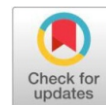


Original Research Article

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Economic analysis of production and utilization pattern of milk and milk products in Andhra Pradesh



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ABSTRACT

Despite the growing importance of dairy as a livelihood source and its role in nutritional security, there remains a noticeable gap in region-specific studies that examine the production and utilization dynamics at the micro level. The present study was conducted in Andhra Pradesh, India, to evaluate milk production dynamics and utilization patterns among dairy households. Primary data were collected from Chittoor and East Godavari districts, and households were stratified into small, medium, and large categories using the cumulative root frequency technique based on herd size. The average daily milk production per household was 13.26 litres, with crossbred cows contributing the highest share (64.53%), followed by buffaloes (28.41%) and indigenous cattle (7.06%). Of the total milk produced, 14.03% was retained for home consumption, 0.71% was lost during handling, and 85.25% was sold. Among the marketed surplus, 57.58% was routed through formal channels, including cooperatives (36.83%) and private agencies (20.75%), while the remaining 42.42% was sold via informal outlets such as vendors (23.39%), direct consumers (9.58%), and creameries/halwais (9.41%). The results highlight a relatively high level of commercialization in the region's dairy sector, driven largely by crossbred cattle. However, the study also identified key constraints affecting dairy farmers, with the inadequate availability of green and dry fodder emerging as the most critical challenge. The findings emphasize the need for region-specific interventions to improve input availability, strengthen formal marketing linkages, and enhance dairy productivity. This study provides empirical evidence to inform policies aimed at sustainable dairy development in Andhra Pradesh.

Keywords: Milk production, Utilization pattern, Dairy marketing, Crossbred cows, Constraints, Andhra Pradesh, region-specific, dairy sector

Introduction

Agriculture contributes 20.19 per cent to the Indian economy and employs more than half of the population (GOI, 2021). The average land holding has decreased from 1.15 hectares in 2010–11 to 1.08 hectares in 2015–16. The percentage of small and marginal land holdings has increased from 85.1 per cent in 2010–11 to 86.21 per cent in 2015–16 (Agriculture Census 2015–16). Farmers are unable to obtain a sufficient amount of income and employment throughout the year due to very small and fragmented land holdings and rising farm input costs (Agriculture Census 2015–16). As Agriculture alone cannot provide farmers with employment and income, this resulted in the development of alternative sources, including livestock and fisheries, which give farmers access to additional sources of income and employment (Economic Survey, 2021–22). The livestock sector is an important subsector of agriculture. A total of 20.5 million people rely on livestock as a source of income (Economic Survey, 2021–22). The livestock sector in India is experiencing a compounded annual growth rate (CAGR) of 5.02

per cent in 2022–23 (DADH, 2024). In 2022–23, the livestock sector contributed 5.50 per cent to the country's GVA. The livestock sector's contribution to total agriculture and allied sector GVA increased from 24.32 per cent in 2014–15 to 30.23 per cent in 2022–23 (DAHD, 2024). Dairying is essential to transforming Indian farmers' lifestyles. Farmers living in drought-prone regions where agriculture is only practised for a brief period (based on the availability of moisture) depend heavily on livestock, making it their primary source of income. Both livestock and dairy farms employ more than one-third of the country's population (DAHD, 2021). Dairy plays a crucial role in income generation and employment of the rural population, providing employment for more than 8 crore farmers directly and contributing around 5 per cent of the national economy (Economic Survey, 2021–22). Like the Green Revolution, the white revolution transformed the country from a milk-deficient to a milk-surplus nation. The nation's milk production has witnessed a compound annual growth rate of approximately 3.83 per cent (against 1.34 per cent world average), reaching 230.58 million metric tonnes in 2022–23 from 21.2 million metric tonnes in 1968–69, which accounts for 25 per cent of the global share (DAHD, 2024).

Milk utilization consists of the retention of liquid milk and the conversion of milk into different milk products at the household level, as well as the remaining part of total milk production that is available for sale as liquid milk and processed milk in the

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market. Out of the total production of milk, 46 per cent is either consumed at the producer level or sold to non-producers at the local level, and 54 per cent is the marketed surplus, i.e., made available for sale (DAHD, 2021). The milk retained by the producer households is used for consumption as liquid milk and conversion into other products (curd, butter, ghee, etc.). The remaining milk (54 per cent) is surplus milk marketed through different marketing agencies to end consumers.

The analysis of milk utilization patterns holds significant potential for informing strategies aimed at enhancing the dairy sector. A clear understanding of how milk is produced, consumed, and marketed can guide evidence-based policymaking, particularly in areas of dairy development, processing, and value addition. Despite the growing importance of dairy as a livelihood source and its role in nutritional security, there remains a noticeable gap in region-specific studies that examine the production and utilization dynamics at the micro level.

Andhra Pradesh, located in the southern part of India, is one of the leading milk-producing states, yet it remains underrepresented in scholarly literature on milk utilization and marketing patterns. While several national and state-level policies aim to strengthen the dairy sector, their effectiveness often hinges on region-specific insights that are currently lacking for Andhra Pradesh. Most existing studies focus on northern and western states, leaving a vacuum in understanding the local stakeholder networks, milk flow systems, and constraints unique to the southern context.

Given this backdrop, the present study was undertaken to bridge this knowledge gap by systematically assessing the milk production and utilization patterns in Andhra Pradesh. It aims to map the various stakeholders involved in milk production, consumption, and marketing, and to trace the flow of milk across formal and informal channels within the state. By doing so, the study provides a crucial foundation for designing targeted interventions and policies that address the specific challenges and opportunities of the dairy sector in Andhra Pradesh.

Review of literature

Several studies across India have examined milk production, utilization, and marketing patterns, highlighting regional differences in dairy practices. Kumari et al. (2022), in their study conducted in the eastern region of India, observed that nearly 10 percent of total milk production was retained for home consumption, while the remaining 90 percent was marketed through various channels. Among these, informal marketing agencies accounted for the largest share at 61 percent, followed by cooperatives at 21 percent, with the remaining quantity sold through home-based sales. The study also emphasized that improved feeding and herd management practices were positively associated with increased milk production, while milk prices and herd size significantly influenced the disposal patterns.

In the dry regions of Karnataka, Rebasiddanavar et al. (2021) found that crossbred cows contributed a higher share of milk production compared to local cows and buffaloes. The marketed surplus in the study was substantial, amounting to 82.89 percent of the total milk produced. This trend aligns with Bhawar et al. (2019), who investigated the disposal patterns of milk and noted that 57.73 percent of surplus milk was sold to the unorganized sector, while 42.27 percent was sold to the organized sector.

These findings underscore the continued dominance of informal marketing channels in rural dairy economies.

Similarly, Meena and Tiwari (2015) reported that 31.51 percent of surplus milk was directly sold to consumers, followed by sales to vendors (30.18 percent), cooperatives (23.85 percent), and tea shops (11.26 percent). The study highlighted that most milk was sold locally due to strong consumer demand at the village or town level. Singh et al. (2018), in their study on milk production and disposal in Jaipur, found that buffaloes had the highest daily milk yield, contributing 73.11 percent to the total milk production, surpassing both crossbred and indigenous cattle.

Further supporting the dominance of buffaloes in milk production, Agarwal and Raju (2021) found that in Madhya Pradesh, buffaloes accounted for the largest share of milk production, followed by crossbred and indigenous cattle. However, despite their contribution to milk production, dairy farmers face a multitude of challenges. Malik et al. (2017), in Punjab, reported major constraints such as unstable milk prices, high feeding and treatment costs, and losses from unproductive animals and male calves.

Constraint analysis by Dhaka et al. (2017) using Garrett's ranking technique in Rajasthan revealed that dairy farmers are hindered by lack of knowledge, poor extension services, inadequate credit facilities, poor communication infrastructure, and the high cost of inputs. Similarly, Harisha et al. (2019) identified critical challenges in Karnataka, such as limited green fodder availability, high feed costs, poor artificial insemination success rates, and inadequate awareness of proper dairy management practices.

These studies collectively highlight that milk production and marketing patterns vary considerably across different agro-climatic regions of India. Moreover, the constraints faced by dairy farmers are region-specific and multifaceted, warranting tailored interventions. However, despite the large contribution of states like Andhra Pradesh to India's dairy sector, there exists a notable gap in region-specific research related to milk production, utilization, and the challenges faced by farmers. Therefore, the present study has been framed to address this gap by providing a comprehensive assessment of milk production and utilization patterns in Andhra Pradesh, with a special focus on the constraints confronting dairy farmers in the region.

Garret Ranking method

The Garrett ranking technique was employed to understand the various constraints the milk-producing farmers faced in the study area. The farmers' preferences for a particular constraint vary from individual to individual or from one to one. So, this method provides better evidence by converting the preferences to scores than following them by ranks. Studies by different authors suggested that the technique showed accuracy in ordering the preferences (Raj, 2022; Jain et al., 2023; Gautam and Jha, 2022; Dhaka et al., 2017; Malik et al., 2017; Lakshmi and Nagaraja, 2022). The preferences of the respondents were ordered while collecting the data on constraints. The ordered preferences were converted into percent positions by using the following formula:

$$\text{Percent position} = \frac{100(R_{ij} - 0.50)}{N_j}$$

R_{ij} refers to the rank given for the i_{th} factor by j_{th} individual

N_j refers to the number of factors ranked by the j_{th} individual

The percent position was converted into scores by referring to the table suggested by Garrett and Woodworth (1969). The score will be estimated for each constraint, arranged in

descending order and ranked accordingly based on mean scores.

RESULTS AND DISCUSSION

Milk yield per animal per day (productivity)

Productivity has a strong impact on the returns from the animal. As the productivity per animal increases, the overall returns from the farm also increase. The productivity of the animal depends upon various factors like species, breed, and quality of inputs, i.e., feed and fodder given to animals, etc. From Figure 1 we conclude that the overall milk per animal per day was highest in crossbreed cows with 10.37 litres per day, followed by buffalo (6.12 litres per day) and indigenous cattle (5.21 litres per day), these results contrasted with the study by Singh *et al* 2018, where they found buffalo has highest milk production per day than indigenous and crossbreed cows and similar to Agarwal and Raju (2021) and Kumari et al 2021.

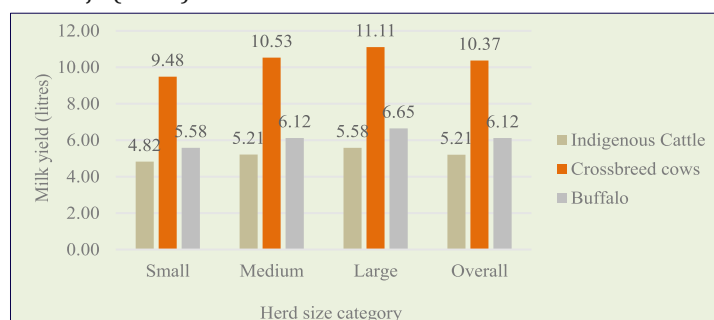


Figure 1: Milk production of animals in case of farmer-producer households (litres/day)

The milk productivity of crossbreed cows was found to be the highest in large herd size category (11.11 litres per animal per day), followed by medium (10.53 litres per animal per day) and small herd size category (9.48 litres per day per animal per day). The milk productivity of buffalo was also highest in the large herd size category (6.65 litres per animal per day), followed by medium (6.12 litres per animal per day) and small herd size category (5.58 litres per day per animal per day). The milk productivity of indigenous cattle was also highest in the large herd size category (5.58 litres per animal per day), followed by medium (5.21 litres per animal per day) and small herd size category (4.82 litres per day per animal per day). The productivity of the animal increases with the increase in the herd sizes.

Milk Production by producer households

Table 1 shows the milk production by the producer households in the study area. The table shows the contribution of different species as well as the categories of producer households in total milk production. The study revealed that the contribution of crossbreed cows was 64.53 per cent of the total milk production, which was higher than the contribution of buffalo (28.41 per cent) and indigenous cattle (7.06 per cent); these findings are similar to Kumari et al., 2021. The inter-herd size category analysis also reveals that the crossbreed cows have the largest share among all the herd categories, followed by buffalo and indigenous cattle. The table also shows the contribution of different households to the total milk production in the study area. The overall milk production in the study area was 13.26 litres per day per household. Meanwhile, the large herd size category had 21.46 litres per day per household, followed by the medium herd size category with 13.17 litres per day per household and the small herd size category with 5.16 litres per day per household.

Table 1: Milk production by producer households (litres/day/household)

Particulars	Small	Medium	Large	Overall
Indigenous cattle	0.33	4.60	3.50	2.81 (7.06) *
Crossbreed cows	9.40	24.64	43	25.67 (64.53) *
Buffalo	5.74	10.28	17.88	11.30 (28.41) *
Overall	5.16 (12.96) **	13.17 (33.10) **	21.46 (53.94) **	13.26

Note: Figures in the parenthesis indicate the contribution of different species to total milk production

****Figures in the parenthesis indicate the share of producer households in total milk production**

Among all the herd size categories, the large herd size category (53.94 per cent) had the largest share in total milk production followed by medium (33.10 per cent), and small (12.96 per cent), herd-size households. The lower amount of milk production by the small herd size category households was due lower number of milch animals as well as the rearing of indigenous and non-descript breeds.

Table 2 shows the milk marketed by the producer households in the study area. The overall milk marketed by the producer households was 11.63 litres per day per household. The milk marketed was highest in the large herd size category at about 19.15 litres per day per household, followed by the medium with 11.75 litres per day per household and the small herd size category with 3.99 litres per day per household. The average marketed surplus was 85.25 per cent in the study area. The marketed surplus of milk also varies not only from region to region but also within the region. As reported, it is 88.19 percent to 90.41 percent in the eastern region (Singh and Datta, 2016; Kumari et al., 2022), 77.38 percent to 82.89 percent in Karnataka (Bhawar et al., 2019; Rebasiddanavar et al., 2024), 39.01 percent to 73.43percent in Rajasthan (Meena and Tiwari, 2015; Singh et al., 2018; Singh et al., 2022). The calculated marketed surplus of the present study was found familiar with the findings of the different authors across the regions of the country.

Table 2: Milk marketed by producer households (litres/day/household)

Category of households	Milk production per household	Milk consumption per household	Marketed surplus
Small	5.16	1.12	3.99 (77.31)
Medium	13.17	1.34	11.75 (89.22)
Large	21.46	2.19	19.15 (89.24)
Overall	13.26	1.55	11.63 (85.25)

Note: Figures in the parenthesis indicate the percentage of marketed surplus

Figure 2 shows the milk production and milk marketed by the producer households. The average milk production was 13.26 litres per day per household and the average milk marketed was 11.63 litres per day per household. Milk production and marketing increase with an increase in the herd size categories.

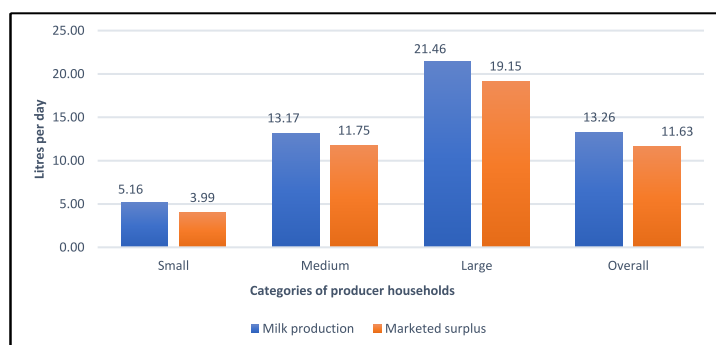


Figure 2: Milk production and marketed surplus of producer households

Utilization pattern of milk production

The utilization pattern of milk consists of the milk retained at home for consumption, milk losses (while milking and handling), and milk sold at the producer household level to different agencies (consumers, milk vendors, creameries, always, cooperatives etc.)

Table 3 shows the utilization of milk at the producer household level. The overall milk production was 13.26 litres per day per household, and the utilization was as follows: the milk utilised for home retention was 1.55 litres per day per household, milk losses accounted for 0.08 litres per day per household and milk sold in the market was 11.63 litres per day per household. The milk utilized for home consumption was highest in the large herd size category with 2.19 litres per day, followed by the medium about 1.34 litres per day and the small category, about 1.12 litres per day. The milk losses were also high in the large about 0.12 litres per day, followed by medium (0.08 litres per day) and small (0.05 litres per day)

Table 3: Utilization pattern of milk production at the producer household (litres/day/household)

Particulars	Small	Medium	Large	Overall
Milk production	5.16	13.17	21.46	13.26
Milk sold	3.99 (77.31)	11.75 (89.22)	19.15 (89.24)	11.63 (85.25)
Losses	0.05 (0.97)	0.08 (0.60)	0.12 (0.56)	0.08 (0.71)
Milk retained at home	1.12 (21.72)	1.34 (10.18)	2.19 (10.20)	1.55 (14.04)

Note: Figures in the parenthesis indicate the percentage to columns of the total milk production

Consumption of milk and milk products by producer households

Figure 3 shows the consumption of milk in the liquid form and milk utilised for processing by the producer households. The producer households consume 63.48 per cent of milk in liquid form, and 36.52 per cent of milk is used for making other milk products like curd, paneer, ghee, etc. The findings of the study are similar to those of Bhattacharjee and Patel (2016), who stated that the consumption of liquid milk was more than the milk products in Kerala. The study by Meena and Tiwari (2015) stated that milk consumed in the form of milk products was more than liquid milk in Rajasthan and milk consumption in milk products (60 per cent) was more than liquid milk in the northeastern region (Kumari *et al.*, 2022), in contrast to the present study. The inferences from the above studies show that there is a regional difference in milk consumption in the form of liquid and milk products across the country. Based on these inferences, we can suggest the marketing of milk and milk products across the nation, either in liquid or product form.

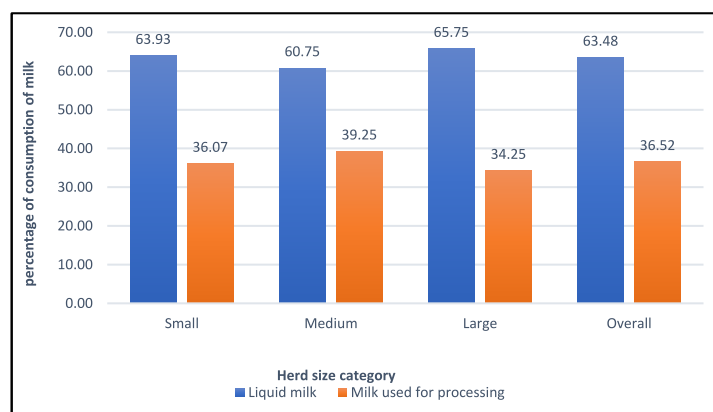


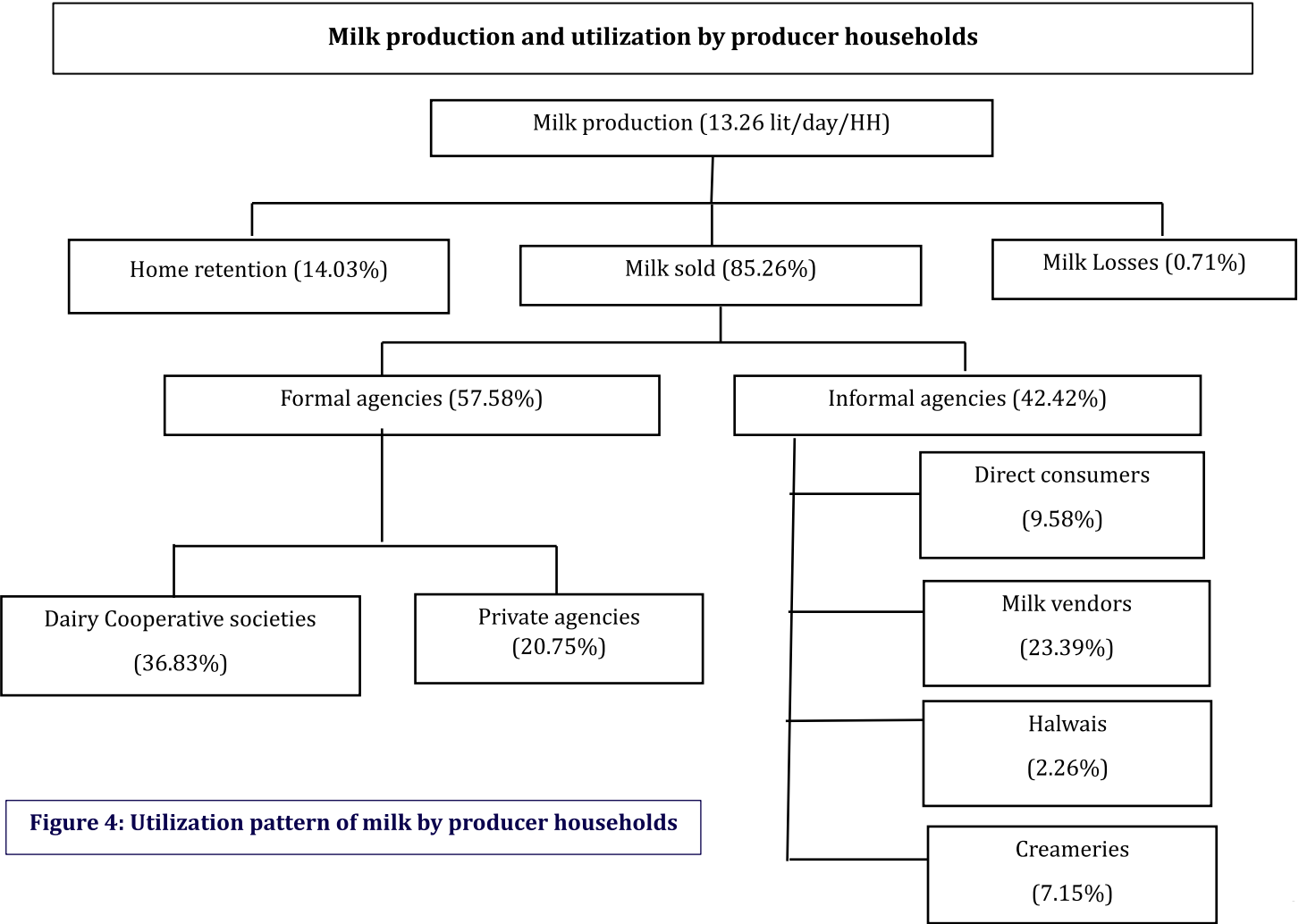
Figure 3: Consumption of milk and milk products by producer households

The liquid milk consumption was highest in the large herd size category at about 65.75 per cent, followed by small with 63.93 per cent and the medium herd category, 60.75 per cent. The milk used for processing was highest in the medium category at about 39.25 per cent, followed by the small with 36.07 per cent and the large category at 34.25 per cent.

Figure 4 shows the flow of milk utilized from producers to consumers, direct or indirect (intermediaries). Out of the total milk produced at the household level, 14.03 per cent was retained for home consumption, 0.71 per cent accounted for losses, and the remaining part of the milk (marketed surplus), i.e., 85.25 per cent, was sold to different milk marketing agencies in the study area. Out of the total milk sold, 57.58 per cent of milk was sold to formal agencies, and 42.42 per cent of milk was sold to informal agencies. These results are in contrast to the study by Kumari *et al.*, 2022; Bhawar *et al.*, 2019; Meena and Tiwari, 2015; and Singh and Datta, 2016, which showed a higher percentage of milk procured by informal agencies, ranging from 60 to 90 percent of the marketed surplus of milk. The study by Singh *et al.*, 2022 found that nearly 60 percent of the milk was marketed through formal agencies. The above studies did not recognise the presence of private players in their study areas and mainly focused on the cooperatives only. In this study, the role of private agencies was also taken into consideration. Among the formal agencies, the cooperatives were procuring 36.83 per cent of Milk, and private agencies accounted for 20.75 per cent. Meanwhile, in informal agencies, 9.58 per cent of milk was sold to consumers directly, 23.29 per cent to milk vendors, 7.15 per cent to creameries, and 2.26 per cent of milk to the halwa, respectively. The study identified significant inter- and intra-procurement competition between the private and cooperative agencies.

Table 4: Garrett ranking analysis of constraints faced by dairy farmers

Constraint	Garret score	Garret rank
Inadequate availability of green fodder	66	1
Scarcity of labour	64	2
High input costs, including feed and concentrate	63	3
Non-remunerative price of milk	62	4
High transportation charges	59	5
The effect of climate change, including extreme summer and winter	56	6
The occurrence of diseases and parasitic infections	46	7
Lack of raw milk storage facility	40	8
Interference of local people	26	9



Like agricultural production, milk production also flows seasonally. Even though milk is available throughout the year, its production is influenced by seasonal variations. The large quantity of milk flows mostly in winter, and production decreases gradually as summer comes. The hot summers are affecting milk production, causing both farmers and processors to experience reduced income. The major constraints faced by the producers are green and dry fodder shortages in the summer and rainy days, which affect the milk production by the animals. The price of milk and the timely availability of medicines are also serious concerns in milk production. The major constraints faced by the dairy farmers in the study area are inadequate availability of green fodder, labour scarcity and high cost of the feed and concentrates as presented in Table 4. The constraints faced by the farmers in the study area are more familiar with the studies conducted in the different regions of the country (Harisha et al., 2019; Malik et al., 2017; Lakshmi and Nagaraja, 2022).

Conclusion:

The milk per animal per day was highest in crossbreed cows with 10.37 litres per day, than the buffalo and indigenous cattle. The average milk consumption per day was 1.55 litres. Out of the total milk sold, formal agencies were responsible for acquiring a larger percentage than the milk obtained by informal channels. The milk losses account for milking, handling and cleaning the vessels. The milking awareness should be created to reduce milk losses and to enhance milk quality as well as production. Expanding the scope of cooperatives to other districts within

the state would not only benefit farmers by providing them with better income and employment opportunities but also contribute directly to the growth of livelihoods in rural areas. Consequently, this expansion would lead to an automatic increase in the nation's welfare. Moreover, by extending the reach of cooperatives, essential resources, knowledge, and support systems can be disseminated more widely, fostering sustainable agricultural practices and enhancing community resilience. Additionally, increased cooperation among districts can stimulate economic development, promote social cohesion, and mitigate disparities across regions.

Implications of the study

The milk productivity of indigenous cattle was low, so it can be enhanced through sustained breed improvement programs and improved artificial inseminations. The subsidies on feed and fodder can enhance milk production, increase the producer's welfare and increase the continuous availability of milk.

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Author contribution statement

All the authors contributed to the paper in developing the conception, data collection, analysis, interpretation and manuscript preparation.

Conflict of Authors

There is no conflict of interest among the authors in the present study and the work carried out by the authors has not been published in any journal.

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