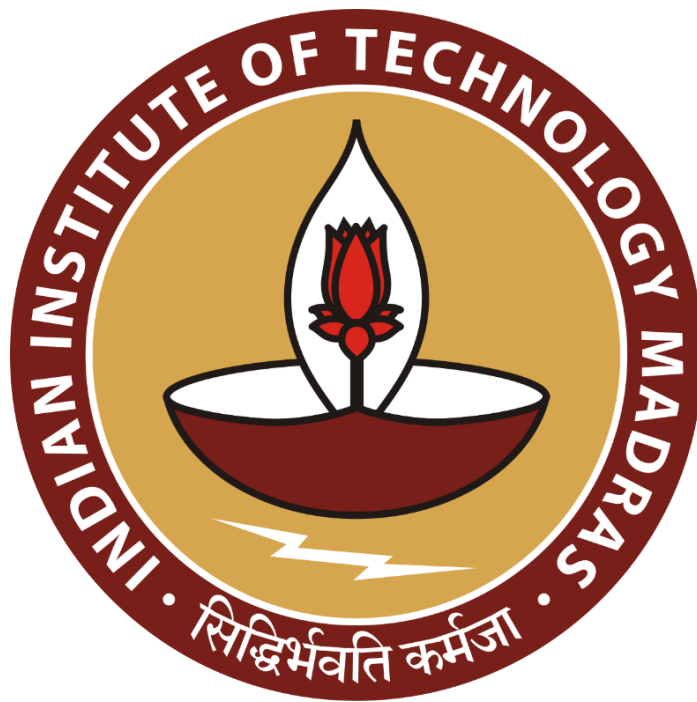# Optimizing Inventory Management of Sufal Bangla,Satlake

Final report for the BDM capstone Project

Submitted by

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Contents

1   <u>Executive Summary</u>

Sufal Bangla,Saltlake is a well-established vegetable vendor in Sector-3, Saltlake, Kolkata, known for providing fresh, high-quality vegetables sourced directly from local farmers. The store has earned a strong reputation for its commitment to quality and service, focusing primarily on vegetables to cater to its community's needs.

However, Sufal Bangla faces several significant challenges. They experience considerable waste due to the short shelf life of fresh vegetables, which impacts their profitability. Additionally, the store struggles with business expansion and securing necessary funds. The growing competition from online grocery platforms like Blinkit, which uses advanced technology and data analytics, further intensifies their challenges.

To tackle these issues, a comprehensive approach was taken. This involved a **detailed analysis** of vegetable sales, shelf life, and waste patterns to identify key areas for improvement. Furthermore, **a survey was conducted** to understand customer preferences between online and offline grocery options and their reasons for choosing them. The findings from this survey, combined with the operational analysis, provided actionable insights. Recommendations include improving inventory management, reducing waste, and adapting strategies to better compete with online platforms, aiming to boost Sufal Bangla's profitability and market position.

2 Detailed Explanation of Analysis Process/Method

2.1 Understanding the Problem Statement

The analysis begins by clearly defining the challenges faced by Sufal Bangla and establishing the objectives:

Challenges:

- **High Wastage Due to Short Shelf Life:** Fresh vegetables typically have a short shelf life, leading to significant waste. Items like leafy greens, which have a shelf life of only a few days, contribute heavily to wastage.
- **Difficulties in Scaling the Business:** Expanding the reach of Sufal Bangla involves logistical challenges, securing consistent supply chains, and managing the cost of expansion.
- **Funding and Resource Allocation:** The limited availability of funds can restrict efforts to grow the business or invest in new technology.
- **Growing Competition from Online Platforms:** E-commerce platforms like Blinkit, which offer the convenience of home delivery, are drawing customers away from traditional vegetable vendors.

Objective: The goal of this analysis is to provide actionable insights to improve Sufal Bangla's profitability and market share. This will involve:

- **Reducing Wastage:** Identifying strategies to minimize loss due to unsold vegetables.
- **Improving Operations and Supply Chain:** Optimizing inventory management, pricing, and distribution.
- **Understanding Customer Preferences:** Determining why customers might favor online platforms and how Sufal Bangla can adapt.

2.2. Data Collection and Preparation

The analysis is based on two key types of data: operational metrics and customer preferences.

Operational Data:

- **Sales and Revenue Data:** Weekly data includes:

- o **Total Sales Volume** (kg per vegetable).
- o **Revenue Generated** (total income from sales).
- o **Profit Margins** (revenue minus costs).
- **Shelf Life Data:** Data for each vegetable on average shelf life (in days).
- **Wastage Data:** The percentage of stock wasted, particularly for vegetables with a shelf life of 7 days or less.

Mathematical Data Processing:

1. **Revenue per Vegetable (R):**

$$R_i = X_i \times Q_i$$

where X_i is the price per kg and Q_i is the quantity sold of vegetable *i*.

2. **Profit per Vegetable (Π):**

$$P_i = R_i - C_i$$

where C_i is the purchase cost per kg of vegetable i.

3. **Wastage Calculation (W):**

$$W_i = Wasted\ Quantity(kg) * \frac{100}{Total\ Stock\ Purchased(kg)}$$

The operational data is stored in an Excel sheet, which is cleaned and pre-processed for outliers or missing values.

2.3. Operational Analysis

The core analysis involves assessing the operational data to uncover inefficiencies and opportunities for improvement.

Revenue vs. Sales Analysis:

- **Objective:** To assess the correlation between weekly sales and revenue.
- **Approach:** Use scatter plots and regression analysis:
  - o **Correlation Coefficient (r):**

$$r = \frac{\sum(x_i - x_{mean})(y_i - y_{mean})}{\sqrt{\sum(x_i - x_{mean})^2 \sum(y_i - y_{mean})^2}}$$

where x_i represents weekly sales volume and y_i represents weekly revenue.
  - o If r is close to +1, sales and revenue are highly correlated. If it is low, this indicates possible inefficiencies.

Pareto Analysis:

- **Objective:** Identify which vegetables contribute the most to revenue and sales.
- **Approach:** Applied the 80/20 rule:
    - Sorted vegetables by revenue and cumulative sales.
    - Visualized using a Pareto chart (cumulative percentage vs. vegetable category).
    - Identified the top 20% of vegetables that account for 80% of revenue (and similarly for sales).

Wastage Analysis:

- **Objective:** Quantify the financial impact of wastage on profitability.
- **Mathematical Model:**
    - **Wastage Cost (WC):**
      $WC_i = W_i \times X_i$, W_i is wastage and X_i is the price of the vegetable.
    - **Profit Loss due to Wastage (PL):**
      $PL = \sum WC_i$
    - Items with a high wastage percentage and low shelf life should be prioritized for strategies like better storage, discounting, or promotions.

Inventory Optimization Model:

- **Objective:** Balance inventory to minimize waste while meeting demand.
- **Mathematical Model:**
    - Used a **Linear Programming (LP)** approach:
    - **Objective Function:** Maximize profits Z.
      $Z = \sum (P_i \times Q_i) - \sum WC_i$
    - **Constraints:**
        - Stock availability.
        - Shelf life (inventory must be sold within a given timeframe).
        - Demand forecasts.

2.4. Customer Preference Survey

A structured survey is conducted to understand shopping behaviors and preferences.

Survey Structure:

- **Shopping Preferences:** Online vs. offline, criteria for choosing a platform.
- **Reason for the preference:** Price, freshness, variety, convenience, trust in local vendors.

Survey Data Analysis:

- **Quantitative Analysis:**
  - **Response Categorization:** Categorize responses based on preference (online vs. offline).
- **Qualitative Analysis:**
  - **Text Analysis:** Perform sentiment analysis on open-ended responses (e.g., why customers prefer online shopping).
  - **Thematic Analysis:** Group reasons into themes such as convenience, trust, and variety.

2.5. Integrated Analysis and Insights

The final step is to integrate the operational analysis with customer preferences, offering actionable recommendations.

Linking Operational Data and Customer Insights:

- **Sales-Wastage Relationship:** Correlate high-wastage items with customer feedback on freshness. Vegetables with high wastage might need better promotion or faster turnover.
- **Competitive Pricing:** If customers prefer online platforms due to price, Sufal Bangla might need to consider dynamic pricing or special offers.
- **Adapting Online Features:** Insights on why customers prefer online platforms can guide strategies like offering pre-cut vegetables, home delivery, or subscription models.

2.6 Integrated Recommendations:

1. **Inventory Management:** Prioritize stocking vegetables with high customer demand and low wastage risk.
2. **Promotional Strategies:** Offer discounts on perishable items nearing the end of their shelf life.
3. **Adopting Technology:** Introduce an online ordering system to capture tech-savvy customers while retaining offline trust.
4. **Expansion Strategy:** Focus on areas with high offline shopping preference while considering partnerships with e-commerce platforms.

2.7 Analysis Summary:

The detailed mathematical models and statistical techniques provide a strong foundation for making data-driven decisions:

- **Regression Analysis:** Identifies inefficiencies in sales vs. revenue.
- **Pareto Analysis:** Prioritizes key vegetables for inventory focus.
- **Linear Programming:** Optimizes inventory to reduce waste and maximize profit.

3 Results & Findings

3.1 Revenue vs. Sales Data Overview

The weekly data spanning 12 weeks serves as a foundation for understanding the correlation between sales volume and revenue.

Revenue and Sales Summary:

- **Total Revenue Across 12 Weeks:** ₹583,096

3.2 Correlation Results

A Pearson correlation coefficient of **0.558** suggests a moderate positive relationship between revenue and sales, implying that while higher sales typically result in higher revenue, other factors might be influencing profitability.
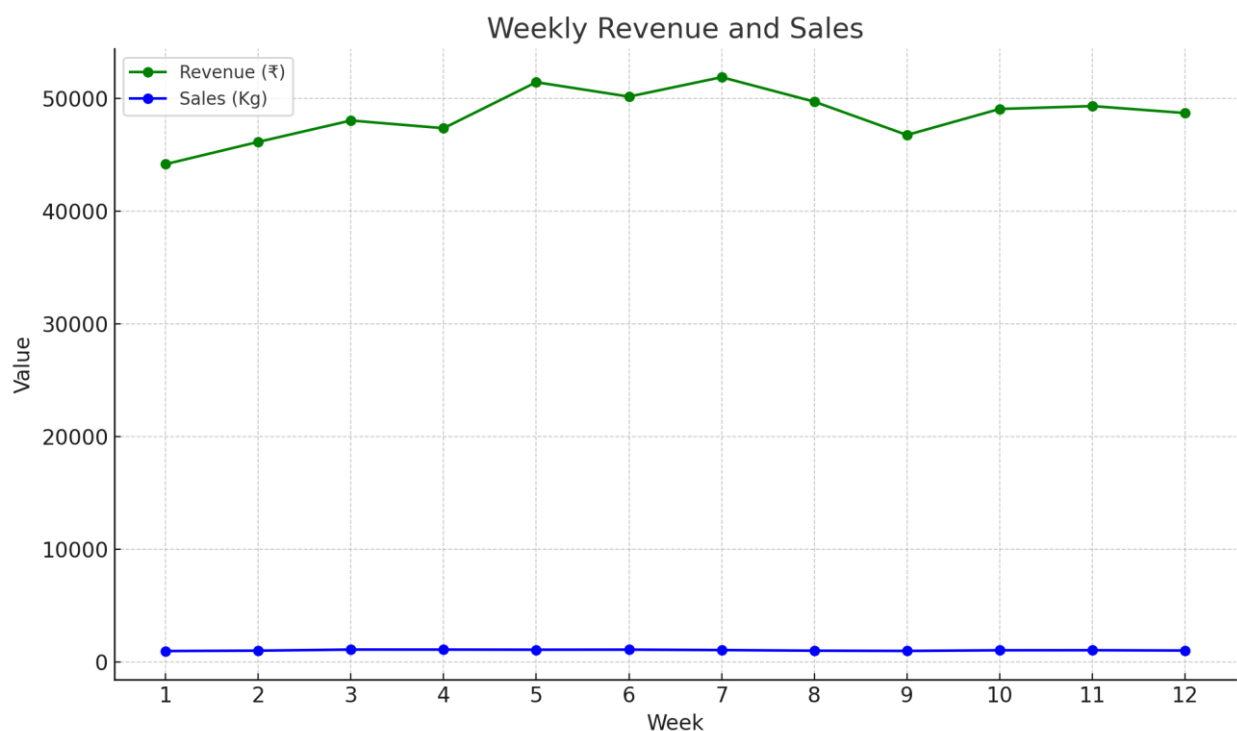

Chart 1:Above is a line chart illustrating the relationship between revenue and sales over the 12-week period

Key Insights from Revenue and Sales Patterns

- **Revenue Stability:** The revenue shows a stable trend with minor fluctuations. The peak occurs in Week 7 at ₹51,914.
- **Sales Volume:** The sales volume also remains consistent with minor increases and decreases, closely following the revenue pattern.

3.3 Identifying Key Products

A Pareto analysis was conducted to identify the top-performing vegetables in terms of revenue and sales.

Key Findings:

- **Top 20% of Vegetables Contribute:** Approximately 80% of total revenue.
- **Strategic Inventory Management:** These high-revenue items, such as potatoes, onions, and tomatoes, should be prioritized.
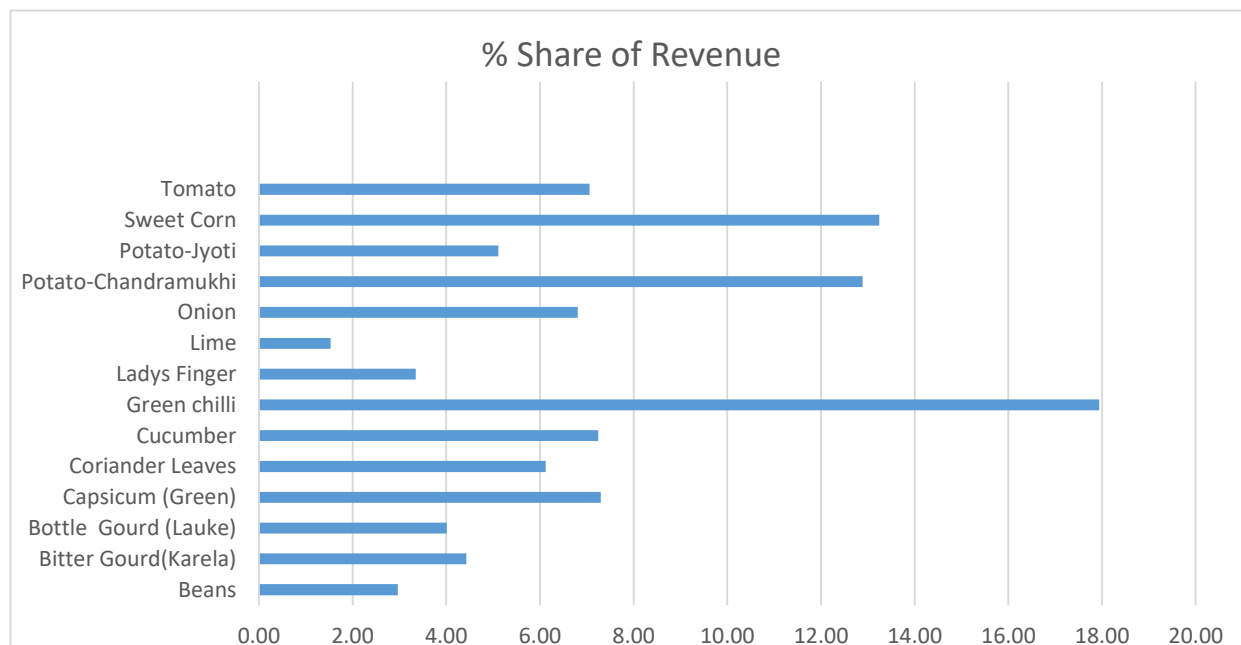

Chart 2:Above is a bar chart representing the cumulative contribution of various vegetables to total revenue

Insights:

- High revenue contributors should be stocked in larger quantities, while low performers need promotions or reduced inventory to avoid wastage.

3.4 Shelf Life Data and Wastage Findings

Wastage is a critical issue for items with a short shelf life. A detailed analysis was conducted to quantify the wastage rates and their impact on overall profitability.

Key Metrics:

- **Wastage Rate (W):** Calculated as the percentage of stock that goes unsold before spoilage.
- **Profit Loss:** Wastage leads to direct profit erosion, with leafy greens and other perishables being the primary culprits.
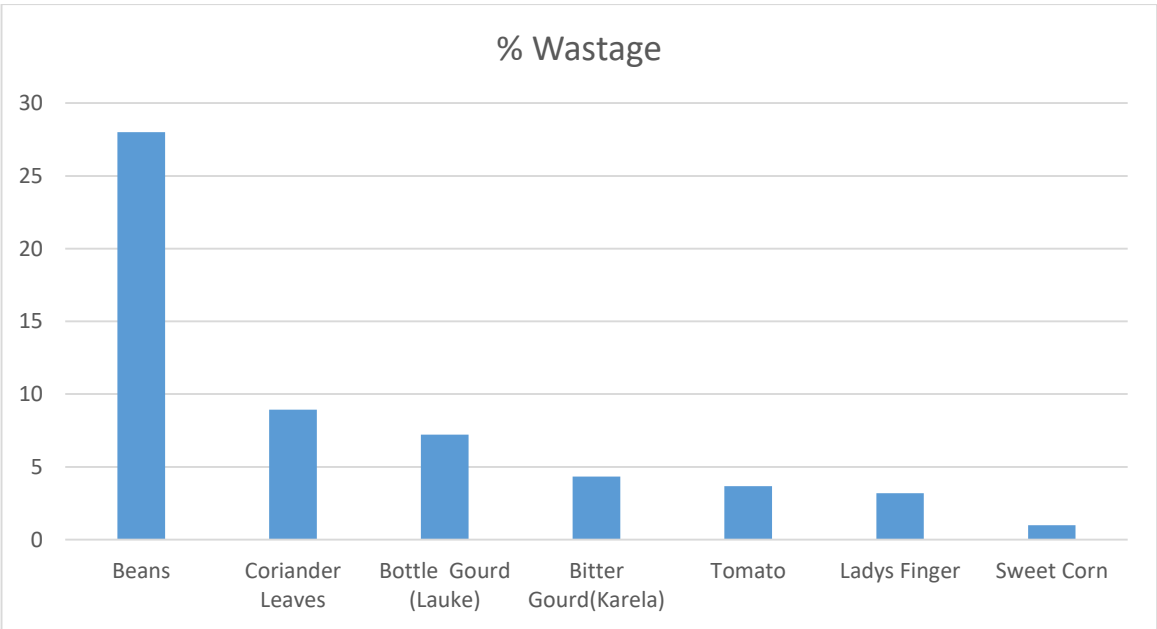

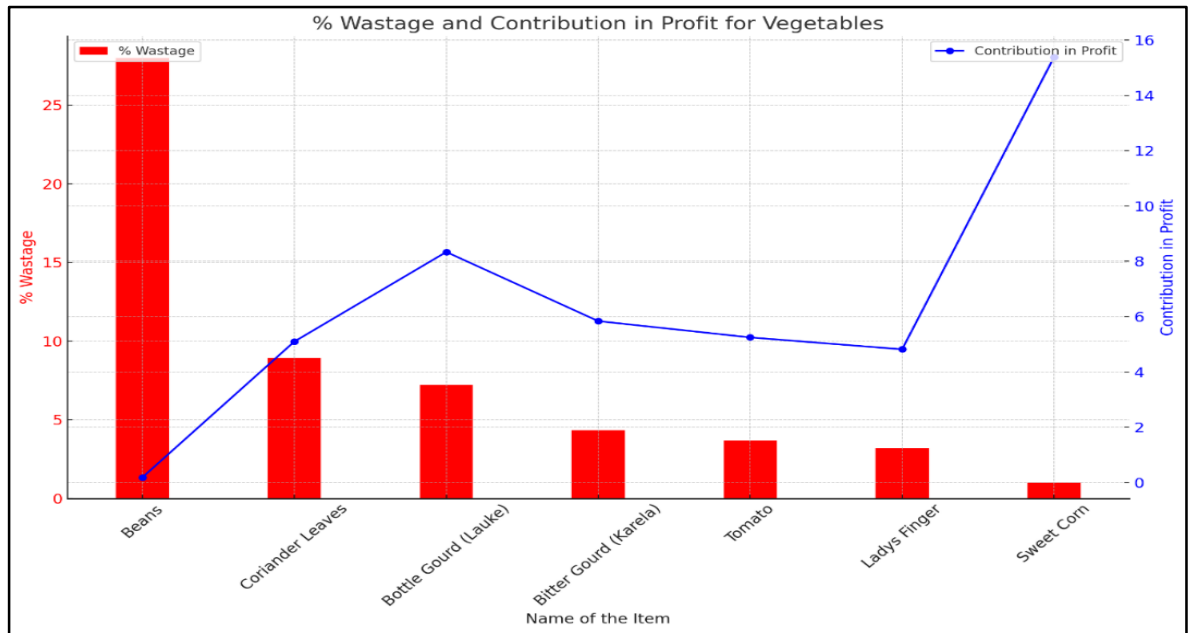*Chart 3:Above is a chart visualizing the wastage percentage across vegetables with average shelf life <= 7 days*

Chart 4:Above is a chart visualizing the wastage percentage vs Contribution to profit of vegetables with average shelf life <= 7 days

Insights:

- Items with high wastage rates should be closely monitored, with targeted promotions or dynamic pricing strategies used to reduce losses.
- Beans with high wastage has the lowest contribution in profit.

3.5 Inventory Optimization

A mathematical model using linear programming was applied to optimize inventory levels. This model considers factors like demand forecasting, shelf life, and profit margins.

Outcome:

- The model suggested reducing inventory levels for high-wastage items during low-demand weeks and reallocating resources to high-margin vegetables.

3.6 Customer Preference Survey Results

The survey responses provide insights into the purchasing behavior of customers and their reasons for choosing online platforms versus offline stores.
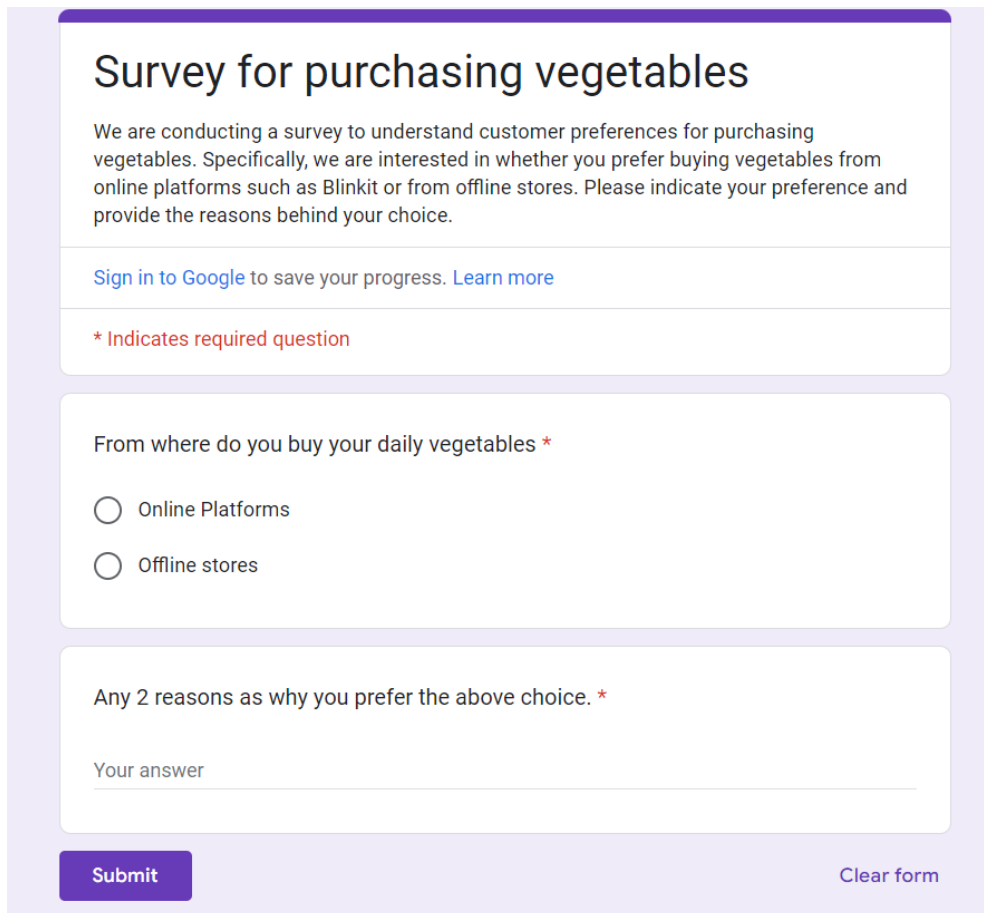

Figure 1: Google-form through which the survey was conducted

Overview of Responses

The responses indicate a near-even split between customers preferring online platforms and those sticking to offline stores. The top reasons for each choice were analyzed:

- **Online Platforms:** Home delivery, variety, and organic options.
- **Offline Stores:** Freshness, trust in local vendors, and lower prices.
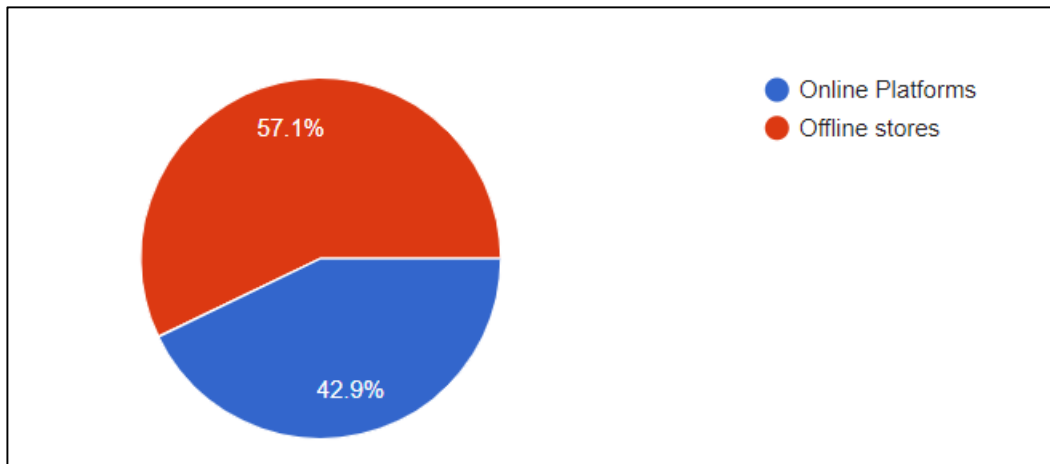
Chart 5:Above is a pie chart showing the distribution of customer preferences

Thematic Analysis of Customer Responses

- **Online Platforms:**
  - **Convenience:** Majority of online shoppers prefer platforms due to home delivery options.
  - **Product Variety:** Availability of non-seasonal and organic vegetables draws a specific customer segment.
- **Offline Stores:**
  - **Freshness and Quality:** Majority of respondents cited freshness as the primary reason for shopping offline.
  - **Price Sensitivity:** Price is a major factor, with customers mentioning lower costs compared to online options.
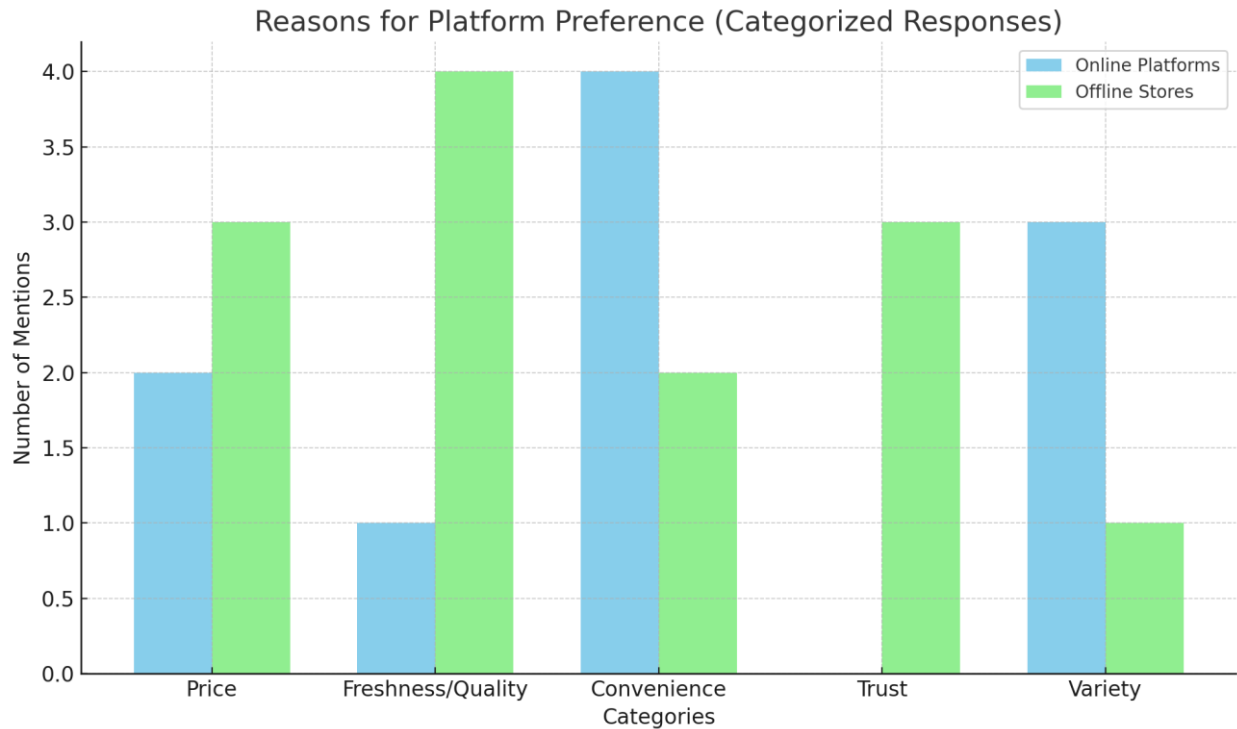
Chart 6:Above is a bar chart categorizing customer reasons based on their choice of platform

Key Insights:

1. **Price**:
   o **Offline Stores** have more mentions related to better pricing compared to Online Platforms.

2. **Freshness/Quality**:
   o Offline stores dominate in this category, highlighting that customers perceive better quality and freshness when shopping locally.

3. **Convenience**:
   o Online platforms lead here due to features like home delivery, making it a strong selling point.

4. **Trust**:
   o Trust is primarily associated with Offline Stores, where customers feel more confident about their purchases.

5. **Variety**:
   o Online Platforms are slightly ahead in offering variety, including options like cut vegetables and non-seasonal items.

4 Interpretation of Results and Recommendations

4.1 Interpretation of Results

1. **Revenue and Sales Performance Analysis**

- **Leading Revenue Contributors**:

  o **Top Revenue Generators**: Green Chili, Sweet Corn, and Potato-Chandramukhi are identified as the top revenue contributors. Green Chili and Sweet Corn not only generate substantial revenue but also reflect strong consumer preference and pricing power. Potato-Chandramukhi's significant revenue contribution underscores its market acceptance and effective pricing strategy. This performance suggests that these vegetables are crucial to the financial health of the project and should be given priority in inventory and marketing strategies.

- **Sales Volume Insights**:

  o **High Sales Leaders**: Potato-Chandramukhi and Lime stand out for their high sales volumes. The high turnover of these vegetables indicates strong consumer demand and popularity. This high sales volume can be attributed to either favorable pricing, high market need, or effective promotional strategies. It also suggests that these products have a wide consumer base and play a significant role in maintaining overall sales volume.

2. **Demand and Profitability Analysis**

- **High Demand and Efficient Products**:

  o **Profitable Vegetables**: Green Chili and Sweet Corn are not only in high demand but also exhibit low levels of wastage. This combination of high demand and low wastage implies efficient inventory management and successful demand forecasting. The low wastage rate for these vegetables suggests that they are well-received and have a consistent market demand, which enhances their profitability.

- **Discrepancies in Sales and Revenue**:

  o **High Sales but Low Revenue**: Despite their high sales volumes, Lime and Potato-Jyoti contribute less to revenue, which may be due to their lower pricing. This disparity indicates that while these vegetables are popular, their lower price points limit their

revenue potential. This could reflect a pricing strategy aimed at maximizing sales volume at the expense of revenue per unit.

- **Revenue and Sales Correlation**:

  o **Moderate Positive Correlation**: The moderate positive correlation between sales volume and revenue (Pearson coefficient of 0.558) suggests that while increased sales generally lead to higher revenue, the relationship is influenced by other factors. This implies that while boosting sales volume can enhance revenue, it is not a guaranteed one-to-one increase, and other factors such as pricing, market conditions, and product mix also play a significant role.

3. **Wastage and Profitability Insights**

- **Impact of Wastage**:

  o **Wastage Concerns**: The analysis reveals that high wastage rates, particularly for items with short shelf lives like leafy greens, are a significant concern. Wastage directly affects profitability by eroding potential revenue and increasing operational costs. High wastage can also signal issues with demand forecasting and inventory management.

- **Inventory Optimization**:

  o **Efficient Stock Management**: The inventory optimization analysis suggests that adjusting inventory levels based on demand forecasts and shelf life is crucial for reducing wastage. By aligning stock levels with anticipated demand and managing perishable items more effectively, the project can improve profitability and minimize losses due to spoilage.

4. **Customer Preference Insights**

- **Survey Results Overview**:

  o **Online vs. Offline Preferences**: The survey results indicate a near-even split between customers preferring online platforms and those favoring offline stores. Online shoppers value the <u>convenience of home delivery and cut vegetables</u>. In contrast, offline shoppers prioritize freshness, trust in local vendors, and lower prices, which are perceived benefits of physical stores.

- **Consumer Behavior Patterns**:

  - **Online Shoppers**: Convenience is a significant factor driving online shopping, with 71% of respondents favoring home delivery ,cut options and product variety. This insight suggests that enhancing the online shopping experience, including delivery efficiency and product range, could further capture and retain online consumers.
  - **Offline Shoppers**: For offline shoppers, freshness and price sensitivity are paramount, with 62% of respondents citing these factors as primary reasons for shopping in physical stores. Emphasizing product quality and competitive pricing in offline stores can attract and retain this customer segment.

4.2 Recommendations

1. **Enhance Focus on High-Revenue Vegetables**

   Strategic Prioritization:

   - **Inventory Management**: Given the strong revenue performance of Green Chili, Sweet Corn, and Potato-Chandramukhi, prioritize these vegetables in inventory management. Ensuring optimal stock levels of these high-revenue items can prevent stockouts and meet customer demand effectively.
   - **Marketing Strategies**: Implement targeted marketing and promotional strategies to boost visibility and sales of these top-performing vegetables. Highlight their unique qualities and benefits to attract more customers and reinforce their market position.

   Justification:

   - **Revenue Contribution**: The high revenue contribution of these vegetables underscores their importance to the project's financial success. By focusing on these key products, the project can enhance profitability and maintain a strong market presence.

2. **Optimize Pricing for High Sales Vegetables**

   Adjust Pricing Strategies:

   - **Revenue Enhancement**: For vegetables with high sales volumes, such as Potato-Jyoti and Lime, review and adjust pricing strategies to increase revenue per unit. Explore options for implementing tiered pricing, promotional discounts, or bundling with higher-priced items to boost overall revenue.

Justification:

- o **Sales vs. Revenue**: The discrepancy between high sales volumes and lower revenue highlights the need for pricing adjustments. By optimizing pricing strategies, the project can improve revenue without significantly impacting sales volume.

3. **Capitalize on High-Demand, Low-Wastage Vegetables**

Support and Expansion:

- o **Market Expansion**: For vegetables like Green Chili and Sweet Corn, which are both in high demand and exhibit low wastage, focus on expanding their market presence. Consider increasing distribution channels, enhancing product visibility, and exploring new market segments to capitalize on their profitability.

Justification:

- o **Efficiency and Profitability**: The low wastage rates and high demand for these vegetables indicate efficient inventory management and strong market appeal. Expanding their market presence can further enhance profitability and support overall project success.

4. **Address Wastage and Inventory Management**

Wastage Reduction:

- o **Promotional and Pricing Strategies**: Implement targeted promotions or dynamic pricing strategies to manage high-wastage items more effectively. Reducing wastage through strategic promotions can help minimize losses and improve overall profitability.

Justification:

- o **Impact on Profitability**: Addressing wastage and optimizing inventory levels directly impacts profitability by reducing losses and improving stock management. Efficient inventory practices are crucial for maintaining financial health and operational effectiveness.

5. **Enhance Customer Experience Based on Preferences**

Home delivery and Cut-Vegetable options: For offline stores, offering higher-priced cut vegetable options can attract customers seeking convenience and quality, potentially increasing sales and revenue. Additionally, expanding home delivery services to nearby residential complexes can boost sales by catering to customers who prefer the convenience of having fresh produce delivered directly to their doorstep.

Justification:

o **Customer Satisfaction**: Tailoring offerings to customer preferences can enhance satisfaction and loyalty. By aligning product and service features with consumer expectations, the project can improve market competitiveness and drive sales.

As instructed by TA from mid-term report comments:

➢ **I have added the solution to problem 2 &3 : Refer point 3&5 from Recommendations.**

➢ **I have used the following data for analysis-: Link to the data-**Data for BDM Project

➢ **Here is the link to survey data collected: Data of Survey(Although the responses were less but it helped me get into a conclusion).**

THANKS A LOT.