Optimizing Inventory Management and Sales Strategies in Fertilizer Shop

Mid-Term report for the BDM capstone Project

Submitted by

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Executive Summary

My project focuses on IFFCO BAZAR, a fertilizer retail outlet located in Doulthabad, Hathnoora Mandal, Sangareddy District, Telangana state. It operates as a B2C business, serving the local agricultural community by providing a wide range of fertilizer products. IFFCO BAZAR primarily functions within the agricultural sector. IFFCO (Indian Farmers Fertilizers Cooperative Limited) is India's largest cooperative society. IFFCO BAZAR, managed by Nenavath Rajesh, an employee of IFFCO Company, was established in 2017. The shop consists of two go-downs and one main office, with two workers employed. The employee maintains daily sales data and submits daily sales reports to IFFCO Company. The employee orders fertilizer based on requirements and stock replenishment by sending an email to the company, which then supplies the products to the shop**.**

To enhance inventory efficiency, the project aims to analyze sales trends and revenue trends. The main problem this business encounters is stockouts during the peak seasons. To address this issue, three months of data were collected from the shop owner, specifically for January, February, and March, when sales are at their peak. The shop owner recorded daily sold product quantities and revenue generated by each product sale. However, the purchase cost of fertilizer was not included. The volume of sales and revenue from sales are the most important parameters for this data analysis.

The data will be analyzed on a weekly basis using bar charts and column charts to observe weekly sales patterns. Pareto Analysis will be employed to identify the most important products for revenue and sales. By observing these trends (sales trends and revenue trends), future demand can be forecasted and the shop's performance during these three months can be evaluated. From the analysis, it will be possible to understand which products are important for inventory and when to order different categories of products. This will be useful for inventory management as well.

2 Proof of Originality of Data

Letter from Organization:

- https://drive.google.com/file/d/148OEQ6Q-ZIQ2J8SwOMSMNAsidBdap7y4/view

Video interaction with owner:

I talked with the shop owner when I requested his business data for my project. In this video he discussed about his business with me. The video of this interaction is approximately 6 minutes long. The link to the video is provided below.

- https://drive.google.com/file/d/1L1qD3CafYcu9mM1I3WQIQxCFkShbU6aN/view?usp=sharing

Images of the business:

Picture-1: Main office and storage area of this shop.

Picture-2 and Picture-3: Inside the main office of the IFFCO BAZAR.

3 Metadata

Raw Dataset Description:

Title: IFFCO BAZAR Daily sales Data.

Source: IFFCO BAZAR Daily Sales Report.

Time Period: January 2024 – March 2024.

Three months daily sales data was collected from the IFFCO BAZAR. Daily Sales data was collected from January, February and March of 2024. It is recent sales data of this year. This period was selected for data collection due to the sales of all fertilizers are high during this period. In these three months farmers purchase the different types of fertilizers to their Rabi crops. IFFCO BAZAR owner properly maintained the daily sales and revenue details of all fertilizers that are available in the shop. He maintained data in company provided format.

The owner provided 90 days worth of daily sales report in the format of 90 PDFs. For each day data spread across six pages. Upon receiving the data, online PDF TO Excel conversion software was utilized to convert each PDF into an Excel sheet. These individual Excel sheets were merged into a single table, organized on a daily basis.

Following the consolidation process, issues arising from merged cell values during PDF to Excel conversion were addressed. This cleaned data was not suitable for creating pivot tables for data aggregation, because shop maintained data in a manner conductive to their understanding and economic calculations which are useful for company to evaluate the shop performance. However, this data was not ready for analysis. To overcome this issue, daily sales and revenue for different product IDs were manually aggregated into one table over 90 days. Some fertilizer sales quantities were entered in terms of metric tons, while others were entered in terms of the number of bottles and packets sold. After aggregating the data, sales entered in metric tons were converted into the number of packets based on fertilizer weight, such as 50kg or 25kg packets.

The analysis will be conducted on a weekly basis. The data was cleaned into two tables: Weekly Sales Data and Weekly Revenue Data. The data contains different columns and rows as follows:

- Column 1: This column stores the category of fertilizer. The data includes 12 different categories: Bio Fertilizer, Complex Fertilizer, Natural K Fertilizer, Nano Fertilizer, Other fertilizers, Pesticides, Sagarika Granular, Sagarika Liquid, Secondary & Micro Nutrient, Urea, and Water-Soluble Fertilizer.
- Column 2: This column stores the Unit of Measure (UOM), which indicates the units in which sales of fertilizers are measured. Fertilizers sold in terms of the number of bottles are recorded as "pieces," while those sold in terms of the number of packets are recorded as "kg."

- Column 3: This column stores the sub-products under each category. Sub-products are differentiated based on their weight and main chemical component of fertilizers. In total there are 113 different sub-products are available under all categories in the shop.

- Column 4: This column stores the stock-keeping unit (SKU) for the sub-products, with different SKUs based on the product packing quantity. For example, under the Bio Fertilizer category, there are two sub-products uniquely identified using SKUs such as B1 and B2.

- Columns 5 to 17: These columns store the sales volume for each product in the shop over 13 weeks. Each column represents sales of products in one week.
- Columns 1 to 4 contain categorical data, while Columns 5 to 17 contain numerical data.
- The Weekly Revenue Data table contains the same type of data, with revenue generated by each product instead of sales volume.
- In total data contains 17 columns and 113 rows.

In the raw data SKU for different products are different but they are missy for the data analysis, so product SKU are created based the category of product and weight of the product.

From the collected raw data, daily closing stock data is extracted into a separate table, with closing stock data entered for 90 days. The owner did not maintain the ordered stock data separately; they added the ordered stock to the closing stock data on the day of order received. The daily closing stock data for all the products is created in one table.

Data link:

https://1drv.ms/x/c/dde39ec3046c7e63/EbDyhq539ilKvKW7WA0rOhAB9IebUhw4vNOwmofLz0UDZQ?e=sIxrSe

4 Descriptive Statistics

To obtain descriptive statistics for my weekly sales data for each category over 13 weeks, I used Pandas function pd.describe(). This function provided basic descriptive statistics for every week of all categories sales, including the Mean, Median, Standard Deviation, and Percentiles.

	week-1	week-2	week-3	week-4	week-5	week-6	week-7	week-8	week-9	week-10	week-11	week-12	week-13
count	11.000000	11.000000	11.000000	11.00000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000
mean	100.181818	82.909091	79.545455	77.00000	82.000000	102.363636	43.000000	103.909091	71.181818	1.090909	1.363636	3.909091	16.545455
std	172.966366	114.034604	135.799384	92.39697	110.015453	123.872735	57.332364	159.578479	92.049789	2.586679	3.640679	12.003787	23.325367
min	0.000000	0.000000	0.000000	0.00000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	2.500000	1.500000	2.000000	0.00000	5.000000	0.000000	4.500000	14.500000	4.500000	0.000000	0.000000	0.000000	0.000000
50%	35.000000	50.000000	21.000000	48.00000	26.000000	88.000000	20.000000	35.000000	43.000000	0.000000	0.000000	0.000000	4.000000
75%	86.000000	96.500000	69.000000	115.50000	142.000000	140.000000	55.000000	136.500000	87.000000	0.000000	0.000000	0.000000	26.000000
max	559.000000	313.000000	421.000000	284.00000	314.000000	350.000000	188.000000	537.000000	275.000000	8.000000	12.000000	40.000000	59.000000

Figure-1: Descriptive Statistics for weekly sales Data for all categories over every week.

From the above descriptive statistics, I observed the following things.

- Sales mean: The mean sales per week fluctuate significantly. For example, week-1 has mean of 100.18 while week-11 has a very low mean of 1.36. This indicates variability in sales across weeks.
- Std: Sales variability it shows that some weeks have a wide range of sales figures, while others have more consistent sales.
- Max value: The maximum sales vary greatly with the highest being 559 in week-1 and the lowest being 8 in week-10. This again points to significant sales spikes in certain weeks.

Category	Bio Fertilizer	Complex	Nano Fertilizer	Natural-K	Other	Pesticide	Sagarika Granular	Sagarika Liquid	Secondary & Micro Nutrient	Urea	Water Soluble Fertilizer
count	13.000000	13.000000	13.000000	13.000000	13.000000	13.000000	13.000000	13.000000	13.000000	13.000000	13.000000
mean	0.076923	170.230769	17.846154	19.923077	24.692308	159.692308	59.538462	39.230769	9.384615	110.692308	36.000000
std	0.277350	170.832351	24.687534	23.092068	24.342640	154.017523	66.316935	42.755417	28.593526	161.189529	57.805709
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.000000	4.000000	0.000000	0.000000	8.000000	59.000000	7.000000	3.000000	0.000000	0.000000	0.000000
50%	0.000000	178.000000	2.000000	12.000000	20.000000	113.000000	35.000000	21.000000	0.000000	0.000000	1.000000
75%	0.000000	275.000000	32.000000	35.000000	35.000000	225.000000	102.000000	95.000000	2.000000	281.000000	48.000000
max	1.000000	559.000000	70.000000	62.000000	88.000000	537.000000	184.000000	107.000000	104.000000	421.000000	200.000000

Figure-2: Descriptive Statistics for each category of fertilizer sales data over 12 weeks.

Apart from above descriptive statistics I have calculated variance, skewness, kurtosis and coefficient of variation for every category of fertilizer across 12 weeks.

Category	variance	skewness	kurtosis	cv
Bio Fertilizer	0.076923	3.605551	13.000000	3.605551
Complex	29183.692308	0.864834	0.534697	1.003534
Nano Fertilizer	609.474359	1.223110	0.238053	1.383353
Natural-K	533.243590	0.825822	-0.747198	1.159061
Other	592.564103	1.537489	2.957965	0.985839
Pesticide	23721.397436	1.191127	1.710620	0.964464
Sagarika Granular	4397.935897	0.995390	-0.337241	1.113850
Sagarika Liquid	1828.025641	0.712423	-1.424733	1.089844
Secondary & Micro Nutrient	817.589744	3.535023	12.617796	3.046851
Urea	25982.064103	1.014778	-0.749200	1.456194
Water Soluble Fertilizer	3341.500000	2.167201	5.238119	1.605714

Figure-3: Each category variance, skewness, kurtosis, and coefficient of variation.

From above descriptive statistics I observed following points.

- Variance measures the spread of the sales data for each category. Complex, Pesticides, Urea show very high variance suggesting that their quantity of sales fluctuate significantly.
- Skewness indicates asymmetry of the sales data distribution of sales data. Positive skewness values across all categories indicate that the data distributions are right skewed. Meaning that there are more low sales and less high sales. Bio fertilizer and Secondary & Micro Nutrient have particularly high skewness, suggesting a heavy tail on the right side of the distribution.
- Kurtosis for Bio fertilizer and secondary Micro nutrient show very high suggesting many outliers. Categories like Nano fertilizer and Complex have low kurtosis, indicating more normal distribution.
- Coefficient of Variation for Bio fertilizer and Secondary & Micro Nutrient are high indicating high variability in sales.

	week-1	week-2	week-3	week-4	week-5	week-6	week-7	week-8	week-9	week-10	week-11	week-12	week-13
count	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000	11.000000
mean	74516.954545	54364.951818	48660.678182	46030.000000	37703.180909	50291.360909	27427.181818	44660.272727	52582.272727	680.000000	2586.363636	880.909091	9925.909091
std	180417.721585	117475.075541	102251.789664	81195.395374	56296.314964	68434.590578	44294.935143	69600.169244	99389.872456	1585.433695	8045.995616	2425.450286	14139.395464
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	615.000000	427.500000	1100.000000	0.000000	1492.500000	0.000000	1682.000000	6790.000000	2135.000000	0.000000	0.000000	0.000000	0.000000
50%	13360.000000	3394.000000	2311.000000	9490.000000	7035.000000	23325.000000	7770.000000	23760.000000	9340.000000	0.000000	0.000000	0.000000	3600.000000
75%	45025.000000	51742.735000	36527.500000	43147.500000	64849.995000	76787.485000	20845.000000	39102.500000	37577.500000	0.000000	0.000000	0.000000	11460.000000
max	613460.000000	397290.000000	338170.000000	252700.000000	157990.000000	219750.000000	123450.000000	240068.000000	327900.000000	4800.000000	26800.000000	8040.000000	39530.000000

Figure-4: Descriptive Statistics for weekly Revenue Data over 12 weeks

5 Detailed Explanation of Analysis Process and Method justification for Inventory Management

Category wise Sales Performance:

- Using Bar graph to visualize Sales volume by category.
- Bar graph is a straightforward and easy to interpret, making it simple to compare the sales volumes across the different categories at a glance.
- The discrete nature of bar graphs allows for clear representation of individual categories without overlap, which might be an issue in other types of graphs like Pie charts or Area charts.
- The length of each bar provides a visual comparison making it easy to see which category have higher or lower sales volume.
- By using Excel tool chart types, bar char was created for this aggregated data of sales volumes.

Revenue Analysis:

- The objective of this analysis is to examine the Revenue generated by different product categories to understand their financial impact on the business.

- A bar graph was chosen to clearly compare the revenue generated by each product category, allowing for easy identification of high and low revenue generation product categories.
- By using Excel chart tool, a bar graph was created for category-wise Revenue Analysis.

Proportional Analysis:

- A pie chart displays data in a circular graph, with slices representing parts of a whole.
- For Inventory Management, pie charts are useful in showing the proportion of different categories of products in total sales or revenue.
- Compared to other charts, pie charts are particularly effective for visualizing the relative proportions of categories in the dataset, which helps to understanding the composition of inventory.
- Using Excel tools, a pie chart was created to illustrate the proportion of sales for each category relative to the overall sales. And proportion of revenue for each category relative to the overall sales.
- By using the pie chart, the business can easily identify which categories are the major contributors to overall sales and Revenue.

Comparative Analysis:

- Column charts use vertical bars to represent data, making it easy to compare the sales for each week directly. The height of each bar corresponds to the sales volume, providing a clear visual comparison between weeks.
- By plotting sales data for each week on a column chart, you can easily see trends such as increasing or decreasing sales over time. This helps in understanding seasonal variations or the impact of specific marketing activities.
- The column chart will clearly show which weeks have the highest and lowest sales. This information is crucial for identifying peak sales periods and potential causes of low sales weeks, enabling better planning and resource allocation.
- Visualizing weekly sales data with a column chart aids in making data-driven decisions. For example, if we notice consistent low sales during certain weeks, we can investigate and address potential issues, such as insufficient stock, marketing inefficiencies.
- Column chart created using Excel tool provided chart types.

Trend Analysis:

- A Line chart is ideal for showing the trend of Revenue over time. It effectively highlights changes in Revenue, enabling easy identification of upwards or downward trends.
- This chart clearly displays how revenue fluctuates over different weeks, allowing for straightforward analysis of patterns and trends.
- To draw this chart, organize the data into a table with weeks in rows and corresponding revenue values in columns.
- Utilized Excel's line chart tool to create a chart based on organized data.

Results and Findings

Sales Volume Analysis:

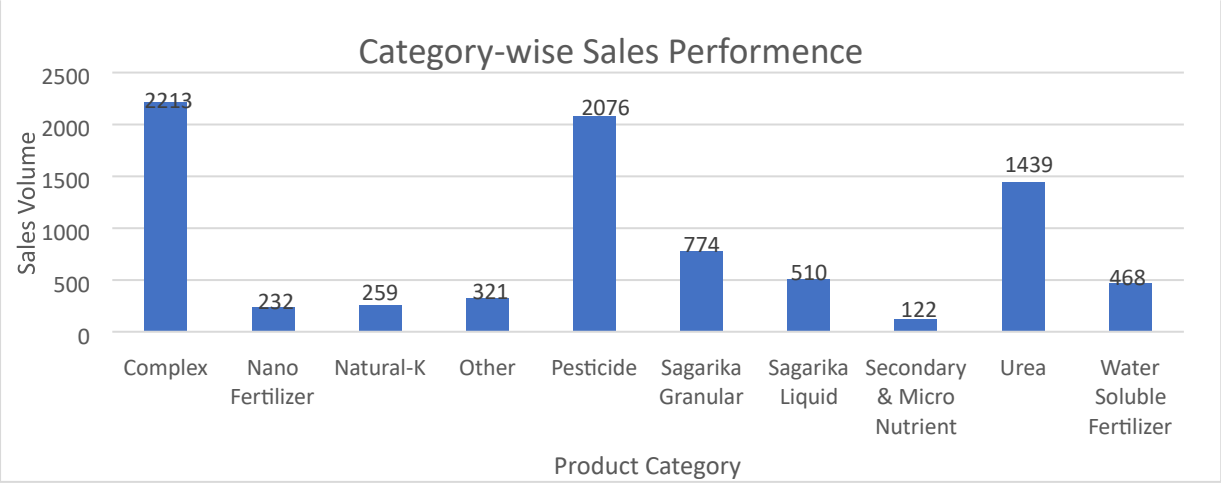

Chart-1: Sales Volume Analysis category wise.

- The above graph is showing that Complex and Pesticide categories are top performing categories.
- Urea and Sagarika Granular are the second highest sales categories.
- Sagarika Liquid, water soluble fertilizer are the moderate sales categories.
- Natural-K, Nano fertilizer, other Secondary & Micro Nutrient are low sales categories.

Revenue Analysis:

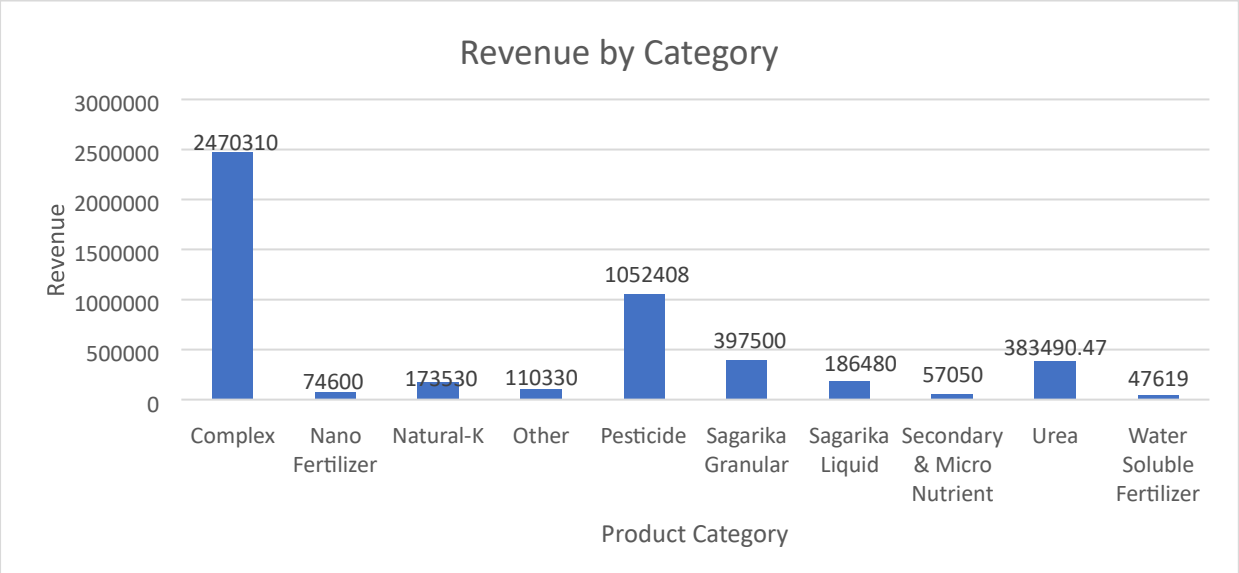

Chart-2: Revenue by category.

- The above graph is clearly showing that Complex fertilizer is the top revenue generating category. It is generating highest revenue in these three months. Complex fertilizer is significantly generating high margin.
- The second highest revenue generating category is Pesticide. Sagarika Granular, Urea are the moderate revenue generating categories.

- Natural-K, other, Sagarika Liquid are low revenue generating categories. The remaining all other categories are generating relatively low revenue.

Proportion Analysis:

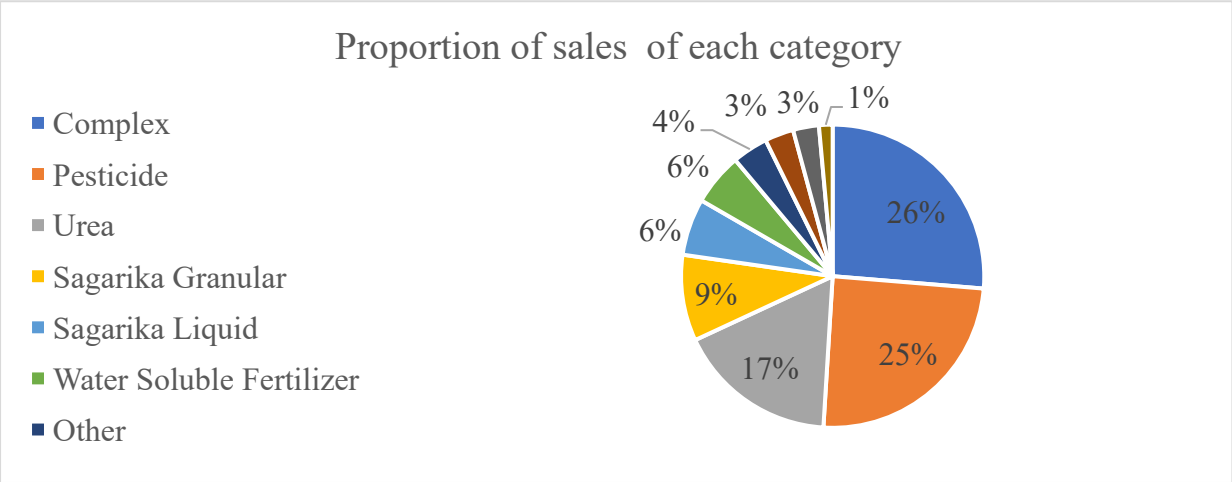

Chart-3: Proportion of sales of each category over 3 months.

- From the above pie chart, it is clear that complex fertilizers contribute significantly to overall sales, holding a share of 26 percent. This indicates that complex fertilizers are the most important item for this season.
- Farmers often use complex fertilizers in January to enrich the soil with essential nutrients before planting.
- Pesticides also hold a significant share of 25 percent, contributing notably to overall sales.

Revenue Proportion:

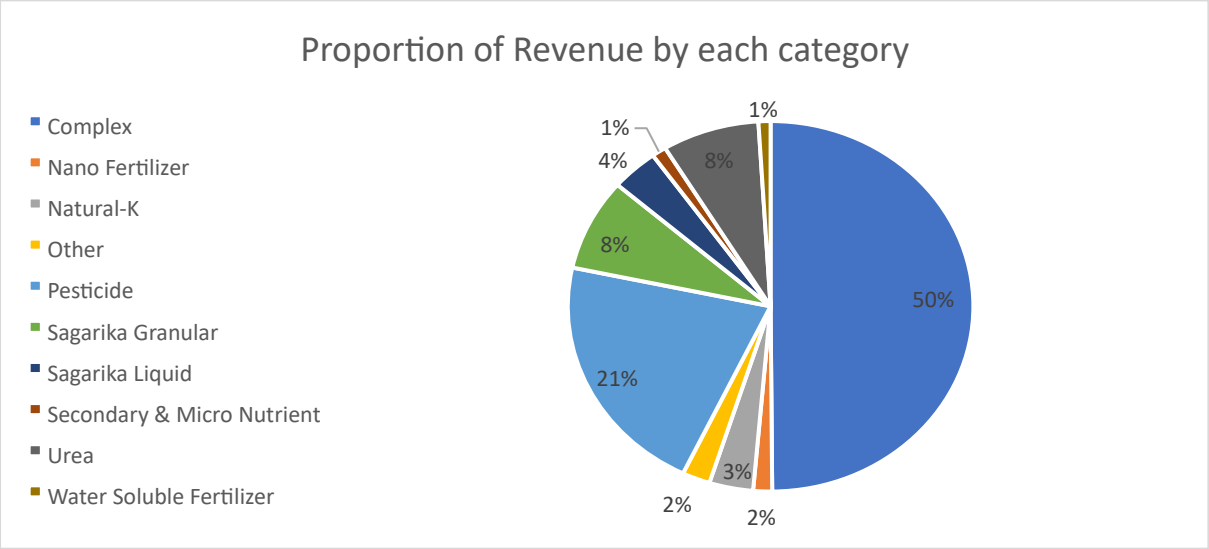

Chart-4: Proportion of Revenue by each category.

- The pie chart is showing that 50 percent of the revenue is generated from the Complex fertilizer. So, it is most important fertilizer for Revenue.
- Pesticides are generating 21 percent of the Revenue to the total. It is the second highest category for the revenue generation.

- Sagarika Granular and Natural-K are the moderate revenue generating categories.

Comparative Analysis:

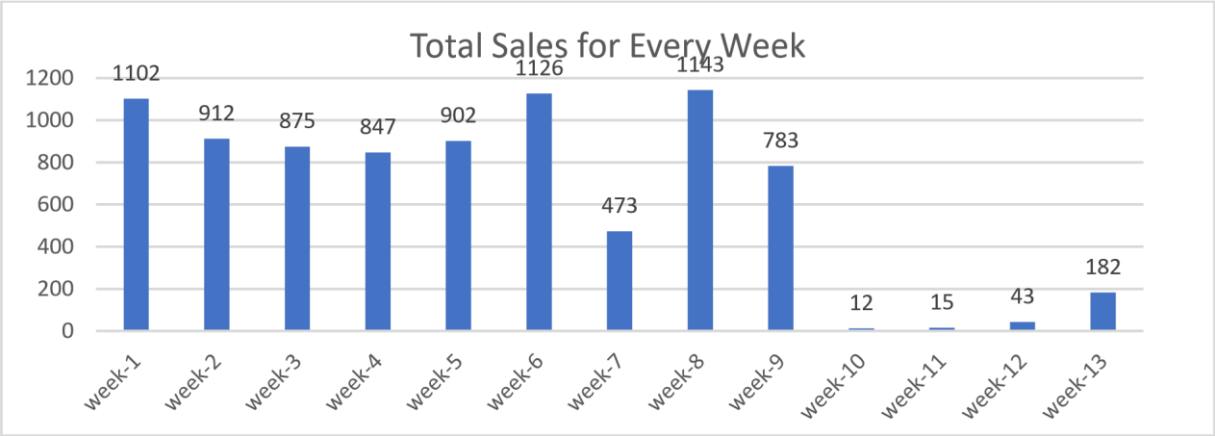

Chart-5: Total Sales for Every Week. (Column Chart)

- High sales at the beginning of January likely reflect farmers purchasing Urea, Complex fertilizers, DAP fertilizer bags, and other inputs needed for land preparation.
- Moderate sales from Week 2 to Week 5 indicate that while sales remain relatively high, they are slightly lower than in Week 1.
- The spike in sales in Week 6 suggests increased purchases of fertilizers to support the initial growth of crops.
- The highest sales in Week 8 suggest that from mid-February to the end of February, farmers focus on protecting their young crops by applying pesticides to prevent damage.