should prioritize veterinary services, artificial insemination and accessible credit. Ensuring hygiene through quality control at collection and processing centers, location-specific milk pricing and training on feed, nutrition and hygiene are essential. Policies on unproductive cattle must also respect religious and cultural sensitivities.

CONCLUSION

Milk production, even for non-commercial producers, is a profitable venture, yielding a net revenue of NRs.75,335.89/ year/cow. However, small-scale farmers face high feed, forage and veterinary costs, which impact the milk cost. Profits increase when there are fewer intermediaries between the producer and consumer. The pricing structure based on milk's fat content leads to reduced farmer earnings. Collection and chilling centers break even, while processors profit from extracting fat to produce value-added items. Direct sales to consumers ensure fresh, high-quality milk, while other channels lower quality, especially fat content. Channel I is the most efficient for marketing raw milk, with farmers often selling partially to collection or chilling centers and partially directly to consumers for higher revenue. Aging cows reduce milk quality and revenue, posing a significant challenge for farmers in Nepal.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All animal procedures for experiments were approved by the Committee of Experimental Animal care and handling techniques were approved by the University of Animal Care Committee.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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