A Strategic Cost - Benefit Evaluation of Dairy Industry in Karnataka

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Abstract

The dairy industry in Karnataka considers a critical component of the agrarian economy, serving as a primary source of income for millions of rural households. This study examines the performance dynamics and economic viability of the dairy sector in Karnataka, with a particular emphasis on cost-benefit analysis across varying production systems and institutional frameworks. Drawing on both primary data from dairy farmers and secondary sources, the research investigates key performance indicators such as milk yield, processing capacity, revenue generation, and technological efficiency. Comparative analysis reveals that modernized dairy units and private sector dairies generally outperform their traditional and cooperative counterparts in terms of profitability and productivity, primarily due to greater investment in technology and infrastructure. However, structural challenges such as inadequate cold chain infrastructure, feed shortages, veterinary service gaps, and policy implementation hurdles continue to constrain sectoral efficiency. The study further utilizes Data Envelopment Analysis (DEA) and descriptive statistics to highlight disparities in operational performance. The findings offer critical insights for policymakers; dairy cooperatives, and private stakeholders to foster sustainable growth and improve competitiveness in Karnataka's dairy sector.

Keywords: Dairy Industry. Karnataka Cost-Benefit Analysis, Productivity, Technological Adoption, Cooperative vs Private Dairies.

Introduction

Overview of the dairy industry in India and Karnataka

India’s agricultural economy leans heavily on dairy production. It provides mass employment, generates steady income, and ensures nutritional security across the subcontinent. Today, India leads global milk output, accounting for roughly 23% of the world’s supply (National Dairy Development Board [NDDB], 2023). Smallholder farming networks and localized cooperatives drive this massive expansion. Karnataka stands out in this landscape. Ranking among the top producers in southern India, districts like Mandya, Hassan, and Belagavi generate immense volume. State processing capacities have scaled aggressively alongside this raw output (Department of Animal Husbandry & Veterinary Services, 2022).

Objectives and research questions

This research evaluates the economic realities of Karnataka's dairy industry, focusing strictly on cost-benefit metrics. We examine three core areas. First, we assess the current operational and economic performance of local dairy enterprises. Next, we

apply a cost-benefit analysis across traditional, semi-modern, and modern production frameworks. Finally, we map the exact structural barriers limiting sector profitability.

These objectives prompt three specific research questions:

1. What exact costs and revenues define Karnataka's varied dairy models?
2. How do technology adoption and operational scale alter profit margins?
3. What institutional hurdles do regional stakeholders confront daily?

Dairy remains the economic backbone of rural Karnataka. It offers reliable, continuous income, especially for landless laborers and female-headed households, which keeps rural poverty in check. Over 65% of Karnataka's rural households raise livestock, with dairying acting as the primary anchor (Department of Animal Husbandry and Veterinary Services, 2022). Macroeconomically, the sector contributes around 4% to the state's agricultural Gross State Domestic Product (GSDP). It feeds downstream processing industries and heavily strengthens regional food security (NABARD, 2021).

Literature review

Overview of prior research on dairy sector performance

Academic and policy researchers frequently examine dairy economics, given its direct link to rural livelihood. Historical data proves that since the rollout of Operation Flood, Indian milk availability has surged (Chand, Birthal, & Negi, 2019). Singh and Datta (2018) note that dairy operations resist agricultural recessions far better than crop farming, offering marginal farmers critical financial stability. In Karnataka specifically, cooperative structures effectively guarantee fair pricing and access to processing facilities (KMF, 2022; Raju & Hegde, 2020).

Yet, systemic inefficiencies remain. Babu (2020) points to fragmented supply chains, clustered infrastructure, and a stark lack of value-added market penetration. Consequently, productivity and profits vary wildly across state districts and individual production systems.

Cost structures and profitability in dairy enterprises

Profitability hinges on a few distinct variables. Feed costs, veterinary care, labor, and herd size ultimately dictate the margins. According to Birthal and Jha (2019), feed and fodder eat up 60-70% of variable costs in smallholder setups, which aggressively shrinks net returns. In Karnataka, farmers linked to cooperatives generally face lower transaction and marketing overhead than those operating independently in unorganized markets (Gowda & Reddy, 2017).

Input-output price imbalances compound these issues. Many marginal farmers struggle with scale, failing to cover overheads when production dips below break-even thresholds. Ramesh and Chand (2021) argue that without targeted institutional credit for mechanization, true commercial scalability remains out of reach for the average producer.

Research methodology

Area of study

The investigation centers on Karnataka, a dominant force in India's milk production. We selected Mandya district as the primary focal point. Mandya is heavily agrarian, features exceptionally high milk density, and hosts an extensive network of dairy cooperatives. Historically, the district anchored the Karnataka Milk Federation (KMF)

expansion, making it a perfect cross-section for comparing cooperative and private-sector operations (KMF, 2022).

Sampling technique and sample size

A stratified purposive sampling framework captured a cross-section of the value chain. The sample comprises:

1. 120 dairy producers (ranging from marginal to semi-commercial scale).
2. 15 processors spanning private and cooperative sectors.
3. 10 cooperative society representatives across village and taluk levels.

Mixing producers with processors guarantees a comprehensive, two-sided cost-benefit evaluation (Rao & Srinivas, 2021).

Data sources

Data collection blended primary and secondary methods. We gathered primary data via field interviews, focus groups, and structured surveys. These tools tracked input expenses, revenue, market linkages, and technology use. Secondary data came from official KMF reports, the NDDB, and state veterinary publications.

Analytical tools used

Analytically, the project relied on Cost-Benefit Analysis (CBA) to test the economic viability of distinct dairy systems. By weighing total production costs against returns per unit of milk, metrics like the Benefit-Cost Ratio (BCR) and Net Present Value (NPV) quantified absolute profitability (Birthal & Jha, 2019). Combining qualitative insights with hard quantitative data paints a highly accurate picture of sector performance.

Performance analysis of the dairy industry

Assessment of key performance indicators

Over the last ten years, Karnataka's dairy output expanded rapidly. Total state production jumped from 7.9 million tonnes in 2018-19 to 12.83 million tonnes by 2022-23. Because of this surge, state per capita milk availability hit 483 grams daily, comfortably clearing the 459-gram national average.

Processing infrastructure grew in tandem. The KMF and competing private dairies scaled operations to absorb the excess yield. Economically, the state's dairy market sat at an estimated INR 1,206.3 billion in 2024. Current forecasts predict this figure will climb to INR 3,575.9 billion by 2033, driven by a 12.19% compound annual growth rate (CAGR). The KMF drives much of this momentum, commanding the processing capabilities necessary to sustain long-term regional growth.

Table 1: Key performance indicators of Karnataka's dairy industry

Indicator	Value	Year
Total Milk Production	12.83 million tonnes	2022-23
Per Capita Milk Availability	483 grams/day	2022-23
Dairy Market Size	INR 1,206.3 billion	2024

Projected Market Size	INR 3,575.9 billion	2033
Market Growth Rate (CAGR)	12.19%	2025-2033
KMF Revenue	Over INR 17,000 crore	2022-23
Processing Capacity (KMF)	8.4 million litres/day	2022-23
Milk Procurement (KMF)	8.4 million litres/day	2022-23
Milk Marketing (KMF)	7.5 million litres/day	2022-23
Number of Dairy Cooperatives	Over 14,000	2022-23

Table 2: Technological adoption in Karnataka's dairy sector

Technology Aspect	Cooperative Dairies (e.g., KMF)	Private Dairies (e.g., Heritage, Dodla)
Artificial Insemination (Al)	Widely adopted; supported by KMF's Al centres and veterinary services	Commonly used; often with access to superior semen and advanced breeding techniques
Mechanized Milking Systems	Limited adoption; primarily in large-scale or model farms	More prevalent; especially in commercia farms for efficiency
Cattle Feed & Nutrition	Standardized feed provided, focus on balanced nutrition	Customized feeding programs; often with better quality concentrates
Health Monitoring & Disease Management	Basic veterinary services; some extension support	Advanced health monitoring systems; proactive disease management
Data-Driven Farm Management	Emerging; some digitization initiatives	Advanced; use of farm management software and IoT solutions

Data Envelopment Analysis (DEA) has been utilized to assess the technical efficiency of dairy cooperatives, revealing variations in efficiency scores and highlighting areas for improvement. Enhancing technological adoption and operational practices in cooperatives could bridge the efficiency gap between them and private dairies.

Table 3: Technical Efficiency of Dairy Cooperatives (KMF) in Karnataka (2013-2024)

Year	Technical efficiency
2013 - 2014	0.99

2014 - 2015	0.96
2015 - 2016	0.97
2016 - 2017	0.98
2017 - 2018	0.86
2018 - 2019	0.98
2019 - 2020	0.90
2020 - 2021	0.84
2021 - 2022	0.88
2022 - 2023	0.89
2023 - 2024	0.88

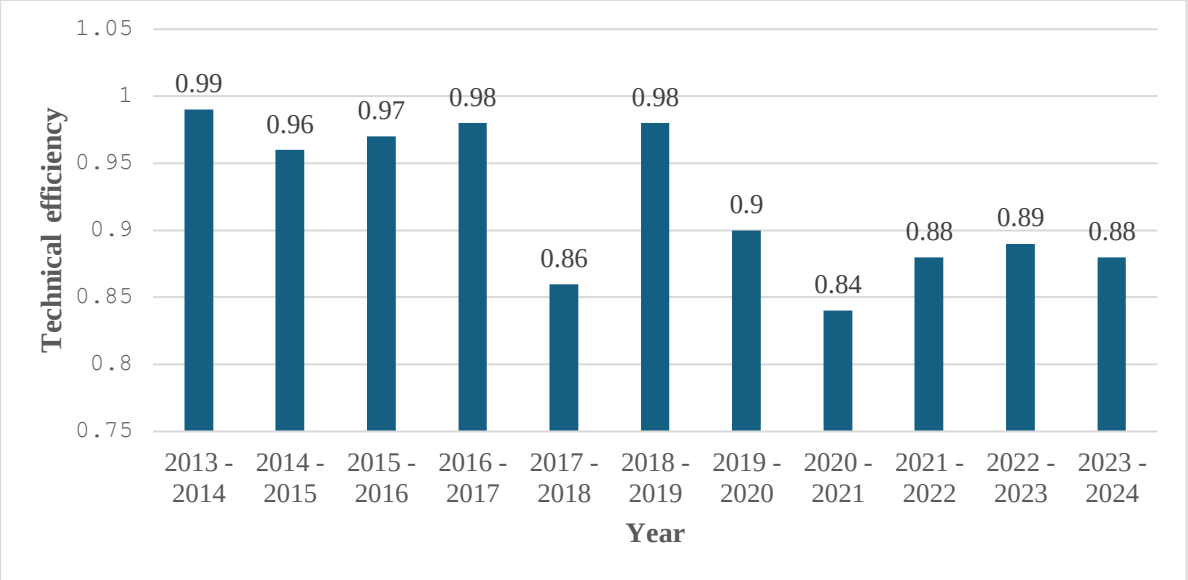

Figure 1: Technical Efficiency of Dairy Cooperatives (KMF) in Karnataka (2013-2024)

Cost-Benefit analysis of dairy production systems

Fixed vs. variable cost components

In Karnataka's dairy sector, variable costs constitute a significant portion of the total production costs across all herd sizes. Specifically, variable costs account for approximately 74.03% in small herds, 74.18% in medium herds, and 75.20% in large herds. The primary components of variable costs include feed and fodder, labour, veterinary expenses, and miscellaneous costs. Fixed costs, encompassing depreciation, interest on fixed capital, and building maintenance, represent the remaining portion of the total costs.

Table 4: Fixed vs. variable cost components

Herd Size	Fixed Cost (Rs/ animal/ year)	Variable Cost (Rs/ animal/ year)	Fixed Cost (%)	Variable Cost (%)
Small	14,488	44,830	25.97%	74.03%
Medium	15,157	44,830	25.82%	74.18%
Large	18,327	55,623	24.80%	75.20%

Revenue analysis by scale and system (traditional vs. modern)

Revenue generation in dairy farming is influenced by the scale of operation and the adoption of modern practices. Large herds, often associated with modern dairy systems, exhibit higher milk yields and, consequently, greater revenue per litre. For instance, large herds achieve a gross revenue of 754.94 per litre, whereas small herds, typically following traditional methods, attain 245.65 per litre. The increased revenue, in modern systems is attributed to enhanced productivity and efficiency.

Table 5: Revenue Analysis by Scale and System

Herd Size	Gross Revenue (Rs/ animal/ year)	Gross Revenue (Rs/ litre)
Small	75,614	45.65
Medium	80,367	47.33
Large	1,09,331	54.94

Break-even analysis

The break-even output (BEO) indicates the minimum production required to cover all costs. In Karnataka, small herds have a BEO of 2.91 litres/day, medium herds 2.70 litres/day, and large herds 2.84 litres/day. Notably, the percentage of BEO to total output is significantly lower in large herds (3.23%) compared to small herds (45.54%). highlighting the efficiency advantages of larger, modern operations.

Table 6: Break-Even Analysis

Herd Size	Break – Even Output (litres/ day)	% Of Total Output
Small	2.91	45.54%
Medium	2.7	11.79%
Large	2.84	3.23%

Net profit margins across different farm sizes and technologies

Net profit margins per litre of milk are positively correlated with herd size and the adoption of modern technologies. Large herds report a net profit of 216.53 per litre, medium herds & 10.81, and small herds 29.92. The higher profitability in larger herds

is due to economies of scale, better resource utilization, and advanced management practices.

Table 7: Net profit margins across different farm sizes and technologies

Herd Size	Net Revenue (Rs/ litre)	Return per Rupee Invested
Small	9.92	1.35
Medium	10.81	1.36
Large	16.53	1.48

Larger herds not only generate higher net revenue per litre but also exhibit better returns per rupee invested. This highlights the financial advantages of scaling up operations and adopting modern dairy farming practices.

Table 8: Cost-Benefit comparison across dairy models

Dairy Model	Avg. Cost (Rs/ litre)	Avg. Revenue (Rs/ litre)	Net Profit (Rs/ litre)	ROI (%)
Traditional	35.73	45.65	9.92	35
Semi-modern	36.53	47.33	10.81	36
Modern	38.41	54.94	16.53	48

Karnataka's dairy sector requires structural adjustments to address prevailing inefficiencies in production economics. Current performance gaps point toward specific interventions capable of driving both short-term yield improvements and long-term sector viability.

Yield optimization remains the primary driver of farm-level profitability. Transitioning toward high-yielding crossbred genetics offers a direct pathway to better margins. Empirical data confirms crossbred variants routinely double the output of indigenous stock, altering the economic baseline for producers (Birthal & Jha, 2019). Feeding protocols require parallel modernization. Replacing ad-hoc rationing with Total Mixed Ration (TMR) systems alongside localized fodder banks substantially limits variable feed costs (Chand et al., 2020). Beyond physical inputs, state-sponsored extension services must shift focus toward clinical hygiene and herd management. Better on-farm practices directly suppress arbitrary veterinary expenditures.

Post-harvest degradation severely limits value capture across the supply chain. Village-level bulk milk coolers (BMCs) and decentralized chilling networks prevent raw milk spoilage, allowing producers to leverage better quality metrics for higher compensation (NDDB, 2022). Yet, capital constraints often hinder local infrastructure development. Integrated dairy parks—equipped with automated processing facilities

and quality testing labs—can be realized effectively through public-private partnerships. On the procurement side, digitizing transactions and grading systems eliminates opacity. Transparent payment architectures foster institutional trust and reduce settlement delays.

Marginal and small-scale operations account for roughly 70% of the state's dairy demographic. Policy frameworks must isolate and address the structural barriers these producers face daily. Access to mineral mixtures, high-quality fodder seeds, and localized veterinary support requires targeted subsidization. Interventions like the Rashtriya Gokul Mission must prioritize geographically marginalized clusters (Department of Animal Husbandry & Dairying, 2021). Organizing these dispersed producers into self-help groups (SHGs) and broader collectives aggregates their bargaining power (Babu, 2020). It also drastically lowers transaction costs when interfacing with formal creditors. Risk mitigation is equally essential. Universal livestock insurance frameworks must abandon heavy bureaucratic prerequisites to shield rural households from sudden mortality or disease-driven asset losses.

Environmental constraints dictate the future trajectory of agrarian industries. Subsidizing solar-driven chilling infrastructure, methane capture protocols, and water-efficient cleaning equipment embeds climate resilience directly into dairy economics. International frameworks increasingly rely on sustainability metrics to gauge sector performance (FAO, 2020). Market regulation needs similar refinement. Overlapping governance structures often disadvantage cooperatives against private entities. Regulatory parity in quality norms and pricing is necessary to protect producer welfare. A dedicated state-level dairy development board could resolve these institutional frictions, synchronizing the efforts of private processors, cooperatives, and research bodies. Finally, linking dairy initiatives with existing rural support architectures—like PM-KISAN and MGNREGA—cements dairy farming as a core component of poverty alleviation.

Ultimately, Karnataka relies on dairying as a bedrock for rural economic stability and nutritional provisioning. By analyzing production economics and institutional frameworks across the state, this research isolates specific friction points in current dairy operations. Addressing these gaps requires deliberate shifts in resource allocation.

Policymakers must pivot toward decentralized capacity building, robust cold chain infrastructure, and equitable pricing models. For processing cooperatives and private entrepreneurs, capital allocation should prioritize supply chain modernization and granular quality control. Financial institutions face a distinct opportunity to rethink capital delivery. Bespoke insurance instruments and credit lines designed for localized production risks can accelerate technological adoption among smaller producers.

Several structural questions remain unaddressed. Future inquiries should leverage longitudinal datasets to track the actual efficacy of state interventions over extended periods. Comparative analyses with neighboring states would help benchmark Karnataka’s trajectory against national averages. Additionally, the intersection of climate adaptation and dairy output demands precise empirical modeling, particularly regarding low-carbon production limits. Shifts in consumer preference toward value-added dairy commodities also present an immediate area for demand-side market analysis.

Moving forward, the viability of Karnataka's dairy economy depends entirely on institutional alignment. Meaningful sector transformation is achievable, provided public agencies, private stakeholders, and rural producers operate under cohesive, evidence-based policy directives.

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