

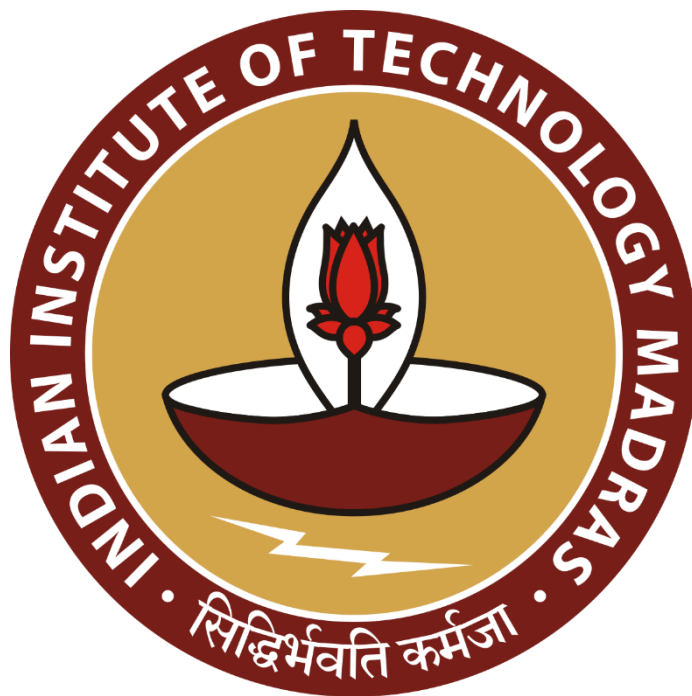
# **Data-Driven Strategies for Revenue Growth and Utility Efficiency at Katraj Dairy**

**Final Report for the BDM Capstone Project**

Submitted by

**Name:** Aishwarya Anil Menon

**Roll number:** 21F1005945



IITM Online BS Degree Program,  
Indian Institute of Technology, Madras, Chennai  
Tamil Nadu, India, 600036

## Contents

1 Executive Summary	3
2 Detailed Explanation of Analysis Process	4
2.1 Data Collection and Preparation	4
2.2 Descriptive Statistical Analysis	5
2.3 Data Visualization	5
2.4 Analysis	6
3 Results and Findings	8
3.1 Graphs	8
4 Interpretation of Results and Recommendation	17
4.1 Interpretation of Results	17
4.2 Recommendations	18
4.3 Conclusion	19

## **Declaration Statement**

I am working on a Project titled **“Data-Driven Strategies for Revenue Growth and Utility Efficiency at Katraj Dairy”**. I extend my appreciation to **Katraj Dairy**, for providing the necessary resources that enabled me to conduct my project.

I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered from primary sources and carefully analyzed to assure its reliability.

Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through thorough analytical procedures.

I am dedicated to adhering to the principles of academic honesty and integrity, and I am receptive to any additional examination or validation of the data contained in this project report.

I understand that the execution of this project is intended for individual completion and is not to be undertaken collectively. I thus affirm that I am not engaged in any form of collaboration with other individuals, and that all the work undertaken has been solely conducted by me. In the event that plagiarism is detected in the report at any stage of the project's completion, I am fully aware and prepared to accept disciplinary measures imposed by the relevant authority.

I understand that all recommendations made in this project report are within the context of the academic project taken up towards course fulfillment in the BS Degree Program offered by IIT Madras. The institution does not endorse any of the claims or comments.



Signature of Candidate: **(Digital Signature)**

Name: Aishwarya Anil Menon

Date: 05/06/2024

## 1 Executive Summary

The final report highlights key findings from the analysis of Katraj Dairy's sales, utility consumption, and pricing strategies. **Buttermilk** and **dahi** contribute over **70% of total sales**, with buttermilk alone accounting for **56.3%**. Sales patterns show significant **seasonal demand spikes** for buttermilk and lassi during the summer months, while dahi maintains steady demand year-round.

Key actionable recommendations include adopting a **dynamic pricing strategy**, particularly for buttermilk during peak summer months, to maximize revenue without negatively affecting demand. Additionally, **improving demand forecasting** for top-performing products will help the company better align production and inventory with seasonal sales trends, avoiding overstocking or stockouts.

Utility analysis revealed a **15% reduction in water consumption**, indicating improved efficiency. However, **electricity usage** remains steady, presenting opportunities for further optimization, particularly during off-peak seasons.

The report concludes with recommendations for **seasonal production scaling**, **strategic pricing adjustments**, and **utility optimization**, all of which will improve Katraj Dairy's profitability and operational efficiency.

## 2 Detailed Explanation of Analysis Process

### 2.1 Data Collection and Preparation

In this report, we used several datasets to analyze Katraj Dairy's performance. The datasets included detailed records of monthly product sales, utility consumption, and pricing data, spanning from FY 2019 to FY 2024. Here is a detailed breakdown of each dataset:

- **Sales Data:** This dataset contains month-wise sales data for key products like buttermilk, dahi, lassi, paneer, and shrikhand. It consists of **over 60 records**, with each row representing the monthly sales volume of these products. The dataset helped us identify top performers, seasonal trends, and patterns of variability across product lines.
- **Utility Data:** The utility data tracks **monthly water and electricity consumption**. It includes **36 records** for each utility from FY 2021 to FY 2024. This dataset was crucial in assessing the efficiency of resource usage in relation to sales, enabling us to identify cost-saving opportunities by comparing utility consumption trends with production and sales volumes.
- **Pricing Data:** This data consists of month-wise pricing information for key products like buttermilk and dahi. The dataset includes **price changes** over the years and corresponding **sales volumes**, which allowed us to calculate the **price elasticity of demand** for these products.

#### Data Preparation:

- **Missing Data:** Some months had missing values in the utility dataset, particularly in water and electricity consumption. These gaps were handled through interpolation where possible, but missing data was flagged for further analysis.
- **Outliers:** Several outliers were observed in the sales data, particularly for products like **ice cream** and **lassi**, where sales showed sudden peaks. These outliers were analyzed carefully, especially during the summer months when demand for these products typically surged.

- **Data Structure and Cleaning:** The sales data was generally consistent, but the utility data required more cleaning due to variations in formatting and recording practices over the years.

## 2.2 Descriptive Statistical Analysis

In the midterm report, I conducted a descriptive statistical analysis to gain a clearer understanding of sales trends and utility consumption at Katraj Dairy.

**Buttermilk** (325,988 units/month) and **dahi** (74,627 units/month) were identified as top performer with majority of sales. Their consistent demand highlights the need for focused optimization strategies around pricing and production.

Products like **paneer** and **shrikhand** exhibited low demand (2,475 and 2,240 units/month, respectively) with relatively stable sales patterns. Efforts should be made to maintain profitability by aligning their pricing and promotional strategies accordingly.

In terms of **variability**, products like **buttermilk** and **lassi** showed high standard deviations due to seasonal sales spikes. So this suggests the need for improved demand forecasting to avoid overproduction or stockouts. Products like **paneer** and **khoa** had much more predictable, stable demand.

Additionally, **skewness** and **kurtosis** were used to understand outliers and sales distributions. **Lassi** and **ice cream** showed positive skewness. This indicates occasional high-demand months driven by seasonal factors. Their high kurtosis suggested frequent demand surges during specific seasons, particularly summer.

Utility data revealed a **15% reduction in water usage** between FY 2021-23, even as sales rose by **12%**. This reflects early operational efficiency improvements. However, **electricity usage** remained steady. So, here, there are potential opportunities for optimization in energy use, especially during low-demand months.

## 2.3 Data Visualization

Initially, we looked at the following visualizations which gave us some crucial insights into sales and utility trends:

**Pie charts** showed that buttermilk contributed **56.3%** of total sales, and dahi added **12.9%**, which indicates high contribution to the driving revenue. Thus, this concentration of sales needs a strategy of prioritizing these products for pricing and production optimization.

**Pareto analysis** confirmed the 80/20 rule: buttermilk and dahi combined made up over **70%** of total sales. These products should be focused on for efficiency improvements and revenue growth.

**Seasonal time-series charts** revealed that buttermilk and lassi experienced their highest demand during summer months (April-June) with sales spiking by up to **25%**. This seasonality suggests better inventory planning and production scaling to meet demand during peak periods, while products like **paneer** and **buffalo cream** experienced low demand during this time, which suggests promotional activities during their off-peak periods.

**Combination charts** comparing sales with utility usage showed that **water consumption** dropped by **15%**, even as sales grew by **12%**, indicating some efficiency gains. However, **electricity consumption** did not scale down proportionally with sales. This means there is a need for better energy usage with production levels to reduce costs further.

## 2.4 Analysis

The analysis section dives into deeper trends in Katraj Dairy's sales data. This helps ensure that decision-making is based on actionable insights.

### Forecasting (ARIMA/SARIMA Models)

To improve future planning, we applied **ARIMA** (Auto-Regressive Integrated Moving Average) models to forecast sales for buttermilk, dahi, and other key products. The ARIMA

model helped us predict future sales based on historical patterns, with an emphasis on **seasonal fluctuations**.

**Buttermilk** showed a clear seasonal peak during summer, with forecasted sales for the next cycle continuing to align with a **25% increase in sales** during April-June. By anticipating this demand surge, Katraj Dairy can scale production and adjust inventory accordingly.

**Dahi**, on the other hand, exhibited more stable trends, with the forecast indicating steady sales across the year, providing a reliable stream of income. Forecasting these stable products ensures better resource allocation and steady production schedules.

These forecasts will allow Katraj Dairy to plan for peak seasons more effectively, helping to avoid both overproduction during low-demand months and stock shortages during high-demand periods.

### **Strategic Impact of Results**

The insights derived from this analysis have a direct strategic impact on Katraj Dairy's operations:

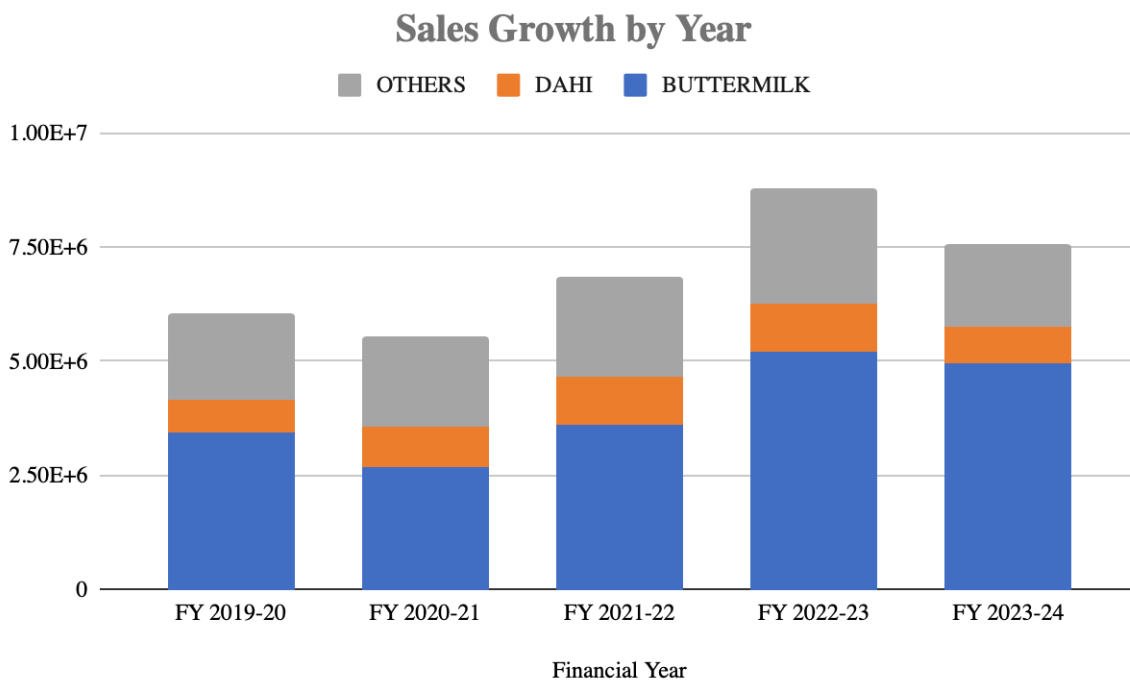
1. **Demand Forecasting:** Improved demand forecasting using ARIMA will help optimize production, inventory management, and reduce costs associated with overproduction or stockouts.
2. **Dynamic Pricing:** Week-wise and seasonal sales trends suggest that a dynamic pricing strategy can be implemented for buttermilk during peak demand periods, allowing Katraj Dairy to maximize revenue without negatively affecting sales.
3. **Utility Optimization:** Aligning electricity consumption more closely with production during peak demand periods can reduce operational costs, improving overall profitability.



### 3 Results and Findings

#### 3.1 Graphs

##### 1. Sales Growth by Year (Stacked Bar Chart)



*Figure 1: Stacked Bar Chart indicating contribution of the products to the total revenue for each year.*

The stacked bar chart demonstrates the steady growth in overall sales from FY 2019-2024, with a noticeable spike in FY 2022-23. Buttermilk remains the biggest contributor to this growth across the years, followed by dahi. This sales increase in FY 2022-23 highlights a recovery post-pandemic. Continuing to drive sales of buttermilk and dahi will sustain this growth momentum. Other products contribute less significantly but remain steady.

## 2. Sales of Buttermilk and Dahi Over Time (Line Graph)

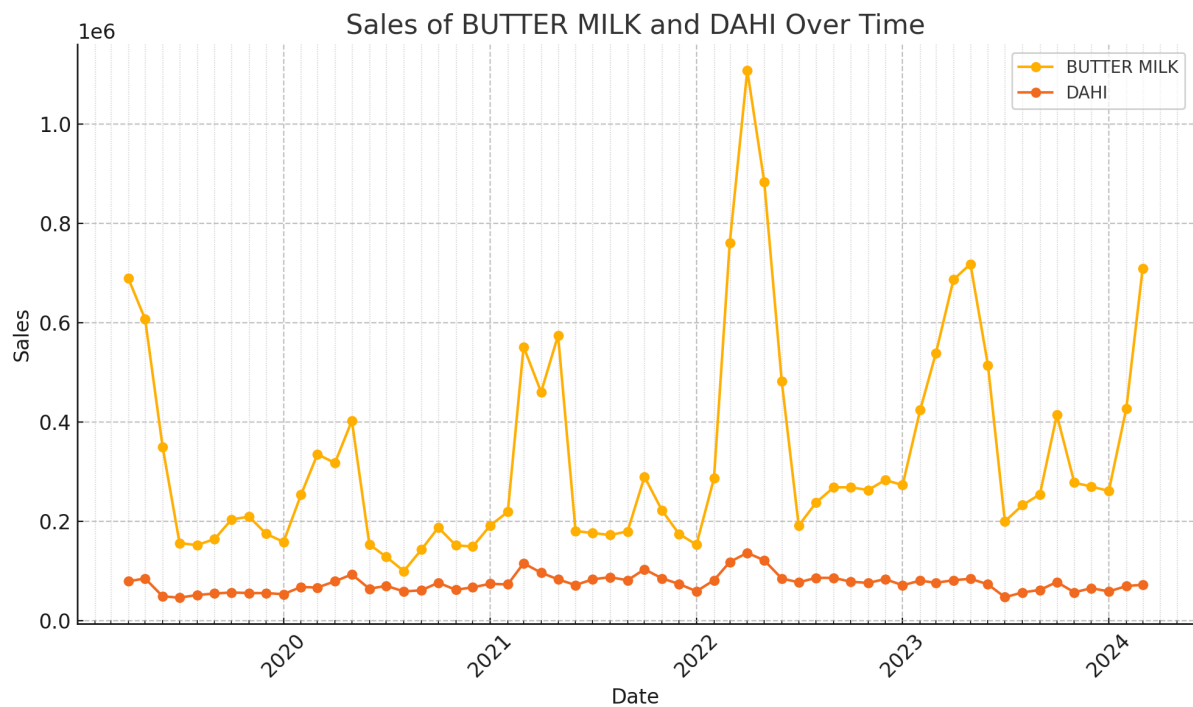


Figure 2: Time-series line chart showing sales of Buttermilk and Dahi over time

This time-series chart highlights the seasonal peaks for buttermilk, especially during the summer months (April-June). Dahi shows more consistent, though lower, sales volume throughout the year. This indicates that demand forecasting and production scaling should focus on these high-demand periods. Dahi is less seasonal but can benefit from targeted price adjustments.

### 3. Seasonal Decomposition of Sales Data

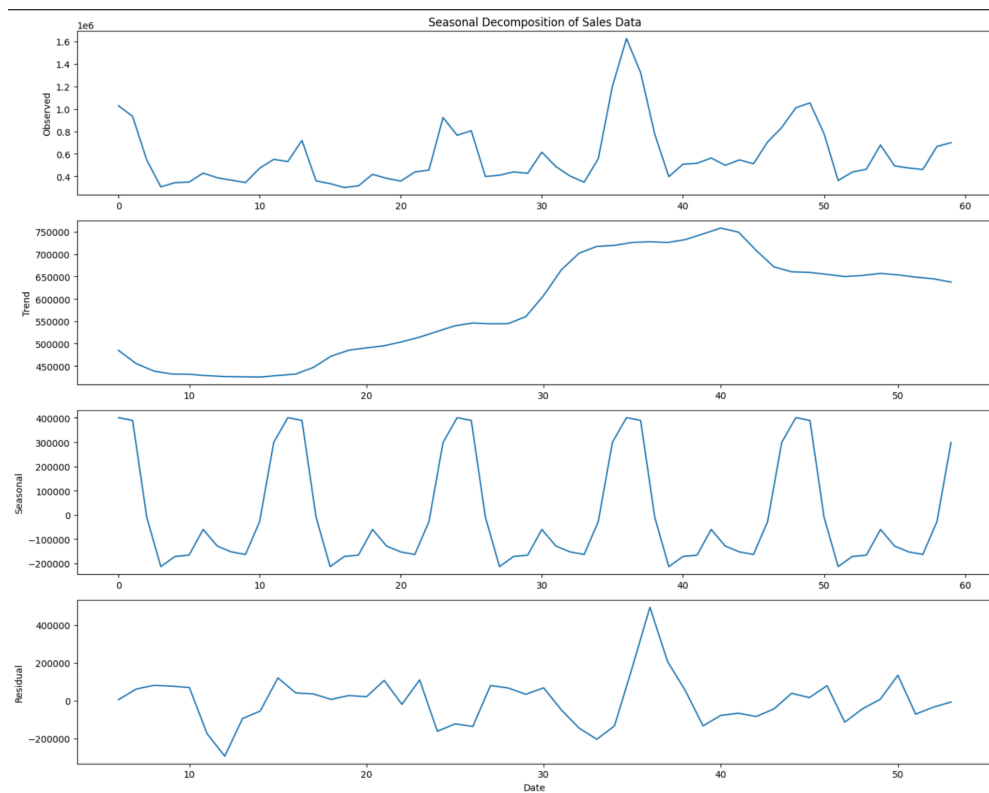


Figure 3: Seasonal Decomposition Graph of Sales Data Showing Patterns and Trends.

The seasonal decomposition graph breaks down the sales patterns into trend, seasonal, and residual components. We can clearly see the recurring **seasonal peaks** in buttermilk sales, which coincide with warmer months, while the **trend component** shows steady overall sales growth. Inventory and production must be managed to meet this demand efficiently, avoiding shortages and overproduction.

#### 4. Monthly Average Sales by Product (Bar Charts)

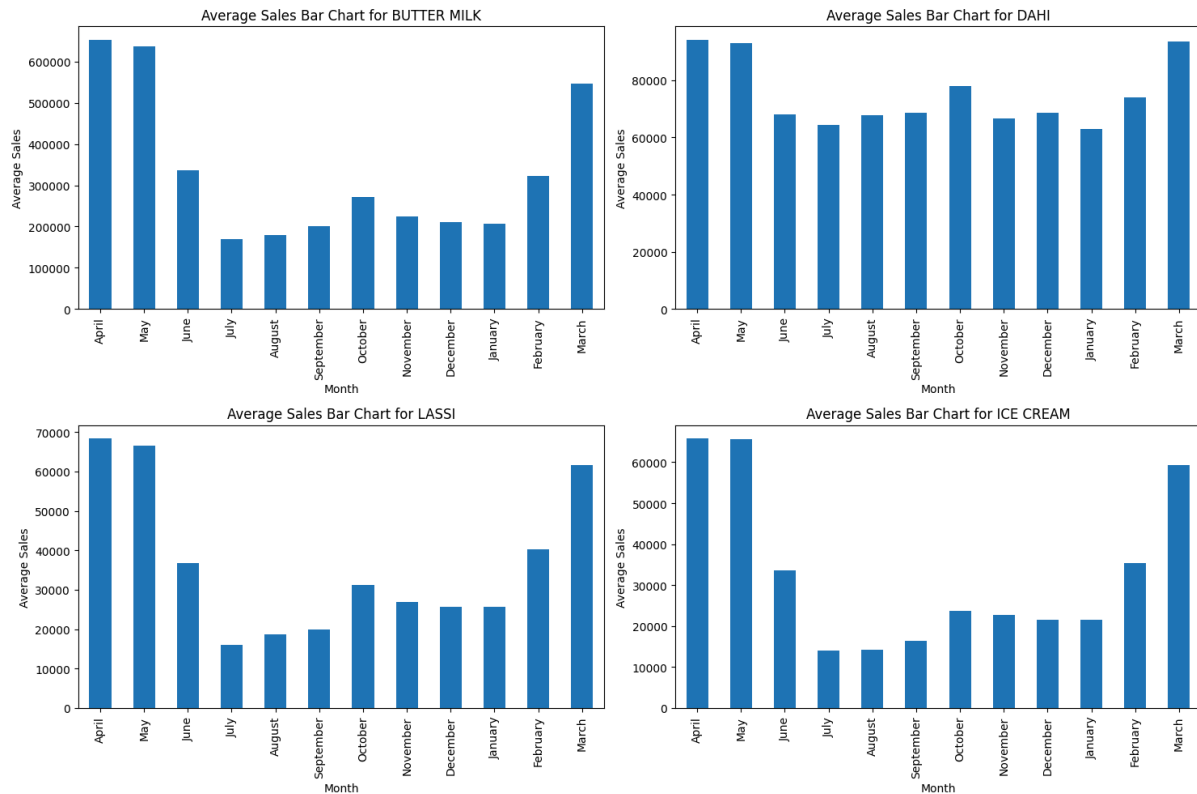


Figure 4: Bar Chart Showing Monthly Average Sales for (a) Buttermilk, (b) Dahi, (c) Lassi, (d) Ice-cream

These bar charts illustrate the monthly average sales for buttermilk, dahi, lassi, and ice cream, showing that:

- **Buttermilk** peaks around **April-May**, with another smaller peak in winter.
- **Dahi** sales are steady throughout the year.
- **Lassi** follows a similar summer demand curve as buttermilk.
- **Ice cream** sales also peak during summer months.

Promotional campaigns and pricing adjustments should align with these demand peaks. Buttermilk and lassi have strong seasonality, while dahi offers a consistent sales stream.

## 5. Season-Wise Sales Volume (Bar Chart)

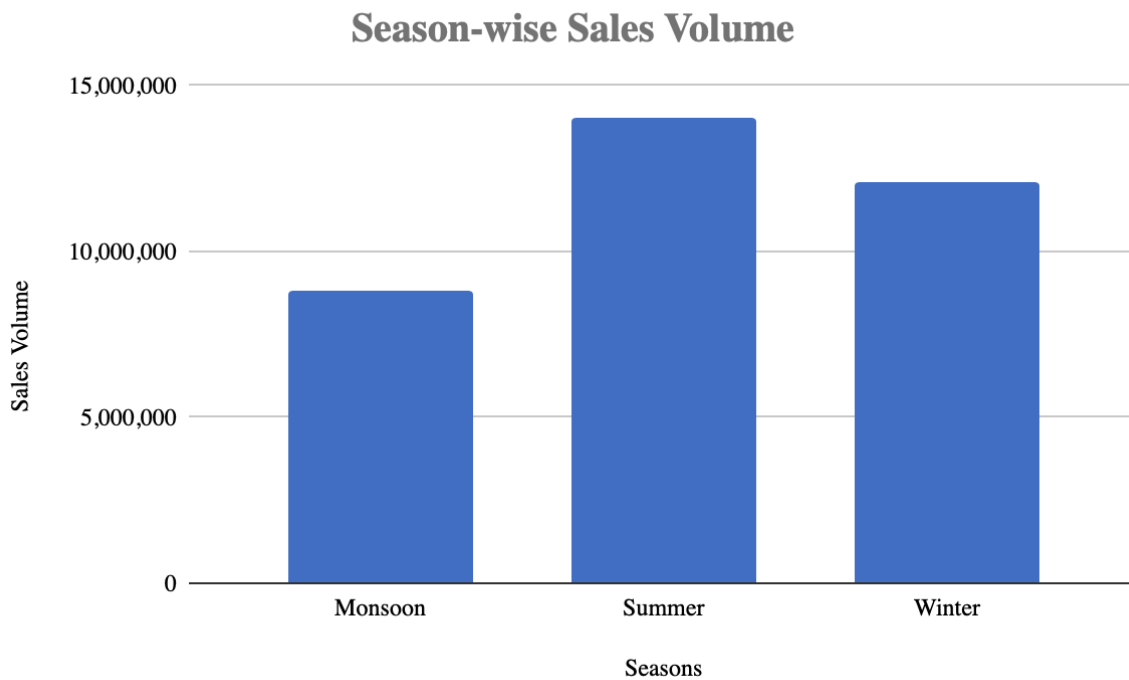


Figure 5: Bar Chart Showing Season-wise Sales Distribution.

For this seasonal analysis, I took the seasons particularly in Pune district to see how they vary. Here's the table:

Summer	March, April, May
Monsoon	June, July, August, September
Winter	October, December, January, February

This chart reveals that the highest sales volume occurs in the **summer season**, followed by winter, with the lowest sales in the monsoon. So, summer is the critical season for maximizing sales, especially for buttermilk and lassi. Inventory and marketing strategies must be aligned to capture this peak demand.

## 6. Water Consumption vs. Sales Revenue (Combination Chart)

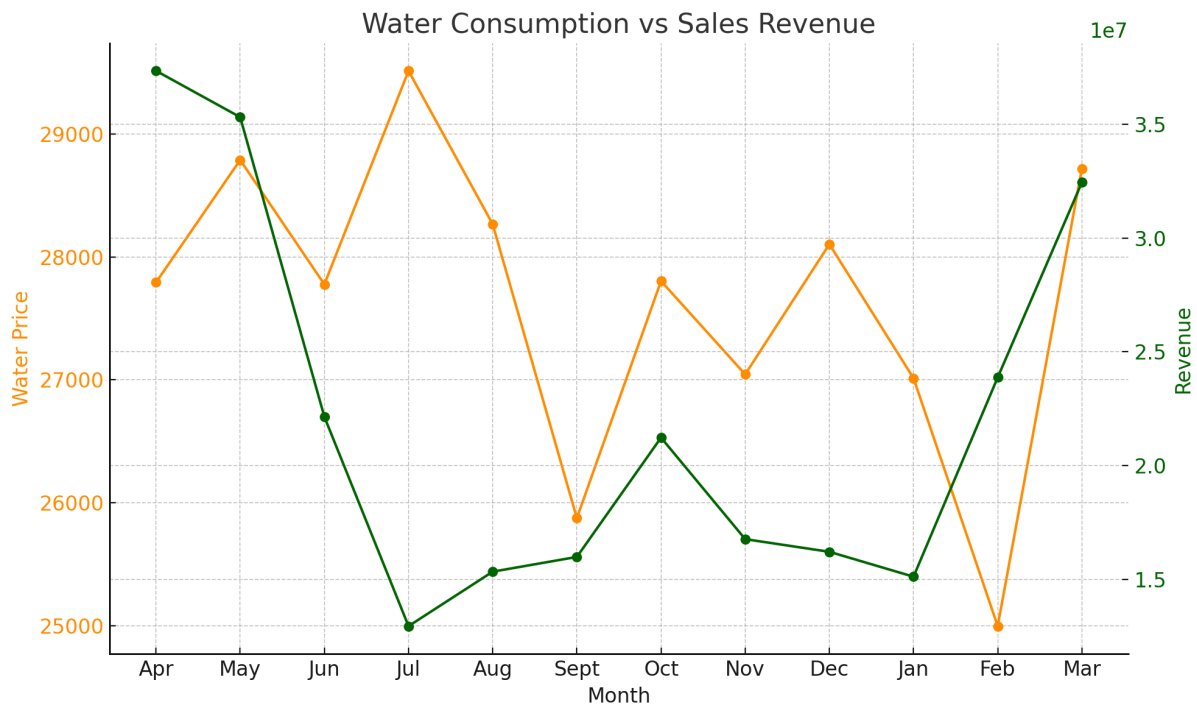


Figure 6: Combination Chart comparing Water Consumption and Sales Revenue

The combination chart shows water consumption (orange line) compared to sales revenue (green line). Notably, water usage decreases as sales grow, particularly in **FY 2022-23**. Continued monitoring and implementing water-saving measures can further reduce costs while maintaining production levels.

## 7. Electricity Consumption vs. Sales Revenue (Combination Chart)

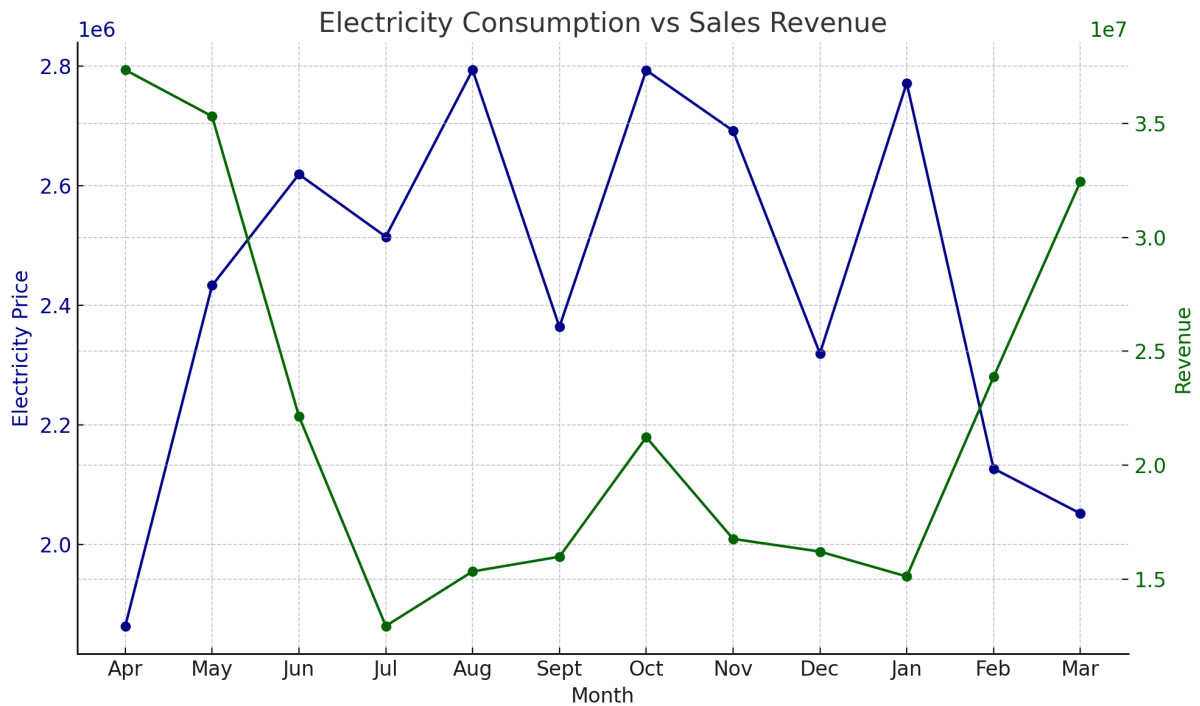


Figure 7: Combination Chart comparing Electricity Consumption and Sales Revenue

Similar to water, electricity consumption (blue line) compared to sales revenue (green line) shows that electricity usage remains relatively high, even when sales drop. It is less responsive to sales fluctuations, indicating inefficiencies in energy usage during low-demand periods. Introducing energy-efficient equipment or optimizing production schedules can help reduce electricity costs.

## 8. Sales Forecasting (Line Graphs)

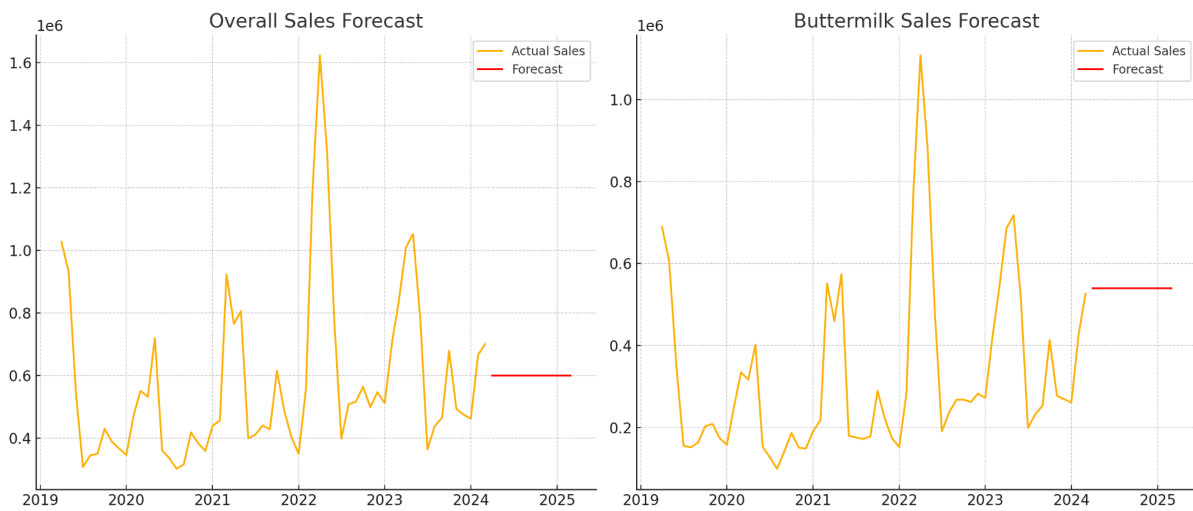


Figure 8: Line Charts forecasting sales for the coming year using ARIMA.

The sales forecast graphs for overall sales and buttermilk show expected range moving into **2024 and 2025**. The forecasted sales suggest consistent demand, with peaks aligning with seasonal trends from previous years. The forecasts confirm the need for careful demand planning, particularly during peak seasons. Buttermilk's forecasted sales peak again in summer, requiring proactive production scaling.



## 9. Elasticity Analysis

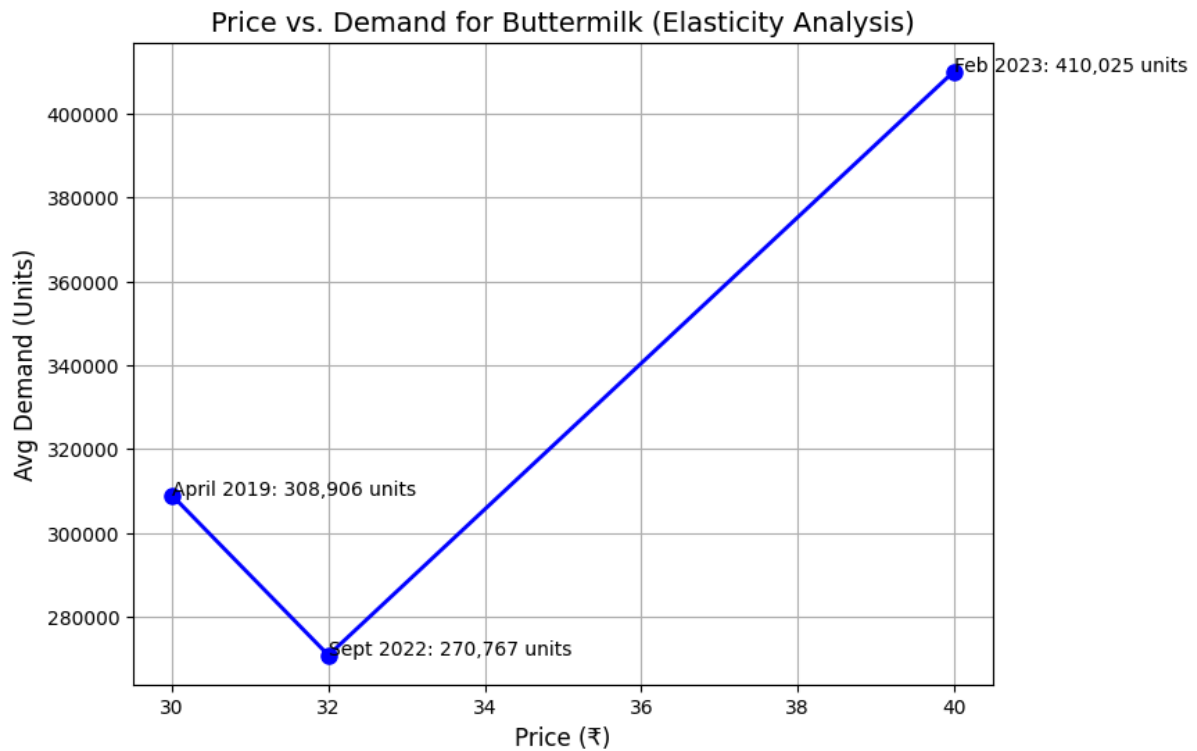


Figure 9: Line Chart for Elasticity Analysis for Buttermilk.

### Elasticity Between April 2019 and Sept 2022:

- Price change:  $\frac{32-30}{30} \times 100 = 6.67\%$
- Quantity change:  $\frac{270,767.4-308,905.61}{308,905.61} \times 100 = -12.36\%$

$$E_d = \frac{-12.36\%}{6.67\%} = -1.85$$

**Interpretation:** The price elasticity of demand between April 2019 and Sept 2022 is **-1.85**. This suggests that for a 1% increase in price, the demand for buttermilk decreases by 1.85%, indicating relatively **elastic demand**.

### Elasticity Between Sept 2022 and Feb 2023:

- Price change:  $\frac{40-32}{32} \times 100 = 25\%$
- Quantity change:  $\frac{410,025.29-270,767.4}{270,767.4} \times 100 = 51.43\%$

$$E_d = \frac{51.43\%}{25\%} = 2.06$$

**Interpretation:** The price elasticity of demand between Sept 2022 and Feb 2023 is **2.06**. This indicates that buttermilk is **highly elastic** during this period, meaning a 1% increase in price results in a 2.06% increase in demand. This could reflect higher demand for buttermilk in February, potentially due to seasonal factors.

## 4 Interpretation of Results and Recommendation

### 4.1 Interpretation of Results

#### 1. Product Sales Performance:

Buttermilk and dahi emerged as the top-performing products, accounting for over **70%** of the total sales. This dominance underscores the importance of focusing marketing and operational efforts on these key products. The seasonal trend analysis revealed that buttermilk demand spikes during summer, while dahi maintains steady sales year-round.

#### 2. Seasonal Sales Trends:

Sales data highlighted strong **seasonality**, especially for buttermilk and lassi. Both products showed significant demand peaks during the summer months which indicates the need for scaling up production and inventory to meet this huge demand. The time-series and seasonal decomposition analysis confirmed that efficient forecasting and planning during these periods can avoid understocking or overproduction.

#### 3. Utility Consumption:

While water consumption has decreased by **15%** over the analyzed period, reflecting some efficiency improvements, **electricity usage** remains relatively steady, even during months of lower sales. This suggests that there are opportunities for better alignment between electricity consumption and production levels, especially during off-peak seasons.

#### 4. Elasticity of Buttermilk:

The price elasticity of buttermilk showed varying results. Between April 2019 and September 2022, demand was **elastic** (elasticity of -1.85), with price increases leading to reduced demand. However, between September 2022 and February 2023, demand became **highly elastic** (elasticity of 2.06), with significant sales growth despite higher prices. This indicates that buttermilk demand is sensitive to both price and **seasonal factors**, especially during peak months.

## 4.2 Recommendations

### 1. Dynamic Pricing Strategy:

Given the results of the elasticity analysis, Katraj Dairy should implement a dynamic pricing strategy. During peak seasons (e.g., summer and early spring), buttermilk demand remains strong even with price increases. The company can capitalize on this by raising prices slightly during these periods to maximize revenue. However, in off-peak months, maintaining competitive pricing is crucial to avoid losing sales.

### 2. Seasonal Production and Inventory Planning:

To address the strong **seasonal demand** for buttermilk and lassi, production and inventory levels should be **scaled up** during peak summer months. By aligning production more closely with seasonal trends, Katraj Dairy can prevent understocking during high-demand periods and reduce excess inventory during off-peak months.

### 3. Utility Optimization:

There is significant potential to further reduce operational costs by **optimizing electricity usage**. Since water consumption has already shown improvement, similar efforts should be made to reduce electricity usage during periods of lower production. Investing in **energy-efficient machinery** or adjusting production schedules to reduce energy consumption during low-demand months could yield substantial cost savings.

### 4. Focused Marketing on Key Products:

Given that buttermilk and dahi are the top contributors to total sales, Katraj Dairy should continue to focus marketing efforts on these products, especially during their high-demand periods. Special promotions and **targeted advertising** during the summer for buttermilk and consistent marketing for dahi can further boost sales.

## 5. Improve Forecasting Models:

The seasonal demand trends clearly show the need for accurate **demand forecasting models**. By refining these models using historical data, Katraj Dairy can better predict peak demand periods and ensure production and inventory levels are adjusted accordingly. This will help avoid stockouts during high-demand months and reduce waste in lower-demand periods.

## 4.3 Conclusion

This report identifies strategic opportunities for Katraj Dairy based on data-driven insights. **Buttermilk** and **dahi** contribute over **70%** of total sales, with buttermilk alone accounting for **56.3%**. Sales patterns show that buttermilk experiences sharp **seasonal peaks**, particularly in summer, while dahi maintains consistent demand year-round.

Our **elasticity analysis** of buttermilk revealed that between **April 2019 and September 2022**, a **6.67% price increase** resulted in a **12.36% drop in demand** (elasticity of **-1.85**). However, from **September 2022 to February 2023**, a **25% price increase** led to a **51.43% rise in demand**, reflecting **high elasticity** (elasticity of **2.06**), likely driven by seasonal factors.

On the operations side, **water consumption dropped by 15%**, while electricity consumption remained steady, signalling room for optimization. Aligning electricity usage with production could yield further cost savings.

Katraj Dairy can leverage these insights by adopting a **dynamic pricing strategy**, particularly for buttermilk during peak seasons, improving **demand forecasting**, and optimizing **electricity consumption**. These measures will enhance profitability and operational efficiency.