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Comparative study of the performance of co-operative sugar factories in South Gujarat

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DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i8Sg.3650

Abstract
This study aims to analyze various growth and performance parameters of selected co-operative sugar factories in the South Gujarat region, with the objective of identifying the factors contributing to their success or failure and suggesting appropriate measures for improvement. Five co-operative sugar factories were selected for this purpose. The study is based on secondary data sourced from the annual reports and official records of the respective sugar factories, along with additional information obtained from relevant magazines and publications.

The performance of the factories was analyzed over a 13-year period, from 2001-02 to 2012-13. Key indicators studied include growth rate, capacity utilization, sugar recovery, and the cane price paid by the co-operative sugar factories.

Findings suggest that the Maroli Co-operative Sugar Factory, in particular, requires significant improvements in capacity utilization, machinery maintenance, and financial management. Additionally, harvesting and transport operations, as well as sugar recovery percentage, need to be enhanced, especially in the case of Maroli. All the factories should take concerted efforts to increase the hectarage yield of sugarcane, ensure adequate production, and supply high-quality sugarcane cultivars within their operational areas.

Keywords: Co-operative sugar factories, South Gujarat, performance analysis, growth rate, capacity utilization, sugar recovery, cane price, financial management

Introduction
The sugar industry is the second-largest agro-based industry in India, next only to the textile industry. It holds a significant position in the rural economy, playing a pivotal role in both agricultural and industrial development. With a strong symbiotic relationship with rural communities, the sugar industry acts as a catalyst for rural development by generating employment and promoting allied activities.

In the year 2012-13, Gujarat produced approximately 127.50 lakh tonnes of sugarcane, covering an area of 2.02 lakh hectares, with an average productivity of 63.1 tonnes per hectare (Anon, 2013) [1]. Notably, over 90% of the area under sugarcane cultivation and production was concentrated in the South Gujarat region, where sugarcane serves as the main cash crop.

South Gujarat has consistently contributed a major share of the state's sugarcane and sugar production. Gujarat is home to 22 co-operative sugar factories (Anon, 2013) [1], out of which 15 are located in South Gujarat. As of the latest data, 13 of these factories are currently operational.

Methodology
A multi-stage random sampling technique was employed for the selection of sugar factories included in this study. The selection process and acquisition of primary information and relevant data were carried out using records obtained from the office of the Director of Sugar, Ahmedabad. Initially, all co-operative sugar factories in the South Gujarat region were categorized based on their installed cane crushing capacities.

From each crushing capacity category, one sugar factory was selected for detailed study:

- **10,000 tons/day:** Only one factory falls under this category—Bardoli Co-operative Sugar Factory—which was selected.

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- **7,000 tons/day:** Only one factory, Madhi Co-operative Sugar Factory, was present in this category and hence selected.
- **5,000 tons/day:** Among four factories with this capacity, Gandevi Co-operative Sugar Factory was selected through random sampling.
- **3,500 tons/day:** Only one factory exists in this category—Mahuva Co-operative Sugar Factory—which was selected.
- **2,500 tons/day:** Out of six factories in this category, Maroli Co-operative Sugar Factory was randomly chosen.

Considering the number of sugar factories and the constraints of time and resources available to the investigator, the scope of the study was limited to the co-operative sugar factories located in the South Gujarat region only.

The study is based on secondary data collected from the annual reports and office records of the selected sugar factories. Where data was not available in published reports, additional information was obtained through direct contact with the Managing Directors and concerned officers of the respective factories. The analysis covers ten crushing seasons of these sugar factories, providing insights into their performance over a significant period.

1. Growth Analysis (2000-01 to 2011-12)
The study used time series data to assess growth in the following parameters:
(i) Total quantity of Sugarcane crushed
- Reflects the total raw material input processed.
- Growth here indicates expansion in operations or increased supply of sugarcane.

(ii) Total sugar produced
- Represents the output of the factories.
- Directly affected by both the quantity of cane crushed and the sugar recovery rate.

(iii) Total area under Sugarcane available for crushing
- Shows the agricultural support base.
- An increase suggests more farmers engaging in cane cultivation, possibly due to better pricing or support.

2. Performance Indicators
To judge the efficiency and effectiveness of the sugar factories, the following factors were evaluated:
(i) Percentage capacity utilization
This indicates how efficiently the installed machinery and equipment are being used.
Two formulas are used:

$$\text{Percent Capacity utilization I} = \frac{\text{Total cane crushed in a season}}{\text{Installed crushing capacity x 160}} \times 100$$

Assumes a standard 160 days as the season length.

$$\text{Percent Capacity utilization II} = \frac{\text{Total cane crushed in a season}}{\text{Installed crushing capacity x Actual days in the season}} \times 100$$

Uses actual days of operation for more accurate performance measurement.

(ii) Percentage sugar recovery
- Recovery rate (%) = (Total sugar produced / Total cane crushed) $\times$ 100
- A higher recovery rate indicates more efficient extraction of sugar from cane.

(iii) Per quintal cost of production of sugar
- Indicates the cost incurred to produce one quintal (100 kg) of sugar.
- Helps in understanding the profitability and cost management of the factory.

(iv) Cane price paid to farmers
- Shows how much farmers are paid per quintal of cane.
- Affects farmer loyalty, supply consistency, and socio-economic impact.

3. Cost and Return Structure
- **Cost of Production:** All expenses (fixed + variable) involved in producing sugar.
- **Returns:** Revenue from sale of sugar and by-products (molasses, bagasse, etc.)
- **Per quintal cost estimation:** Used to analyze the factory's profitability and operational efficiency.

This comprehensive analysis using growth rates and performance indicators provides insights into:
- The operational efficiency of co-operative sugar factories.
- The economic viability of their business models.
- The impact on farmer incomes and regional agricultural dynamics.

Results and Discussion
Performance of selected co-operative sugar factories
This section analyzes the performance of the selected co-operative sugar factories using the following parameters:
1. Percentage capacity utilization
2. Percentage sugar recovery
3. Per quintal cost of production of sugar
4. Cane price paid to farmers

A comparative analysis of the average values for these performance indicators has been undertaken to determine whether variations across the selected factories are statistically and economically significant. It is important to note that the sugar industry in India experiences periodic fluctuations—commonly referred to as the "sugar cycle"—which can contribute to significant variation in performance across different factories and years.

Growth and performance of the selected co-operative sugar factories
Growth of the various parameters of the selected co-operatives sugar factories was measured in respect of the following:
(i) Total quantity of sugar crushed
(ii) Total sugar produced
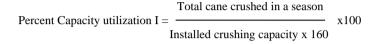(iii) Total area under sugarcane available for crushing
Time series data on the above-mentioned aspects were used for the purpose of analysis. Linear and compound growth rates were

estimated for the period from 2000-01 to 2011-12.

The factors considered for judging the performance of the selected sugar factories were as under:
(i) Percentage capacity utilization
(ii) Percentage sugar recovery
(iii) Per quintal cost of production of sugar, and
(iv) Cane price paid to the farmers

The cost of production of sugar and the structure of total cost and returns of the sugar factories studied. This point can be made clear by estimating per quintal cost of production of sugar.

Percentage capacity utilization

$$\text{Percent Capacity utilization I} = \frac{\text{Total cane crushed in a season}}{\text{Installed crushing capacity x 160}} \times 100$$

$$\text{Percent Capacity utilization II} = \frac{\text{Total cane crushed in a season}}{\text{Installed crushing capacity x Actual days in the season}} \times 100$$

1. Percentage Capacity Utilization
Capacity utilization is a critical indicator of operational efficiency in a sugar factory. Under-utilization of installed capacity can lead to:
- Reduced overall production,
- Increased per quintal cost of production,
- Inefficient use of capital investment, and
- Slower growth of the factory.

Table 1 presents the average capacity utilization (both Method I and Method II) for each of the five selected co-operative sugar factories during the period 2001-02 to 2012-13.

Table 1: Average capacity utilization (%) (2001-02 to 2012-13)

Sr. No.	Name of Factory	Capacity Utilization - I (%)	Capacity Utilization - II (%)
1	Bardoli Co-operative Sugar Factory	110.04	98.24
2	Madhi Co-operative Sugar Factory	100.02	93.82
3	Gandevi Co-operative Sugar Factory	126.91	112.79
4	Mahuva Co-operative Sugar Factory	111.60	103.52
5	Maroli Co-operative Sugar Factory	74.19	77.88

Analysis
- The Gandevi Co-operative Sugar Factory exhibited the highest average capacity utilization using both methods (126.91% and 112.79%), indicating superior operational efficiency.
- The Maroli Co-operative Sugar Factory recorded the lowest values under both methods (74.19% and 77.88%), well below the standard benchmark of 100%.
- Factories such as Bardoli, Madhi, and Mahuva also performed well, with capacity utilization-I exceeding 100%, suggesting efficient deployment of installed capacity over a standard crushing season of 160 days.

Interestingly, in the case of Maroli, the capacity utilization-II was higher than capacity utilization-I. This anomaly is attributed to the factory operating for fewer than 160 days in some seasons, thereby slightly increasing the utilization ratio under the second method.

Conclusion
Based on both capacity utilization metrics, the Gandevi Co-operative Sugar Factory demonstrates the best performance, efficiently using its capacity throughout the study period. On the other hand, Maroli Co-operative Sugar Factory underperformed consistently, indicating under-utilization and scope for significant improvement.

2. Percentage Sugar Recovery
After capacity utilization, sugar recovery is the next most crucial factor influencing the economic efficiency of a sugar factory. Both these parameters jointly determine the cost of production of sugar and the cane price payable to growers.
An increase in sugar recovery percentage leads to:
- A reduction in the per quintal cost of production, since more sugar is extracted from the same amount of sugarcane.
- Lower variable costs, as less cane, chemicals, fuel, and labor are needed per unit of sugar output.
- Reduced per unit fixed cost, as the same fixed costs are spread over a larger volume of production.

Formula for Sugar Recovery

$$\text{Percentage sugar recovery} = \frac{\text{Total sugar produced}}{\text{Total cane crushed}} \times 100$$

Table 2: Average Sugar Recovery (%) (2001-02 to 2012-13)

Sr. No.	Name of co-operative sugar factory	Avg. sugar Recovery (%)
1	Bardoli Co-operative Sugar Factory	10.97
2	Madhi Co-operative Sugar Factory	10.73
3	Gandevi Co-operative Sugar Factory	11.50
4	Mahuva Co-operative Sugar Factory	10.77
5	Maroli Co-operative Sugar Factory	10.03

Analysis
- The Gandevi Co-operative Sugar Factory achieved the highest average sugar recovery at 11.50%, indicating the most efficient conversion of sugarcane to sugar.
- The Maroli Co-operative Sugar Factory recorded the lowest recovery rate at 10.03%, which significantly impacts its cost structure and profitability.
- Bardoli, Madhi, and Mahuva factories also demonstrated respectable sugar recovery rates, ranging from 10.73% to 10.97%.

Key factors behind superior recovery

The superior performance of Gandevi and Bardoli factories can be attributed to efficient post-harvest handling and timely transportation of harvested cane. According to R. Nandkumar (2011) [6], both factories arranged for transportation trucks every 11 hours during the harvesting season, significantly reducing sucrose loss caused by delays. This operational efficiency in logistics minimized recovery losses and ensured higher sugar yield.

These findings align with earlier studies such as Hinge *et al.* (1989) [3], which also emphasized the importance of timely cane crushing in maximizing sugar recovery.

Conclusion

The Gandevi Co-operative Sugar Factory outperformed all others in sugar recovery percentage, primarily due to better cane handling and transportation systems. In contrast, Maroli lagged behind, reflecting the need for improvements in harvesting-to-crushing time and factory-level processing efficiency.

3. Cost of Production of Sugar

The per quintal cost of sugar production bears an inverse relationship with the overall health and performance of a sugar factory. This cost reflects the combined efficiency of all departments within the factory. When the per quintal cost is excessively high, it severely hampers the income and profitability of the factory.

presents data on the per quintal cost of sugar production (including and excluding the cost of cane) for selected co-operative sugar factories over the period 2001-02 to 2012-13.

Among the five factories analyzed, the Gandevi Co-operative Sugar Factory demonstrated the best performance.

Table 3: Average per quintal cost of production of suga (2001-02 to 2012-13)

Sr. No.	Name of Factory	Including Cost of Cane (₹)	Excluding Cost of Cane (₹)
1	Bardoli Co-operative	2133.10	334.05
2	Madhi Co-operative	2134.18	423.83
3	Gandevi Co-operative	2135.52	333.47
4	Mahuva Co-operative	2111.44	443.40
5	Maroli Co-operative	2366.86	683.19

Analysis and key Observations

- Gandevi Co-operative Sugar Factory emerged as the most efficient. Despite a slightly higher total cost than Bardoli and Mahuva, it had the lowest production cost excluding cane (₹333.47), indicating strong internal operations.
- The Maroli Co-operative Sugar Factory showed poor performance, with the highest per quintal cost, both including (₹2366.86) and excluding cane (₹683.19).

Notably, Maroli paid less for cane compared to other factories, yet its production cost was the highest—pointing to significant inefficiencies in internal processes.

- Mahuva had the lowest overall cost including cane (₹2111.44), but its high internal cost (₹443.40) suggests that the savings stemmed primarily from paying lower cane prices, not from operational efficiency.
- Bardoli and Madhi had similar total costs, but Bardoli was more efficient internally (₹334.05 vs. ₹423.83).

Conclusion

- The cost of sugar production, particularly excluding cane cost, is a vital indicator of a factory's internal performance.
- Maroli's high production cost, despite paying lower cane prices, highlights operational inefficiencies.
- Gandevi's lower internal cost reflects superior management and operational efficiency.
- These findings align with Lakshmikantham's (1979) [4] study in Andhra Pradesh, which also found that high production costs were associated with weaker factory performance.

4. Cane price paid to the farmers

The cane price paid by a co-operative sugar factory is a key indicator of its performance from the farmers' perspective. It reflects the overall financial health, management efficiency, and operational results of the factory. A well-performing sugar factory is typically in a position to pay a higher cane price to its growers.

Co-operative sugar factories declare a 'final cane price' after accounting for all production costs and income from sugar sales. However, deductions are often made from the declared final cane price for various reasons (e.g., advances, society contributions, welfare funds). Therefore, the actual price received by farmers equals:

Final Cane Price − Deductions

Higher deductions mean lower actual payment to the cane growers.

Table 4: Average Cane Price Paid to Farmers (2001-02 to 2012-13)

Sr. No.	Name of Factory	Average Cane Price Paid (₹/tonne)
1	Bardoli Co-operative	1941.33
2	Madhi Co-operative	1806.33
3	Gandevi Co-operative	2008.50
4	Mahuva Co-operative	1842.33
5	Maroli Co-operative	1650.63

Key observations

- The Gandevi Co-operative Sugar Factory paid the highest average cane price during the study period—₹2008.50 per tonne—demonstrating its strong financial position and superior performance.
- Bardoli, the next best, paid ₹1941.33 per tonne—around ₹67 less than Gandevi—highlighting Gandevi's leadership in farmer returns.
- The lowest average cane price was paid by Maroli Co-operative Sugar Factory (₹1650.63), indicating its poor financial and operational performance.

Conclusion

- The cane price paid to farmers is a direct reflection of a sugar factory's financial outcomes and management effectiveness.
- The data clearly shows that Gandevi Co-operative Sugar Factory was superior among the five selected factories in terms of:

- Capacity utilization
- Sugar recovery
- Cost of production
- Cane price paid to farme**r**s

On average, Gandevi maintained a stronger performance, reinforcing its position as the most efficient and farmer-friendly factory during the study period

Summary and Conclusion
The performance of selected co-operative sugar factories during the period 2001-02 to 2012-13 was assessed across four major parameters: capacity utilization, sugar recovery, cost of production, and cane price paid to farmers. The findings are as follows:

1. Capacity Utilization
- Gandevi Co-operative Sugar Factory achieved the highest average capacity utilization-I (126.91%) and capacity utilization-II (112.79%), both well above the optimum level of 100%.
- Maroli Co-operative Sugar Factory had the lowest capacity utilization, with 74.19% (Capacity-I) and 77.88% (Capacity-II), significantly below the standard norms and other factories.
- Other factories such as Bardoli, Madhi, and Mahuva maintained capacity utilization levels around or above 100%, indicating satisfactory performance.

2. Sugar Recovery Percentage
- Gandevi Sugar Factory recorded the highest average sugar recovery rate at 11.50%, indicating greater efficiency in extracting sugar from cane.
- The lowest sugar recovery was observed in Maroli (10.03%), further confirming its weaker operational performance.
- All selected factories showed a declining trend in sugar recovery percentage in recent years, possibly due to variations in cane quality or climatic factors.

3. Cost of Production
- The average per quintal cost of production (including cane cost) was highest in Maroli (₹2366.86), reflecting inefficiency and higher operational costs.
- Even excluding cane cost, Maroli had the highest cost (₹683.19), suggesting poor internal cost control.
- In contrast, Gandevi, Bardoli, and Mahuva managed production costs more effectively, with Gandevi showing the lowest internal cost (₹333.47 per quintal).

4. Cane Price Paid to Farmers
- Gandevi Co-operative Sugar Factory paid the highest average cane price (₹2008.50 per tonne), underscoring its strong financial position and commitment to farmers.
- Bardoli followed with ₹1941.33, while Maroli paid the lowest (₹1650.63), reflecting its poor financial health and inability to support its growers adequately.

Conclusion
Based on the overall analysis, the Gandevi Co-operative Sugar Factory emerged as the best performer among the selected units.
It consistently excelled in:
- **C**apacity utilization

- Sugar recovery
- Cost control
- Farmer returns (cane price paid)

In contrast, the Maroli Co-operative Sugar Factory consistently underperformed across all key indicators, suggesting inefficiencies in both operational and financial management.
These results highlight the importance of efficient operations, sound management, and financial stability in sustaining the performance and farmer trust in co-operative sugar factories.

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