



Milk Production in Gujarat, India: A District-Wise Scenario of Contributions of Cow, Buffalo, and Goat Milk during 2022-23

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This research provides a comprehensive district-wise analysis of milk production in Gujarat during the 2022-23 period, focusing on cow, buffalo, and goat milk. Gujarat, a leading dairy state in India, produced a total of 17.281 million metric tonnes of milk, significantly contributing to the nation's milk supply. The research was based on secondary data obtained from various published reports of Government of Gujarat's Animal Husbandry Department, NDDB, Amul, GCMMF etc. and articles

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of reputed organisations and authors. The findings of the study indicate that Gujarat's dairy industry in 2022-23 was dominated by a few key districts, with Banaskantha leading in overall milk production. Crossbred cows were the primary contributors to cow milk, while buffaloes played a major role in several districts, especially in Banaskantha and Kheda. Goat milk production, although less significant, was concentrated in districts like Dahod and Kachchh. The success of these regions can be attributed to favorable climatic conditions, robust cooperative networks, and efficient animal husbandry practices. The study highlights the regional concentration of milk production, driven by favorable climatic conditions, robust dairy infrastructure, and cooperative systems. Crossbred cows, indigenous cows, and buffaloes all played vital roles in the state's dairy sector.

Keywords: Milk production; cow milk; buffalo milk; goat milk; crossbred cows; indigenous cows; dairy industry; Banaskantha milk production; Sabarkantha milk production; Mehsana milk production.

1. INTRODUCTION

India's milk production in year 2022-23 was around 230.577 million metric tonnes which is around 23% of world milk production. Milk consumption is high in India as it represents a source of nutrition people of all ages, and has positive effect on especially the digestive system along with appropriate yoga practice (Modi Zeel, et al., 2024) Gujarat, one of India's leading agricultural states, has a long-standing tradition of dairy farming, playing a significant role in the national milk production landscape. The state's diverse climate, vast rural landscape, and robust agricultural infrastructure support the thriving dairy industry. In 2022-23, Gujarat's milk production stood at a mammoth 17.281 million metric tonnes, contributing substantially to the country's overall milk output. This study aims to provide a detailed analysis of the district-wise milk production in Gujarat, focusing on three key sources: cow, buffalo, and goat milk.

Gujarat's dairy sector is characterized by a blend of **crossbred cows**, **indigenous cows**, **buffaloes**, and **goats**, each contributing to the state's total milk production in distinct proportions. With major districts like **Banaskantha**, **Sabarkantha**, **Dahod**, and **Kachchh** leading the way, understanding the specific contributions of each district helps to identify regional strengths, challenges, and opportunities within the dairy industry (Shah and Dave 2010; Patil and Udo 1997). Further, Out of the total livestock reported in Census- 2019, cattle, buffalo, sheep goats and others were 96.34 lakhs (35.82%), 105.43 lakhs (39.20%), 17.87 lakhs (6.65 %), 48.68 lakhs (18.10%) and 0.61 lakhs (0.23%) respectively. The percentage increase in total population of buffalo and sheep was 1.52%, 4.66% respectively over previous

Census-2012. The percentage decrease in the total population of cow and goat was 3.51 % and 1.84% respectively in comparison of previous Census-2012.

The primary objective of this research is to analyze the milk production data for the year 2022-23, focusing on the district-level breakdowns for cow, buffalo, and goat milk. By examining these figures, this study will shed light on regional trends, highlight key contributors to Gujarat's dairy sector, and provide insights into factors influencing milk production, such as geography, livestock management practices, and local economic conditions.

As dairy farming continues to be a critical component of Gujarat's rural economy, this research seeks to contribute valuable information for policymakers, dairy farmers, cooperatives, and industry stakeholders aiming to optimize production, improve sustainability, and ensure equitable growth in the dairy sector across the state.

2. LITERATURE REVIEW

The Gujarat dairy sector promises tremendous opportunities for potential entrepreneurs throughout the dairy value chain. The state is blessed to have many important entrepreneurship supporting schemes available from the state government, central government, and even the dairy cooperatives. The state is also fortunate to have many National level Dairy organisations, Dairy Education Institutes, Training centres and other institutional Infrastructure (Gujar M.D, 2023).

According to DAHD's Annual Report (2023), the contribution of milk production by Cow, Buffalo

and Goat. The analysis shows nearly 45% of the milk production is contributed by Indigenous/Non-Descript Buffaloes followed by 30% by crossbred cows. The Indigenous/Non-descript cows contribute 20% of the total milk production in the country. Goat milk shares a contribution of 3% in the total milk production across the country. The contribution of exotic cows in total milk production is 2%.

According to Chaudhary N.V. et al. (2022) The average cost of milk production by buffalo was Rs. 60928.12 per animal per year. It includes fixed cost and variable cost, which was Rs. 7220.72 and 53707.40 per animal per year, respectively. The overall cost of per litre milk production has been found Rs. 33.70. Overall net income was Rs. 32743.07 per animal per year and Rs. 89.70 per animal per day. On the basis of observations, it is concluded that net income from crossbred cows was highest for large farmers followed by medium, marginal and small category of dairy farmers.

According to Singh M.K. et al. (2023), India possesses vast caprine resources with 37 goat breeds distributed in different bio-climates with varied nutritive value, however, some goat breeds native to north and north-western region namely Beetal, Jamunapari, Jakhrana, Surti and Zalawadi are considered as Indian dairy breed with 150 to 500 litre milk yields. The reported milk yield of Indian dairy goat is far below their potential, since they are primarily raised for mutton and also due to energy-deficient diet. Around 70% of Goat farmers have trouble identifying pure breed animals due to a lack of information. A key barrier is the difficulty of obtaining high-quality breeding animals. The best animals (especially males) from traditional flocks are sold to traders/butchers for slaughter. As a result, good breeding animals have become scarce. This problem has been exacerbated by the lack of coordinated attempts to enhance goat breeds (Pathak et al.,2022).

Kaur and Singla (2018), in their study titled Growth and structural transformations in dairy sector of India, assert that Their study also shows that different states of India has responded differently to the structural changes such as rapid growth in contribution of milk by states like Andhra Pradesh, Gujarat and Rajasthan in national milk production, while traditionally green revolutionary states such as Punjab and Haryana along with Karnataka, Maharashtra, Tamil Nadu, Madhya Pradesh and

West Bengal have registered a decline in milk contribution. At national level, the contribution of crossbred cows has continuously increased, whereas the share of indigenous/local cows and buffaloes has gone down. The study also reveals that around 57 per cent of growth of milk production is contributed by increase in livestock population, while another 31 per cent growth is due to rise in milk yield of the milch animals.

According to Gurjar M. D et al. (2022), There are around 16.5 million dairy farmers registered with around 1,85,903 Village Dairy cooperatives in the country. Majority of the milk producers belong to small and marginal category with only 2 to 5 animal holding. The leading milk producing states are – Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Rajasthan and Gujarat. Further, As per the 2019 livestock census data, there were 192.5 million Cattle and 109.9 million Buffaloes in the country. In India, in 1999, the average milk productivity per cow was 1014 kg/year which was below the global average of 2017 kg/year. The milch animals in their daily biological routine and throughout their lifecycle create environmental pollution.

3. RESEARCH OBJECTIVES

The primary objective of this study is to provide a **comprehensive district-wise analysis** of milk production in Gujarat during the 2022-23 period, specifically focusing on **cow milk, buffalo milk, and goat milk**. The study aims to achieve the following specific objectives:

- i. **To analyze district-wise milk production** of cow, buffalo, and goat milk across various districts in Gujarat for the year 2022-23, identifying the major contributors to each category of milk.
- ii. **To assess the percentage share of cow milk, buffalo milk, and goat milk** produced in key districts of Gujarat
- iii. **To give an overall summary of milk production by major Districts of Gujarat state**

4. METHODOLOGY

This study is based on **secondary data** and aims to analyze the district-wise milk production in Gujarat for the year 2022-23, specifically focusing on **cow milk, buffalo milk, and goat milk**. Secondary data refers to data that has already been collected and made available by government agencies, research institutions, and

relevant organizations, and will be used to perform an in-depth analysis of the milk production trends in Gujarat.

5. RESULTS AND DISCUSSION

5.1 Major Districts Contributing to Gujarat's Total Milk Production (2022-23)

The year 2022-23 saw Gujarat's total milk production being driven by a few major districts. This report focuses on the analysis of the major districts that together accounted for 51.5% of the total milk production in Gujarat during the year 2022-23. The key districts analyzed in this report include Banaskantha, Sabarkantha, Mehsana, Anand, Kheda, Arvalli, Kachchh, and Mahisagar, based on their percentage contribution to the total milk produced in the state. The data reveals a highly concentrated distribution of milk production across Gujarat, with Banaskantha leading the way, followed by other key districts such as Sabarkantha, Mehsana, and Anand. Below is a detailed look at the milk production figures for these major districts:

The **top eight districts**, which together contribute **51.5%** of the total milk production, highlight the critical role of specific regions in Gujarat's dairy sector.

- a) **Banaskantha** emerges as the **largest contributor** to Gujarat's milk production, accounting for **18.29%** of the total milk produced in the state. With a total milk production of **3159.84 thousand tonnes**, this district is the clear leader in milk

production, and its contribution is nearly **three times greater** than that of the second-largest contributor, **Sabarkantha**.

- b) The district's prominence in milk production is likely attributed to its well-established dairy infrastructure, large-scale dairy farming, and the presence of cooperative structures that facilitate high milk yields.

5.2 Crossbred Cow Milk Production in Gujarat for the Year 2022-23

The dataset presents the crossbred cow milk production in Gujarat in 2022-23, measured in thousand tonnes, and it provides the percentage share of each district's contribution to the state's total crossbred cow milk production.

In the year 2022-23, Banaskantha led Gujarat's crossbred cow milk production with nearly 30% of the total output, while other districts like Sabarkantha, Arvalli, Mehsana, and Anand made substantial contributions. Together, these major districts accounted for 88.7% of the state's total production. Gujarat's dairy sector continues to thrive due to a combination of favorable conditions, robust cooperative systems, and growing adoption of crossbreeding techniques.

5.3 Gujarat's Indigenous Cow Milk Production (2022-23)

The Table 3 provides the milk production from indigenous cows in major districts of Gujarat in 2022-23. The total share of these districts accounts for 52.9% of the total indigenous cow milk production in the state.

Table 1. Districts having Major contribution in Gujarat's Total Milk Production for year 2022-23

District	Milk Production (Thousand Tonnes)	% Share of Total Milk Production
Banaskantha	3159.84	18.29%
Sabarkantha	957.99	5.54%
Mehsana	916.86	5.31%
Anand	876.13	5.07%
Kheda	862.44	4.99%
Arvalli	793.26	4.59%
Kachchh	727.58	4.21%
Mahisagar	604.48	3.50%
Total for Gujarat	17280.56	

Table 2. Districts having Major contribution in Gujarat's Crossbreed Cow Milk Production for year 2022-23

District	Crossbreed Cow Milk Production (in Thousand Tonnes)	District wise % Share
Banaskantha	1710.83	29.22%
Sabarkantha	552.85	9.44%
Arvalli	480.99	8.21%
Mehsana	409.93	7.00%
Anand	389.60	6.65%
Kheda	311.82	5.33%
Mahisagar	287.86	4.92%
Navsari	283.69	4.84%
Valsad	203.81	3.48%
Surat	198.16	3.38%
Gandhinagar	191.67	3.27%
Tapi	175.93	3.00%
Total for Gujarat	5855.71	

Table 3. Districts having Major contribution in Gujarat's Indigenous Cow Milk Production for year 2022-23

District	Indigenous Cow Milk Production (in Thousand Tonnes)	District wise % Share
Kachchh	325.72	10.72%
Banaskantha	237.41	7.81%
Surendranagar	189.81	6.24%
Rajkot	182.45	6.00%
Amreli	142.79	4.70%
Dohad	139.94	4.60%
Bhavnagar	132.05	4.34%
Ahmedabad	132.02	4.34%
GirSomnath	127.31	4.19%
Total for Gujarat	3039.69	

Table 4. Districts having Major contribution in Gujarat's Total Cow Milk Production for year 2022-23

District	Cow Milk Production (in Thousand Tonnes)	District wise % Share of Total Cow Milk
Banaskantha	1948.24	21.90%
Sabarkantha	631.46	7.10%
Arvalli	522.98	5.88%
Mehsana	484.17	5.44%
Anand	449.63	5.05%
Kheda	377.49	4.24%
Kachchh	359.57	4.04%
Total for Gujarat	8895.4	

Concentration of Indigenous Cow Milk Production:

- The production is quite concentrated in a few districts, with Kachchh contributing 10.72% of the total indigenous cow milk,

followed by Banaskantha (7.81%) and Surendranagar (6.24%).

- Together, the top three districts (Kachchh, Banaskantha, and Surendranagar) account for 24.77% of the total indigenous cow milk production in Gujarat.

- This concentration indicates that these districts have more favorable conditions for the rearing of indigenous cows and larger agricultural support systems focused on dairy farming.

5.4 Gujarat's Total Cow Milk Production (Crossbreed plus Indigenous) - (2022-23)

The following Table 4 provides the cow milk production from the major districts of Gujarat in 2022-23. These districts collectively account for 53.66% of Gujarat's total cow milk production.

- The total cow milk production is highly concentrated in the top few districts, with Banaskantha alone contributing nearly 22% of the total output.
- The combined contribution of the top three districts (Banaskantha, Sabarkantha, and Arvalli) amounts to 35.88% of the state's total cow milk production, reflecting the strong dairy farming base in these areas.
- While other districts like Mehsana, Anand, Kheda, and Kachchh also make significant contributions, the concentration of milk production in these leading districts highlights their importance in the state's dairy sector.

5.5 Gujarat's Buffalo Milk Production (2022-23)

In 2022-23, the top districts contributed 50.19% of Gujarat's total buffalo milk production. This report will analyze the contribution of these major districts, their share in the overall buffalo milk production, and the factors contributing to their success in the dairy sector.

The Table 5 below shows the buffalo milk production from major districts in Gujarat in 2022-23. These districts together contributed 50.19% of the total buffalo milk production in the state.

Concentration of Buffalo Milk Production

- The buffalo milk production in Gujarat is highly concentrated in the top few districts. Banaskantha alone contributes nearly 15% of the total buffalo milk produced in the state, followed by Kheda and Anand.
- The top three districts—Banaskantha, Kheda, and Anand—together contribute 25.90% of Gujarat's total buffalo milk production. This concentration highlights the importance of these districts in the state's dairy sector and their role in shaping the overall buffalo milk output.

5.6 Gujarat's Goat Milk Production (2022-23)

Goat milk plays a vital role in the dairy industry of Gujarat, contributing significantly to the rural economy and providing essential nutrition to local populations. In the year 2022-23, major districts in Gujarat contributed 53.4% of the state's total goat milk production. This report analyzes the contribution of these key districts, highlighting their share of Gujarat's goat milk production and the factors that contribute to their high production levels.

The Table 6 summarizes the goat milk production from the major districts in Gujarat in 2022-23, which together contribute 53.4% of Gujarat's total goat milk output.

Table 5. Districts having Major contribution in Gujarat's Buffalo Milk Production for year 2022-23

	Buffalo Milk Production (in Thousand Tonnes)	District wise % Share of Buffalo Milk Production
Banaskantha	1180.56	14.72%
Kheda	477.7	5.95%
Anand	419.19	5.23%
Mehsana	418.48	5.22%
Patan	342.14	4.27%
Kachchh	328.41	4.09%
Sabarkantha	304.65	3.80%
Devbhumi Dwarka	280.96	3.50%
Ahmedabad	274.41	3.42%
Total for Gujarat	8021.88	

Table 6. Districts having Major contribution in Gujarat’s Goat Milk Production for year 2022-23

District	Goat Milk Production (in Thousand Tonnes)	District wise % Share of Goat Milk Production
Dahod	52.4	14.42%
Kachchh	39.6	10.90%
Banaskantha	31.04	8.54%
Sabarkantha	21.88	6.02%
PanchMahals	18.36	5.05%
Arvalli	16.58	4.56%
Mehsana	14.21	3.91%
Total for Gujarat	363.28	

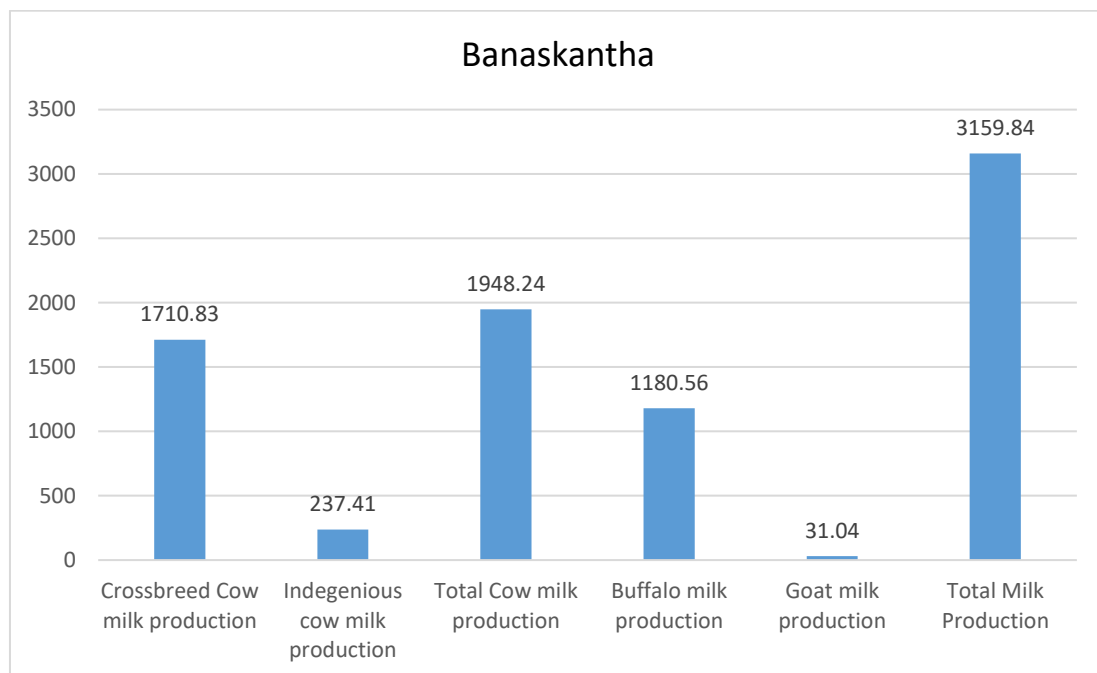


Fig. 1. Milk Production by Cow, Buffalo and Goats- Banaskantha

- The goat milk production in Gujarat is quite concentrated in the top few districts. Dahod, Kachchh, and Banaskantha are the dominant contributors, together accounting for 33.86% of the total goat milk produced in the state.
- The top three districts—Dahod, Kachchh, and Banaskantha—highlight a clear geographical concentration of goat milk production, with these regions leading in both scale and productivity.

5.7 Major Sources of Milk in leading Milk Producing Districts (2022-23)

Following are the Top Five milk contributing districts in the state of Gujarat in the year 202 - 23

a) Banaskantha District

In the 2022-23 milk production year, BanasKantha district achieved a total milk production of **3159.84 units**. Crossbreed cows were the primary contributors, producing **1710.83 units**, while indigenous cows accounted for **237.41 units**, bringing total cow milk production to **1948.24 units**. Buffaloes produced **1180.56 units** of milk, highlighting their significance in the district's dairy output. Goat milk production was minimal, with only **31.04 units**. The data reflects a well-established dairy industry in BanasKantha, driven by high milk yields from crossbreed cows and buffaloes, with goats contributing a smaller portion to the overall milk production.

b) Sabarkantha District

In the 2022-23 milk production year, Sabarkantha district in Gujarat produced a total of **957.99 units** of milk. Crossbred cows contributed **552.85 units**, while indigenous cows produced **78.61 units**, bringing total cow milk production to **631.46 units**. Buffaloes contributed **304.65 units** of milk, and goat milk production was **21.88 units**. The district's milk production reflects a balanced dairy industry, with a strong reliance on crossbred cows and buffaloes for milk yield. Although goat milk production is minimal, it still adds to the overall milk output in the region.

c) Mehsana District

In the 2022-23 milk production year, Mehsana district in Gujarat produced a total of **916.86 units** of milk. Crossbred cows were the largest contributors, producing **409.93 units**, while indigenous cows accounted for **74.24 units**, bringing total cow milk production to **484.17 units**. Buffaloes contributed **418.48 units** of milk, highlighting their importance in the district's dairy sector. Goat milk production was relatively small at **14.21 units**. The data reflects Mehsana's strong dairy industry, with a balanced contribution from both cows and buffaloes, making it a key milk-producing region in Gujarat.

d) Anand District

In the 2022-23 milk production year, Anand district in Gujarat produced a total of **876.13 units** of milk. Crossbred cows contributed **389.6 units**, while indigenous cows produced **60.03 units**, bringing total cow milk production to **449.63 units**. Buffaloes played a significant role, producing **419.19 units** of milk, almost matching the cow milk output. Goat milk production was minimal at **7.31 units**.

e) Kheda District

In the 2022-23 milk production year, Kheda district in Gujarat produced a total of **862.44 units** of milk. Crossbred cows were the largest contributors, producing **311.82 units**, while indigenous cows contributed **65.67 units**, resulting in a total of **377.49 units** from cows. Buffaloes played a dominant role, contributing **477.7 units**, which surpassed cow milk production. Goat milk production was minimal at **7.25 units**. Kheda's milk production highlights the importance of buffaloes, which significantly contribute to the district's total yield, alongside crossbred cows. The district is a major player in Gujarat's dairy industry, with a well-balanced milk output.

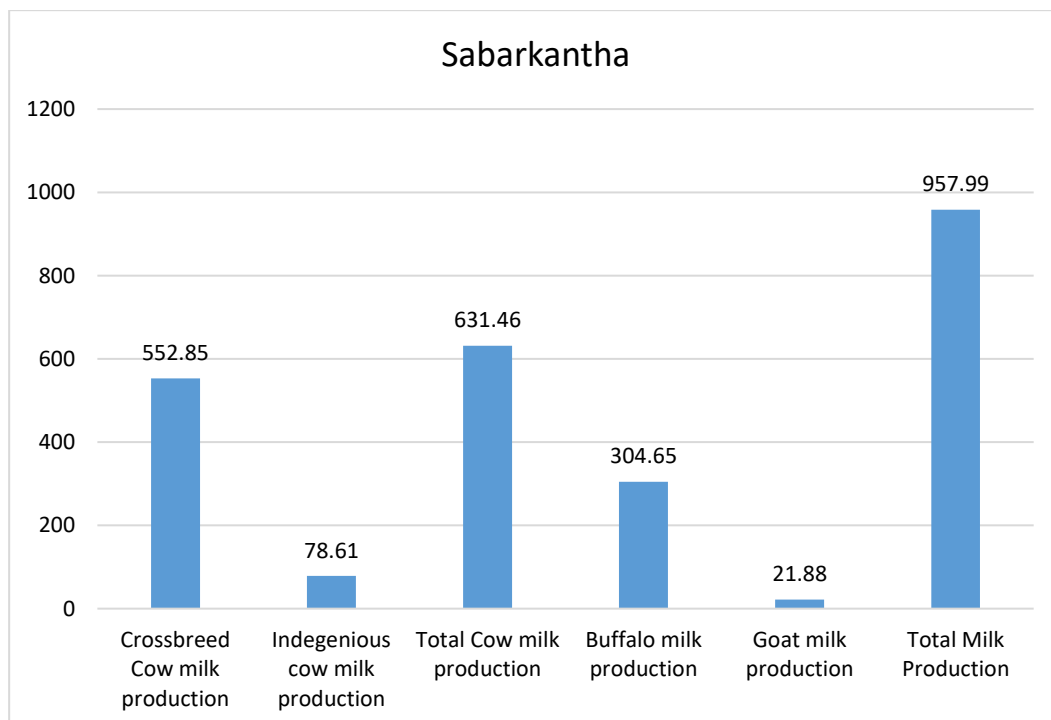


Fig. 2. Milk Production by Cow, Buffalo and Goats - Sabarkantha

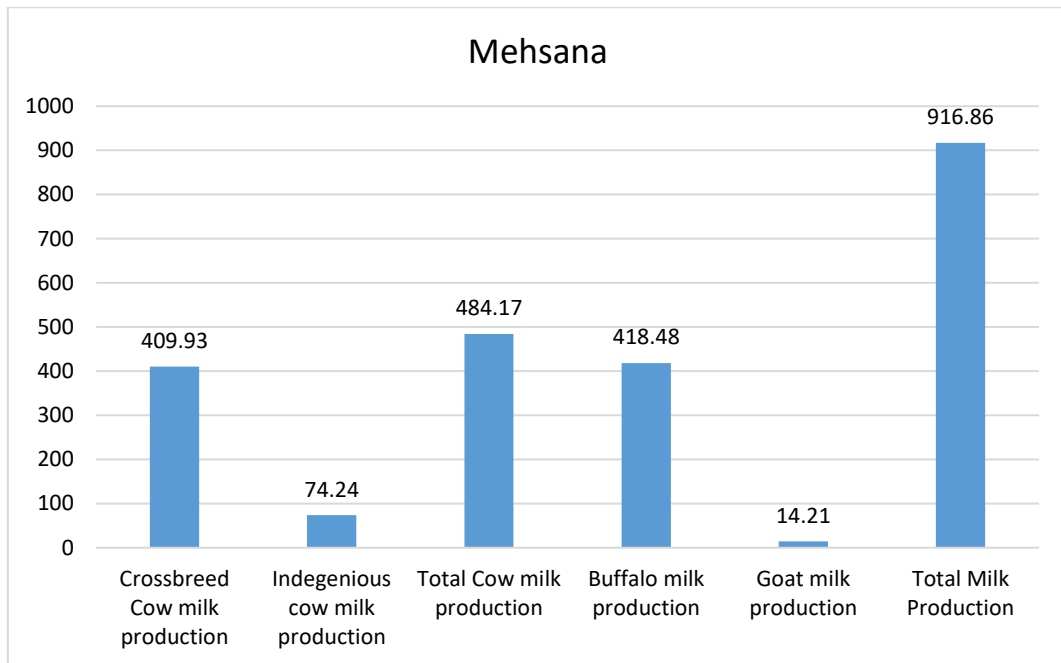


Fig. 3. Milk Production by Cow, Buffalo and Goats - Mehsana

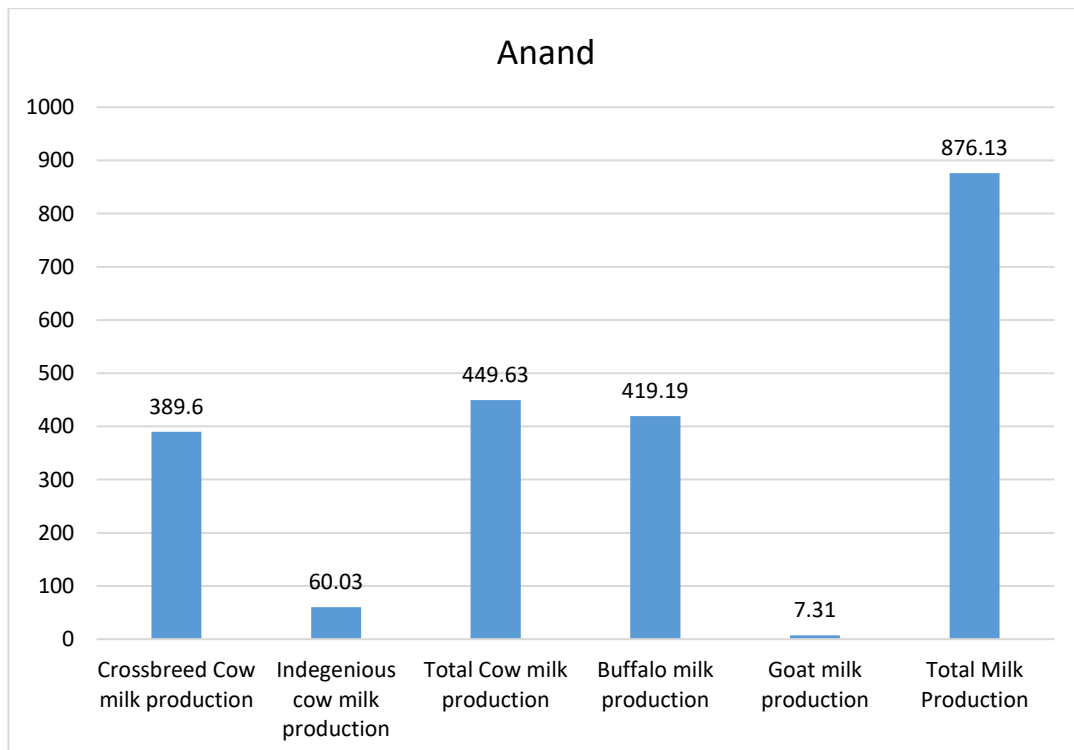


Fig. 4. Milk Production by Cow, Buffalo and Goats - Anand

f) Gujarat

In the 2022-23, the milk production of Gujarat state was as given below

Interpretation:

Cow Milk Production: The combined production from crossbred and indigenious cows (8,895.4 thousand tonnes) accounted for 51.4%

of the total milk production in the state, with crossbred cows being the largest contributor. This highlights the significant role of crossbred cows in Gujarat's dairy sector.

Buffalo Milk Production: Buffaloes contributed 46.4% (8,021.88 thousand tonnes) of the total milk, indicating a robust buffalo dairy sector in Gujarat, traditionally known for its buffalo milk production.

Goat Milk Production: Goat milk made up a smaller portion, 2.1% of total production (363.28 thousand tonnes), reflecting the limited role of goats in commercial milk production compared to cows and buffaloes.

Overall, Gujarat's dairy sector is dominated by cow and buffalo milk production, with crossbred cows playing a key role.

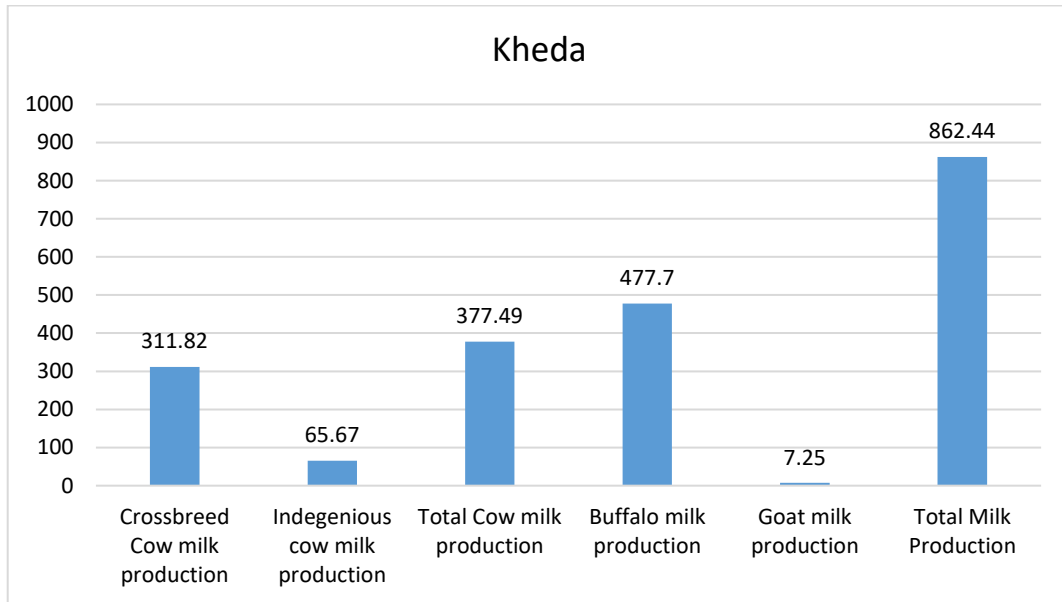


Fig. 5. Milk Production by Cow, Buffalo and Goats – Kheda

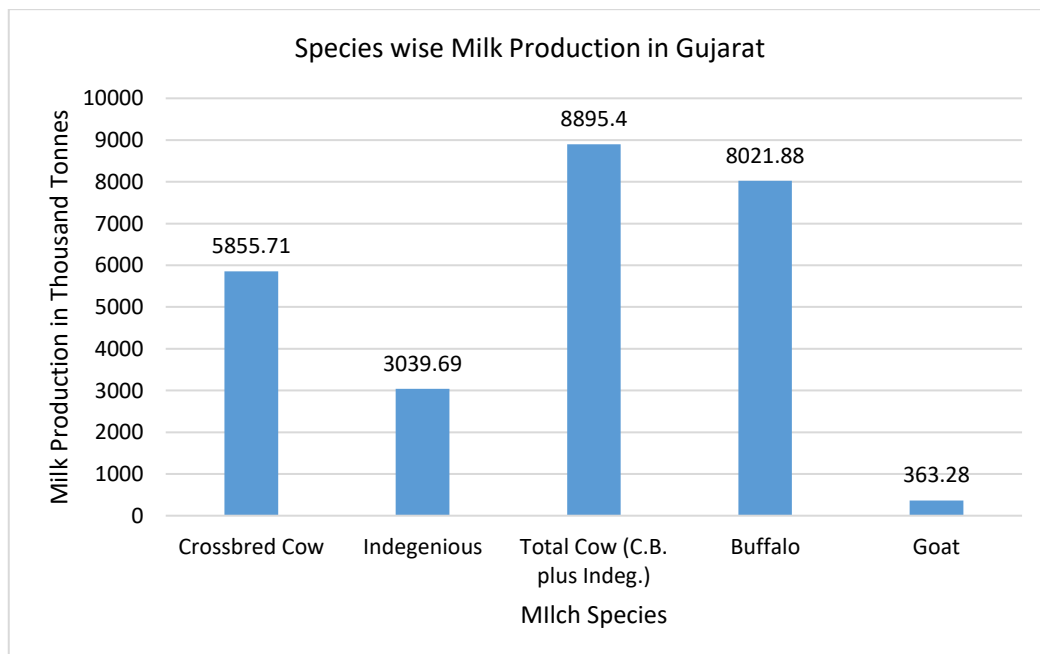


Fig. 6. Milk Production by Cow, Buffalo and Goats – Gujarat State

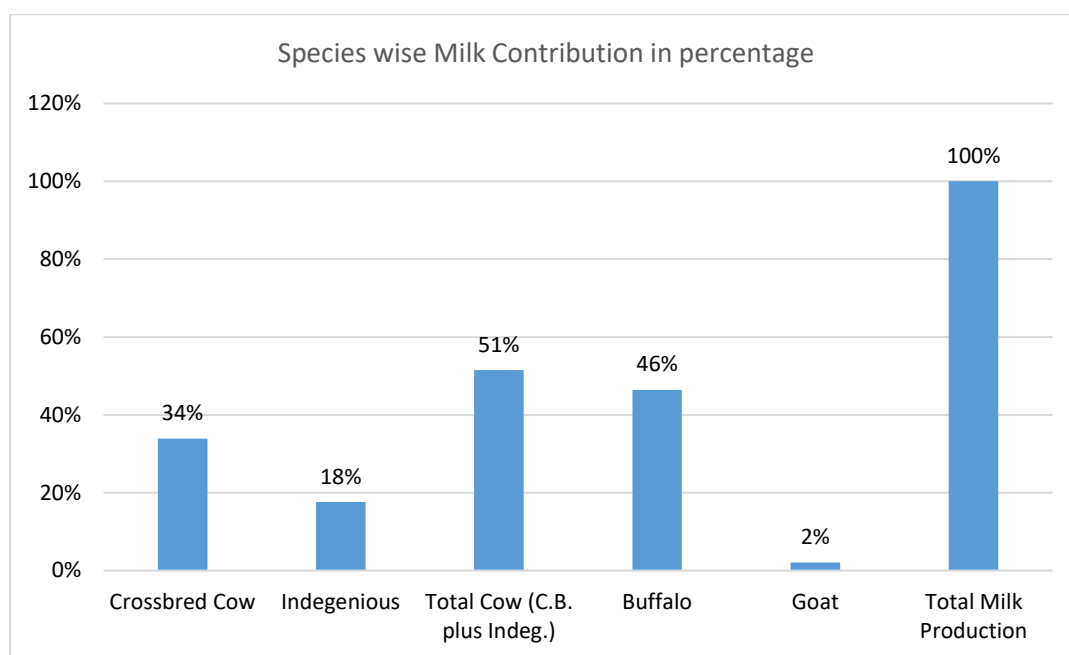


Fig. 7. Milk Production by Cow, Buffalo and Goats – Gujarat State (%)

6. CONCLUSION

The research provides a detailed district-wise analysis of milk production in Gujarat for the year 2022-23, focusing on cow, buffalo, and goat milk. Gujarat, with its significant dairy farming tradition, produced a total of 17.281 million metric tonnes of milk, contributing substantially to India's milk output. Major districts such as Banaskantha, Sabarkantha, Mehsana, Anand, and Kheda were identified as key contributors.

The specific factor contributing to the success of leading districts is the dominance of large dairy cooperatives in these districts which operate under Amul. These districts are also major having Cooperative milk unions namely - Banaskantha District Cooperative Milk Producers' Union Ltd., Palanpur, Sabarkantha District Cooperative Milk Producers' Union Ltd., Himatnagar, Mehsana District Cooperative Milk Producers' Union Ltd, Mehsana and Kaira District Cooperative Milk Producers' Union Ltd., Anand. The dairy cooperative sector of Gujarat had a Daily Milk collection of around 22.5 million litres per day during year 2022-23.

Banaskantha emerged as the leading district, particularly for crossbred cow and buffalo milk. The study also highlights the concentration of milk production, with specific districts excelling in cow, buffalo, or goat milk production due to favourable conditions and strong dairy infrastructures, including cooperative systems.

The research emphasizes the vital role of both crossbred and indigenous cows, as well as buffaloes, in the state's dairy economy.

In conclusion, Gujarat's dairy industry in 2022-23 was dominated by a few key districts, with Banaskantha leading in overall milk production. Crossbred cows were the primary contributors to cow milk, while buffaloes played a major role in several districts, especially in Banaskantha and Kheda. Goat milk production, although less significant, was concentrated in districts like Dahod and Kachchh. The success of these regions can be attributed to favorable climatic conditions, robust cooperative networks, and efficient animal husbandry practices. As Gujarat continues to be a central player in India's dairy sector, further strengthening of infrastructure, veterinary services, and sustainable practices will be crucial for maintaining and enhancing milk production capacity across the state.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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