Enhancing Sales Strategy at Subhash General Stores in Changing Market Dynamics.

End-Term Submission for the BDM Capstone Project

Submitted by

Name: G.Ravi Teja

Roll number: 21f1005274

IITM Online BS Degree Program, Indian Institute of Technology, Madras, Chennai

Contents

Executive Summary

The Final Report of this capstone project shows the detailed analysis, results and insights into the problems of Subhash General Stores, which is a well-established fertilizer shop, that sells fertilizers for farmers and gardeners.

This report provides the deeper understanding to tackle the major problems faced by organization such as To Analyze customer buying behavior and preferences to understand their fertilizer purchasing patterns,To Identify potential opportunities for targeted marketing, To Develop a data-driven sales strategy for better management of the inventory.

The solutions for these problems are addressed by using the data-driven plots which gave insights and more understanding into the data, Excel is used for Data acquisition, and pandas for data cleaning, data aggregation and data extraction, and matplotlib for the data visulization.

The Recommendations are formulated based on the observations from the plots for each problem, which has enabled me to conclude the expected outcomes of the capstone project, by identifying the customer preferences, by enabling the targeted marketing and optimizing the inventory management.,

Detailed Explanation of Analysis Process

Data Preparation

The Subhash General Stores maintained Stock Books which has the inventory data and the bill books which have the sales data. The Stock Books are structured and the bill books are unstructured. So I Started the data preparation by taking the pictures of all the available data for the financial year 22, and financial year of 23 upto october. And I manually entered all the data to excel, which needed a lot of time as frequently as to clarify the names of the villages.

Data Cleaning

Once the data is entered into the excel, I used python pandas library for data cleaning, data manipulation, and matplotlib library for data visualization. Imported the data to jupyter notebook using pandas. Then observed some typing errors in dates, and duplications in

customer names and village names like (Chirala, chirala), which were cleaned using pandas.

Upon Entire Data Cleaning, Here is a sample of the Inventory Data - Extracted from Stock Books. Which has product name, Supplier name, Packing (in Kgs), Info Date, Opening Balance (in Kgs), Received Product amount today (in Kgs), Total Opening Balance (in Kgs), Sales Today (in Kgs), Closing Balance (in Kgs).

	Product Name	Supplier	Packaging	Info Date	Opening Bal	Received Today	Total Opening Bal	Sales Today	Closing Bal
0	Urea-46%N	NFCL	45.0	2023-04-01	2700	0	2700	0	2700
1	Urea-46%N	NFCL	45.0	2023-04-28	2700	0	2700	270	2430
2	Urea-46%N	NFCL	45.0	2023-05-04	2430	0	2430	270	2160
3	Urea-46%N	NFCL	45.0	2023-05-20	2160	0	2160	90	2070
4	Urea-46%N	NFCL	45.0	2023-05-23	2070	0	2070	45	2025

Here is a sample of the Sales Data - Extracted from Bill Books. Which has the Customer name, Village name, Purchase Date, Items Bough, Weight of the item (in Kgs), Selling Rate (in Rs.), Quantity (according to the mentioned weight), Total amount of purchase.

	Customer Name	Village	Purchase Date	Items Bought	Weight of Item	Selling Rate	Quantity	Amount
0	P Phanidhar	Gavinivaripalam	2023-07-12	Calcium Nitrate	25.0	1650	2	3300
1	S Rama Ravi	Motu Palle	2023-07-12	Gromor 14-35-14	50.0	1500	3	4500
2	B Srinu	Boinivaripalam	2023-07-12	Calcium Nitrate	1.0	105	15	1575
3	D Subharao	Vetapalam	2023-07-12	PN 13-0-45	1.0	150	10	1500
4	M Chandra Reddy	Chirala	2023-07-12	Super Phosphate-G	50.0	430	1	430

Data Extraction

Once the data is ready for analysis, I started with extracting a quantity column for the Inventory data, as we can see the data can be more comparable if we have the products sold in a day in terms of quantity rather than packaging which will be varying for each product.

1) Obtained the Sales Quantity by using the Sales and the Packaging (Used Pandas),
Sales Quantity = Sales Today / Packaging

2) Then I had the prices sheet, which contained the Average Selling price, Average Purchase Price of a product, which was provided by the owner. Hence, Mapped those values to the Inventory data by creating two columns for Average Selling price and Average Purchase price (Used Pandas map feature).

3) By Using the Selling Price and the Sales Quantity, Obtained the Revenue for each day. And Revenue of each day can be summed up to get the total revenue.

*Revenue = Selling Price * Sales Quantity*

4) Similarly like the Revenue, Expenditure is also calculated using the Purchase Price and the sales quantity, the owner has provided average purchase price for an unit quantity, Hence the expenditure is calculate based on the sales quantity.

*Expenditure = Purchase Price * Sales Quantity*

5) Then Calculated the Profits for each product on each date, which is be summed up to get the total profits.

Profits = Revenue - Expenditure

Here is the sample of the Final Inventory Data (one more column with product name).

Supplier	Packaging	Info Date	Opening Bal	Received Today	Total Opening Bal	Sales Today	Closing Bal	Purchase_Qu	Sales_Qu	Avg_selling	Avg_purchase	Revenue	Spendings	Profits
NFCL	45.0	2023-04-01	2700	0	2700	0.0	2700.0	0.0	0.0	266	250	0.0	0.0	0.0
NFCL	45.0	2023-04-28	2700	0	2700	270.0	2430.0	0.0	6.0	266	250	1596.0	1500.0	96.0
NFCL	45.0	2023-05-04	2430	0	2430	270.0	2160.0	0.0	6.0	266	250	1596.0	1500.0	96.0
NFCL	45.0	2023-05-20	2160	0	2160	90.0	2070.0	0.0	2.0	266	250	532.0	500.0	32.0
NFCL	45.0	2023-05-23	2070	0	2070	45.0	2025.0	0.0	1.0	266	250	266.0	250.0	16.0

Problem Analysis

To Proceed with the analysis, Let's first take a look at the task at hand for this project, they are as follows:

1. To Analyze customer buying behavior and preferences to understand their fertilizer purchasing patterns.
2. To Identify potential opportunities for targeted marketing.
3. To Develop a data-driven sales strategy for better management of the inventory.

Analyze Customer Buying Behavior and Preferences

To tackle this, I need to identify the popular products or the most purchased products. So to find that I started off with the inventory data, I grouped the products based on the product name and calculated the sum of the sales quantity for each product, popularity depends on the quantity purchased rather than the Revenue or profits, hence grouped the sales Quantity.

From that I was able to figure out the top 10 most purchased products over the past 1.5 years. But Considering the fact that this business is a seasonal business which highly depends on the rains and climate conditions over the year, it is suggested to check the seasonal preferences. Hence, there is a need for another column referring the seasons, and added the year and financial year columns as well.

So Using Pandas, Extracted the month and year as separate columns using the Info Date column, and from that extracted the Seasons Column based on the following order, such as Winter: 1,2,3 months; Summer: 4,5,6 months; Monsoon: 7,8,9 months; Post-monsoon: 10,11,12 months. For each season, I grouped the Products and took the sum of the quantity sold, and plotted them in a horizontal bar plot for each season for clear visualization.

Through this approach, Obtained the popular products / Product preferences for each season. To get a deeper look into the buying patterns over seasons, plotted the Revenue over the financial year 2022 to observe the Revenue trend throughout the seasons.

Info Date	Opening Bal	Received Today	Total Opening Bal	Sales Today	Closing Bal	Sales_Qu	Avg_selling	Avg_purchase	Revenue	Spendings	Profits	year	month	Season	fyear
2023-04-01	2700	0	2700	0.0	2700.0	0.0	266	240	0.0	0.0	0.0	2023	4	Summer	F23
2023-04-28	2700	0	2700	270.0	2430.0	6.0	266	240	1596.0	1440.0	156.0	2023	4	Summer	F23
2023-05-04	2430	0	2430	270.0	2160.0	6.0	266	240	1596.0	1440.0	156.0	2023	5	Summer	F23
2023-05-20	2160	0	2160	90.0	2070.0	2.0	266	240	532.0	480.0	52.0	2023	5	Summer	F23

Identity Potential Opportunities for Targeted Marketing

To Implement targeted marketing, First I used the Sales data to observe the villages that make most purchases from the shop often, it is obtained by grouping the Villages in Sales data and taking the sum of the Quantity field.

Once I get the Order of Villages that make most purchases, I Considered the top 10 Villages, and grouped the Products and took the sum of the Quantity Sold for each product in these villages, and plotted them in a horizontal bar plot for each village.

Through this approach, Observed the Product preferences for each village, which can be used for targeted marketing.

Data-Driven Strategy for better Inventory Management

As per the discussion with the owner, it was said that there was often cases of zero stock for the products during the peak season times. So once I observe the product preferences, had targeted the inventory management to make sure that the top products are available at any point of time.

Calculating the Re-order point for the products

Re-order point is a statistical measure that tells us the inventory level at which a new order should be placed to avoid the stock outs. Hence it will be calculated for all the products. To approach First i created a new table/dataframe for products which contains the Product name column, Avg_sales_quantity column. Average sales quantity is taken from the inventory data by taking the average of all the sales quantity for each product and mapped to the products dataframe. Owner has told that it will take utmost 5 days to receive the stock after ordering, so the lead time is 5. And I have the Avg Sales Quantity. Now, I should calculate the demand during lead time (DDLT). Safety Stock, A buffer stock to account for uncertainnties in demand and leadtime.

$$DDLT = Average\ Sales\ Quantity \times Lead\ Time$$
$$Safety\ Stock = DDLT \times Safety\ Stock\ Percentage$$
$$ROP = DDLT + Safety\ Stock$$

Through this approach, I Calculated the Re-order point for each product, which can be used for better inventory management.

Results and Findings

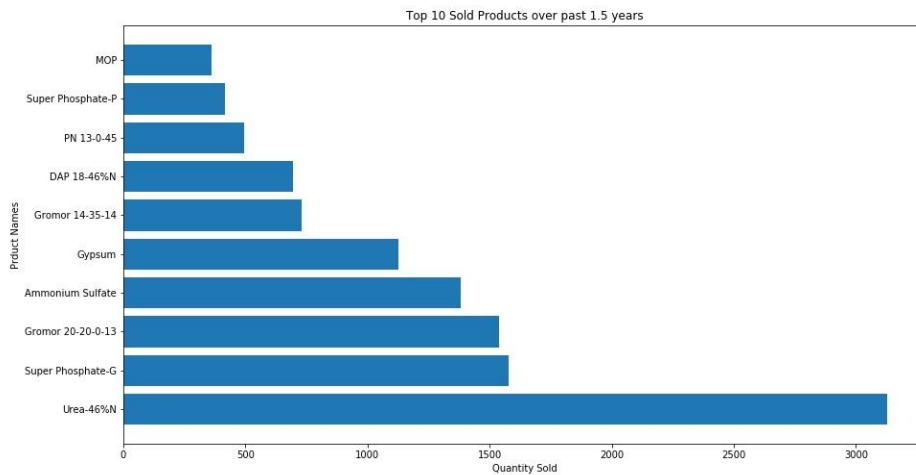## 1. Results and Findings on Analyzing Customer Buying Behavior and Preferences

Fig 1.1 Top 10 Sold Product Preferences over past 1.5 years

On observing the buying pattern over past 1.5 years, it is observed that Urea-46%N is the most purchased product, and the top 10 are as follows 'Urea-46%N', 'Super Phosphate-G', 'Gromor 20-20-0-13', 'Ammonium Sulfate', 'Gypsum', 'Gromor 14-35-14', 'DAP 18-46%N', 'PN 13-0-45', 'Super Phosphate-P', 'MOP'. This information can be used for marketing.
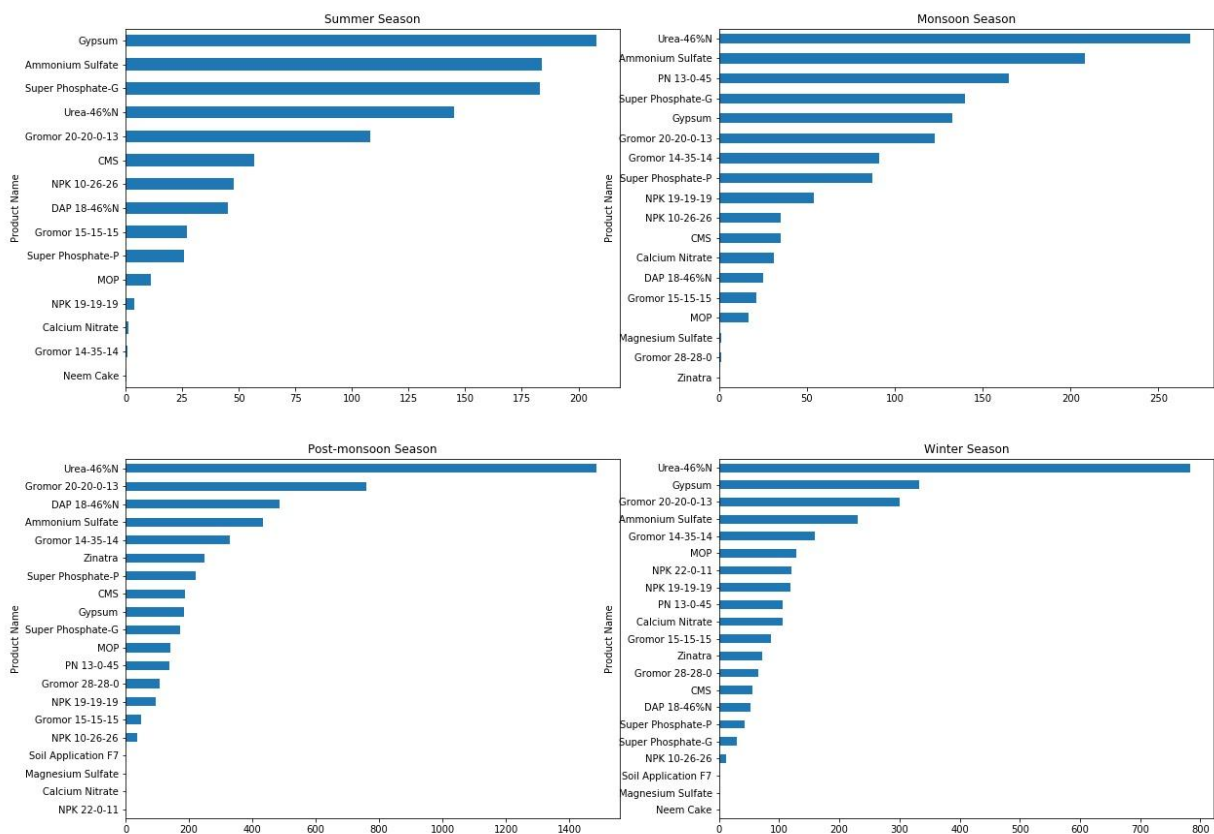
Fig 1.2 Product Preferences Based on the Season for the Financial year 2022

On Observing the above plot of products vs quantity sold for various seasons, it gives insights into the Product preferences based on seasons, Even though Urea-46%N is most selling product overall, It is clear that it is not the most selling product in the summer season! And in Summer, the most selling products are the Gypsum, Ammonium Sulphate and Super phosphate-G.
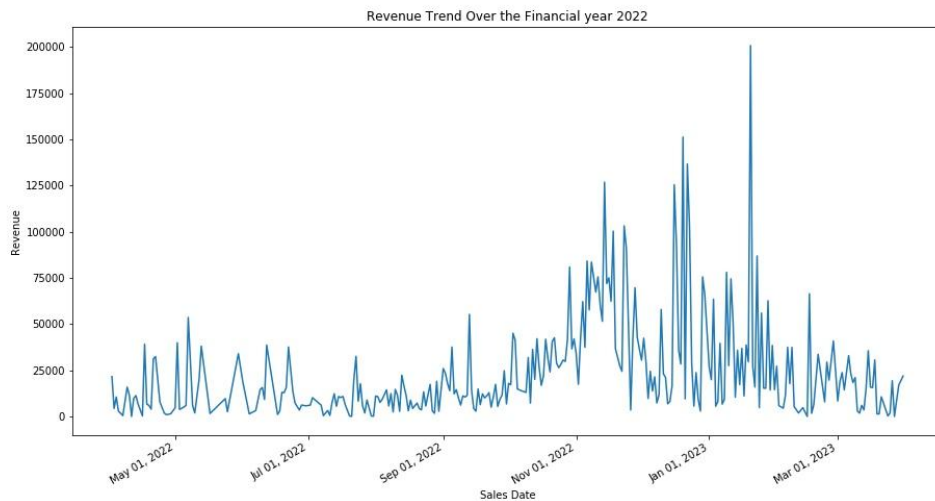

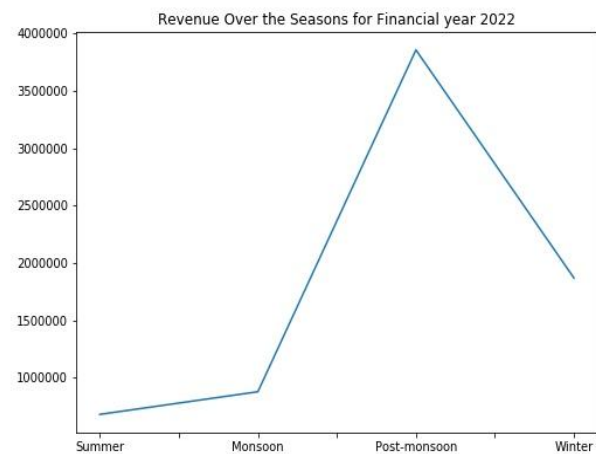Fig 1.3 Revenue Trend over the Financial year 2022   Fig1.4 Revenue over Seasons

Here are the sales from Financial year 2022, Monsoon: Rs.878490.40, Post-monsoon: Rs.3855250.20, Summer: Rs.681112.85, Winter: Rs.1868756.35.

These plots gives an Understanding on the Sesonal behaviour that the sales reasonably good at the start of an year which is winter season (Jan), and will be stable until the start of summer(April), and the sales lay low in Summer and to the mid of monsoon, and they starts to rise from mid of monsoon (August), and have exceptionally good sales in Post-monsoon (Oct-Dec).

2. Results and Findings on Identifying the Opportunities for Targeted Marketing Target Based on the Villages
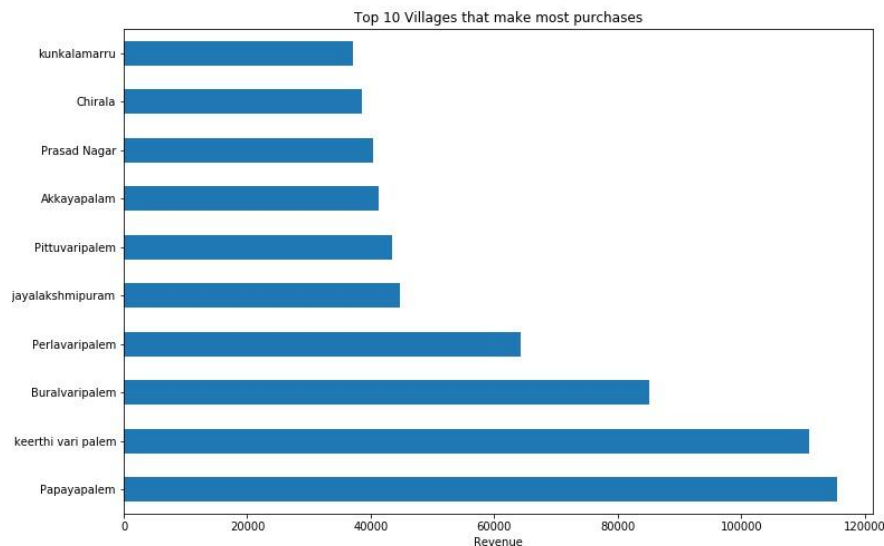
The top 10 Villages that make the most purchases are 'Papayapalem', 'keerthi vari palem', 'Buralvaripalem', 'Perlavaripalem', 'Vijayalakshmipuram', 'Pittuvaripalem', 'Akkayapalam', 'Prasad Nagar', 'Chirala', 'kunkalamarru', which are as shown in the above Plot (Fig 2.1).

This gives an idea on the Valuable customers to the shop. And to target these customers, we need the product preferences from each village, which is plotted below, Products vs Revenue.
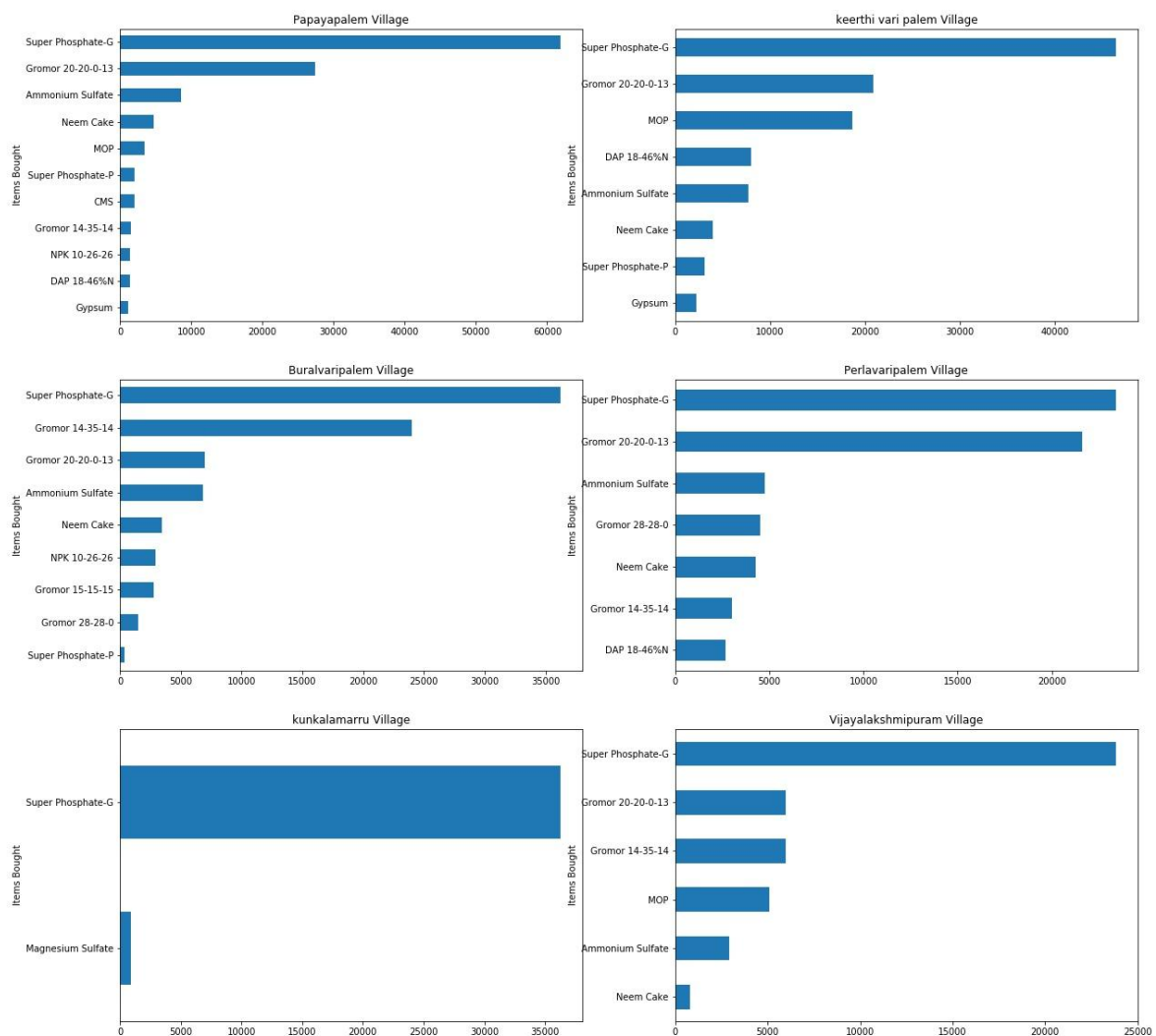

Fig 2.2 Product Preferences for the top 4 villages that make most purchases from the shop
The way a fertilizer work can vary based on the areas' soil/climate conditions. In that case, We can see that Burlavaripalem village are keen to use Gromor 14-35-14, while the other villages use Gromor 20-20-0-13. And Kunkalamaru Village can be planned to introduce with the new Products rather than sticking to only Super Phosphate G. This understanding can be used to marketize the product for the customers from these villages.
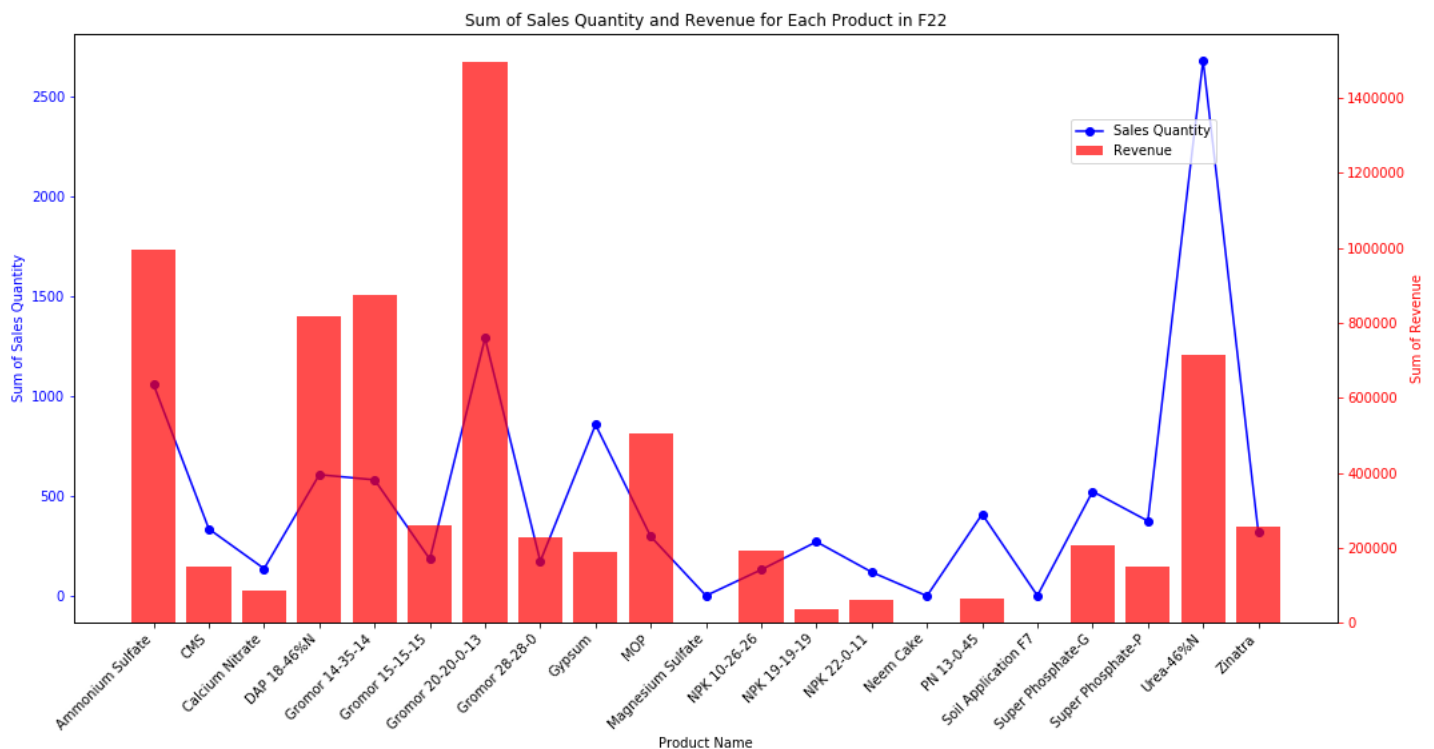
Target Based on the Products

Fig 2.3 Sum of Sales Quantity and Revenue for Each product in the financial year 2022

From this plot, Observed that,

1. Even though Urea has high Sales Quantity, It's revenue is not that high, where as Gromor 20-20-0-13 has less sales quantity compared to Urea, but still it generates very high Revenue.

2. The products that give high Revenue even with less sales units are as follows, Ammonium Sulfate, DAP 18-46%N, Gromor 14-35-14, Gromor 20-20-01-13, and MOP.

3. The products that give low revenue even with selling high no of quantities are as follows Urea-46%N, Gypsum, PN 13–0-45, Super Phosphate-G and Super Phosphate P.

4. The Revenue is very very low for products such as Neem Cake, Magnesium Sulfate, NPK 19-19-19, Neem Cake, and F7.
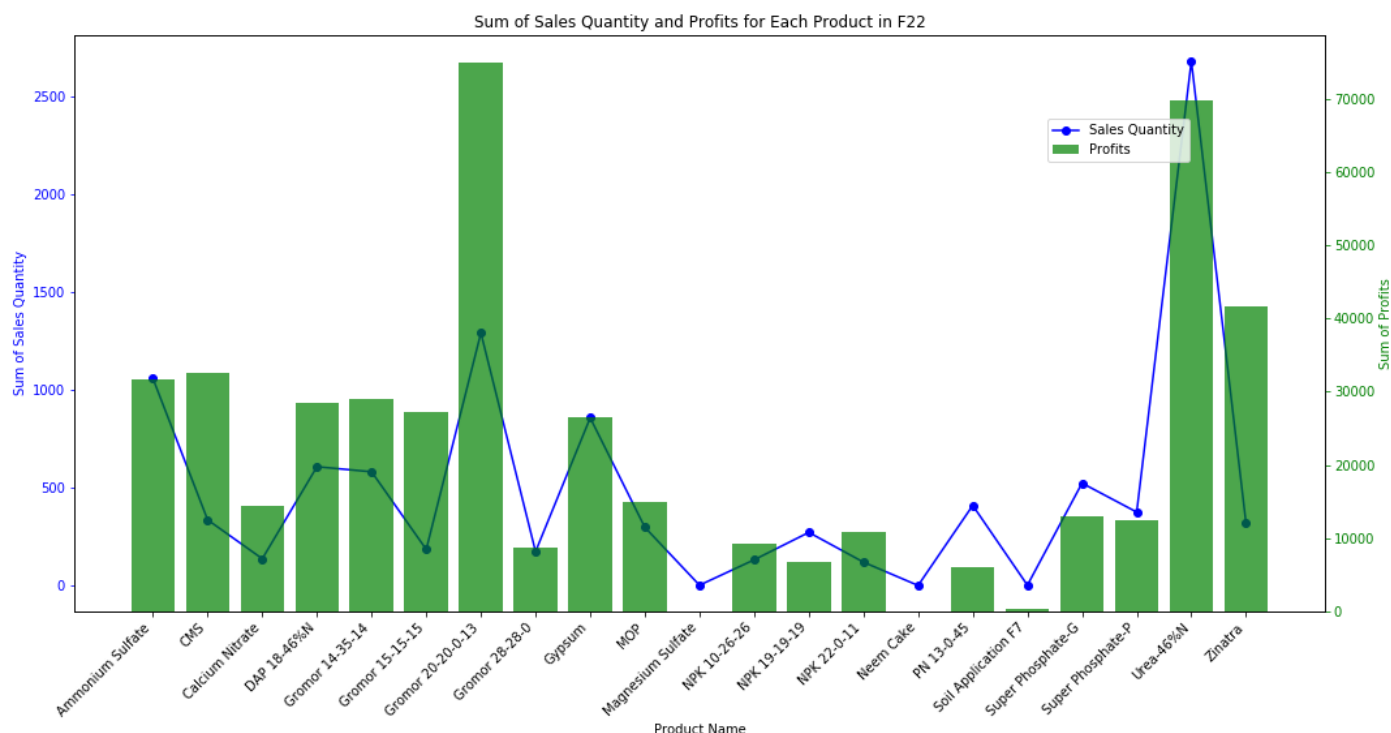
Fig 2.4 Sum of Sales Quantity and Profits for Each product in the financial year 2022

From this plot, Observed that,

1. Even though the Revenue is low for Urea-46%N, the profits are very high and also for the Gromor 20-20-0-13 the profits are very high.

2. From this image, observed the top 10 profitable products as 'Gromor 20-20-0-13', 'Urea-46%N', 'Zinatra', 'CMS', 'Ammonium Sulfate', ''Gromor 14-35-14', 'DAP 18-46%N', 'Gromor 15-15-15', 'Gypsum', 'MOP'.

3. The least profitable products are Neem cake, Magnesium Sulfate and Soil Application F7.

4. This Plots gives understanding which products to marketize more and which products reduces the spendings.

```
Product Name
Gromor 20-20-0-13      74936.0
Urea-46%N              69732.0
Zinatra                41600.0
CMS                    32592.0
Ammonium Sulfate       31740.0
Gromor 14-35-14        29100.0
DAP 18-46%N            28576.0
Gromor 15-15-15        27195.0
Gypsum                 26598.0
MOP                    14900.0
Calcium Nitrate        14427.0
Super Phosphate-G      13100.0
Super Phosphate-P      12408.0
NPK 22-0-11            10800.0
NPK 10-26-26            9240.0
Gromor 28-28-0          8700.0
NPK 19-19-19            6800.0
PN 13-0-45              6150.0
Soil Application F7      330.0
Magnesium Sulfate        100.0
Neem Cake                 13.8
Name: Profits, dtype: float64
```

3. Results and Findings on Inventory Management

	Products	Avg_sales	DDLT	Safety Stock	ROP	Avg_Opening_Units
0	Urea-46%N	8	44	8	53	115
1	DAP 18-46%N	4	22	4	27	57
2	MOP	3	18	3	22	56
3	Super Phosphate-P	7	35	7	42	72
4	Super Phosphate-G	7	39	7	47	81
5	Gypsum	14	70	14	84	179
6	Ammonium Sulfate	5	25	5	30	170
7	Gromor 15-15-15	2	12	2	14	35
8	CMS	6	30	6	36	55
9	Calcium Nitrate	7	36	7	43	25
10	Gromor 28-28-0	3	15	3	18	26
11	Gromor 14-35-14	4	20	4	24	66
12	NPK 10-26-26	2	12	2	15	29
13	Gromor 20-20-0-13	4	21	4	25	58
14	Soil Application F7	0	3	0	4	1
15	PN 13-0-45	14	73	14	87	68
16	NPK 19-19-19	8	41	8	49	85
17	Neem Cake	0	0	0	1	0
18	Zinatra	21	106	21	127	230
19	Magnesium Sulfate	0	1	0	1	0
20	NPK 22-0-11	7	37	7	45	49

Based on the formulas provided before, Calculated the Avg sales per day, and Demand During the Lead time, Safety stock with Safety stock percentage of 0.2, and then the Reorder point.

By doing so, I got the Reorder points as follows, So when the Daily Stock reaches to the Re-order point limit, it is advised to make an re-order for the particular stock.
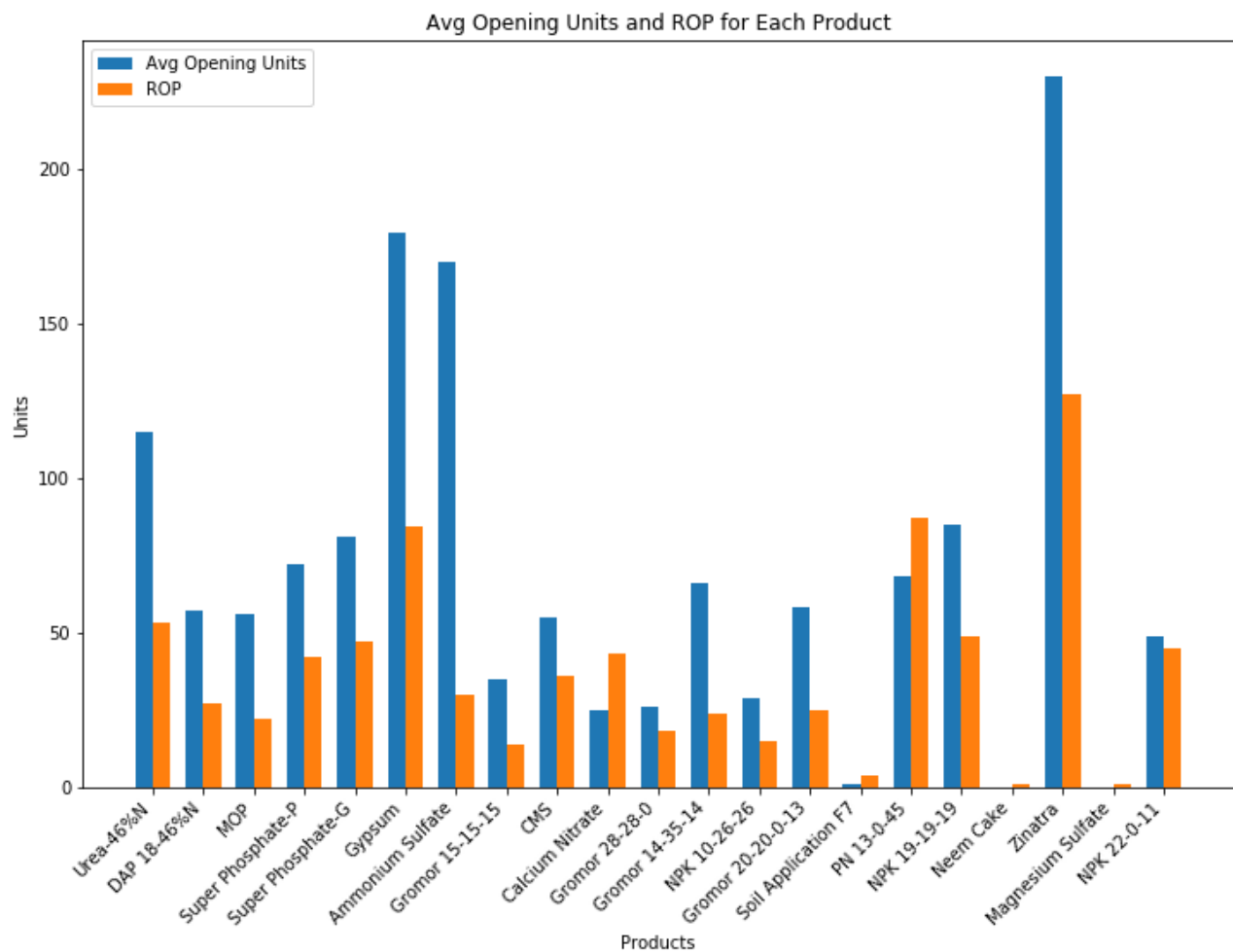
Fig 2.5 Average Opening Units for the products and the Re-order point.

1. In most cases, the average opening units are higher than the re-order point, however there will be edge cases of opening units going down the rop and in such cases, it should be order immediately to avoid stockout.

2. There are certain products where average opening unit is clearly less than or close to the ROP, they are as follows Gromor 15-15-15, CMS, Calcium Nitrate, Gromor 28-28-0, NPK 10-26-26, Soil Application F7, PN 13-0-45, NPK 22-0-11.

3. By Taking the ROP, Further calculated the count of number of times the stock has gone below ROP, and they are as follows 'Urea-46%N': 10, 'DAP 18-46%N': 3, 'MOP': 2, 'Gromor 15-15-15': 2, 'CMS': 1, 'Calcium Nitrate': 14, 'Gromor 28-28-0': 3, 'Gromor 14-35-14': 2, 'NPK 10-26-26': 1, 'Gromor 20-20-0-13': 4, 'Soil Application F7': 1, 'PN 13-0-45': 23, 'NPK 19-19-19': 7, 'Zinatra': 15, 'NPK 22-0-11': 1. They all seem to be very low count, and gives clarity on which products to focus for re-order.
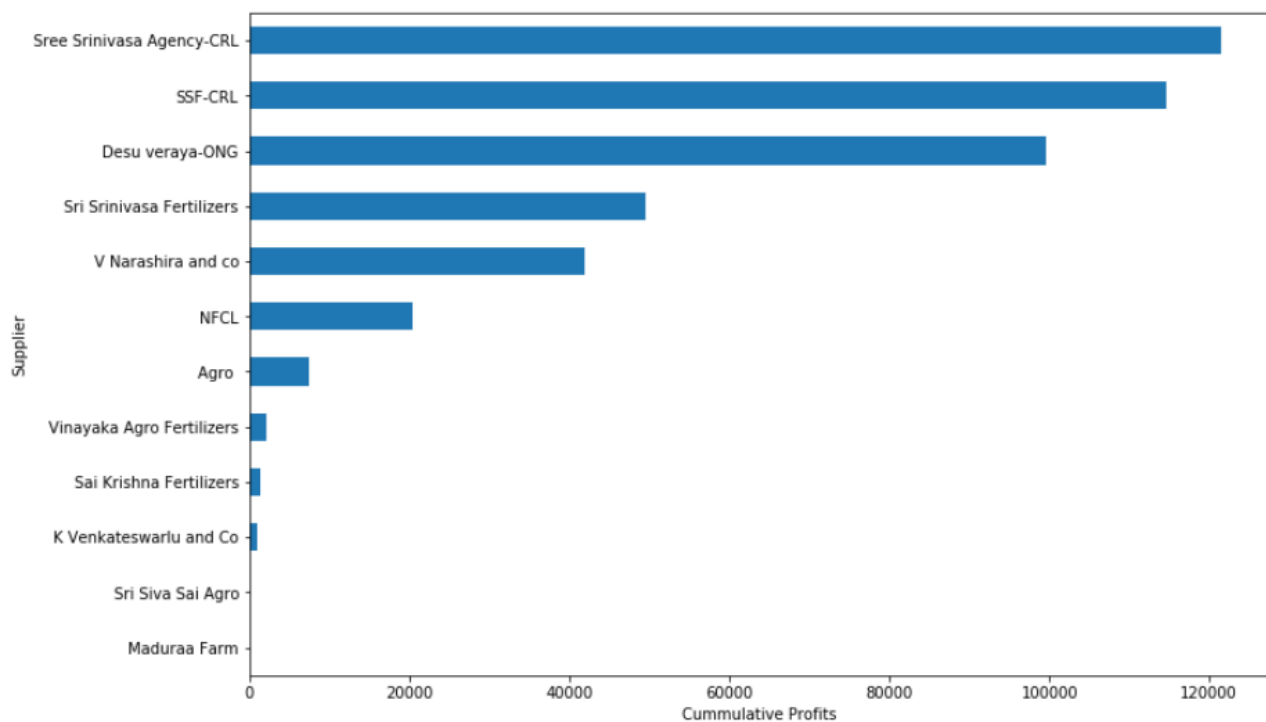
Fig 2.6 Cummulative Profits for the Financial Year 2022 based on the Suppliers.

```
Supplier
Sree Srinivasa Agency-CRL      121414.0
SSF-CRL                        114546.0
Desu veraya-ONG                 99581.0
Sri Srinivasa Fertilizers       49432.0
V Narashira and co              41930.0
NFCL                            20306.0
Agro                             7375.0
Vinayaka Agro Fertilizers        2112.0
Sai Krishna Fertilizers          1400.0
K Venkateswarlu and Co            928.0
Sri Siva Sai Agro                  13.8
Maduraa Farm                        0.0
Name: Profits, dtype: float64
```

1. This plot shows that the most profitable suppliers are Sree Srinivasa Agency, SSF CRL, Desu Veraya-ONG.

2. The least profitable suppliers are Maduraa Farm, Sri siva sai Agro, K Venkateswarly and Co, Sai Krishna Fertilizers, and Vinayaka Agro Fertilizers.

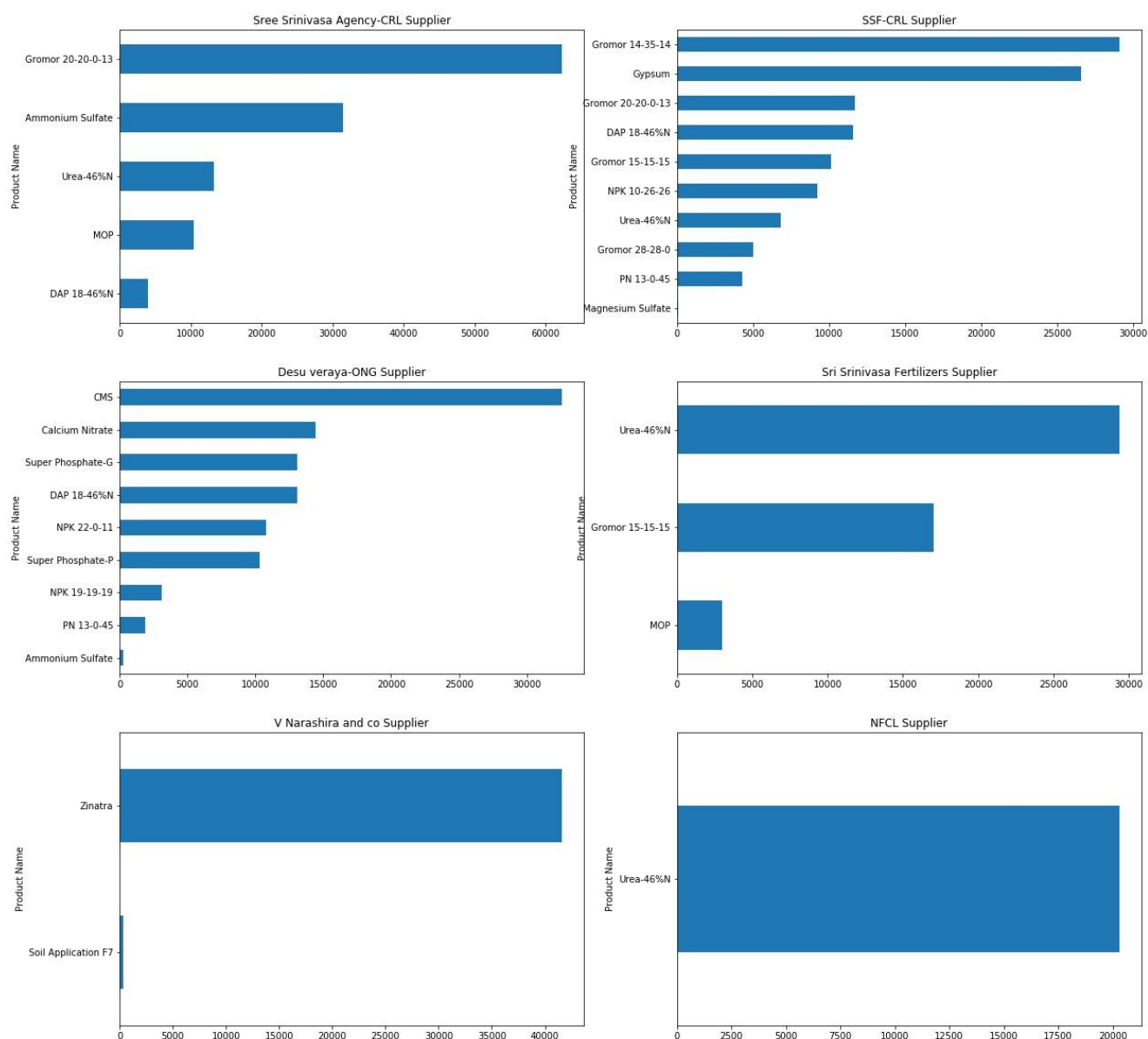3. This gives understanding on which suppliers to choose.

Fig 2.7 Products vs Profits from the top 6 Suppliers

Obserations from this plot,

1. Observed that Urea Purchased from the Sri Srinivasa Fertilizers gives more profits than the Urea purchased from the Sree Srinivasa Agency or NFCL Supplier.

2. Gromor 20-20-13 Purchased at Sree Srinivasa Agency gives more profits than the SSF CRL Supplier.

3. DAP Purchased at Desu Veraya Supplier gives more profits than the Other Suppliers. This gives understanding on which supplier to choose for the particular product.

Interpretation of Results and Recommendations

Recommendation1 - Making a poster of the Most Purchased Products

From the Results Fig 1.1, I have obtained the most purchased top 10 products, and from the Fig 1.2, I have obtained the most purchased products based on the season.

AS of now, the shop has some Random products pictures, I suggest that we can utilize the observation of this most purchased products to attract other customers. So Making a poster of the most purchased products based on the season will be effective to attract customers.

Recommendation2 - Invest in some necessary Gardening tools during Non-seasons

From the Results Fig 1.3, It is observed that the shop has considerably low income in the non-season months, which was even confirmed by the owner that the monsoon months are the peak months for their business. So in the non-season months, they can invest in some of the gardening items such as Hand trowel, watering can, Garden edger, Hedge shears, gloves, shovels, garden fork, complete hand tool kit, etc.

Recommendation3 - Make a Poster of the Villages that most purchase

From the Results Fig 2.1, I Identified which villages had made the most number of purchases. Customers from various villages will be visiting the shop daily, sometimes the regular customers and sometimes the new customers, so a new customer visiting the shop will feel trusted to see that people from his village are buying often in this shop. So Using the obtained facts to make a poster of the top most purchased villages, will give the confidence to buy for the new customers. They can be the villages mentioned in Fig2.1, and they can be told about the products purchased from these villages with the help of Fig2.2

Recommendation4 - Reduce Investment on the Least profitable products

From the results fig 2.3 and 2.4, I have identified the least profitable products such as Neem cake, Magnesium Sulfate and Soil Application F7. These are the least profitable products, but still the expenditure for these product is quite high. Hence for these products alone, if we can reduce the investment and may be when needed without disappointing the customer if we can borrow it from the closer by shops, this will help in making more profits.

Recommendation5 - Following the Re-order Points for Inventory Management

From the Results fig2.5, I have calculated the Re-order points and they can be wisely used to make the re-order based on that point which will make sure there are no stockouts. The owner has mentioned there are various cases of stockout, so these re-order points will be helpful to maintain the proper inventory stock. And If not for all the products, these can be diligently followed for atleast the most purchased top 5 products in every season and that can be obtained from Fig 1.2.

These are the recommendations and data driven strategies concluded from the capstone Project Enhancing Sales Strategy at Subhash General Stores in Changing Market Dynamics, which are discussed with the owner of the shop, which he mentioned to be quite new and believed to be useful for the business growth and profits.

Important Links

Subhash Stores Data

Data Analysis Notebook

Thank you for providing the opportunity.